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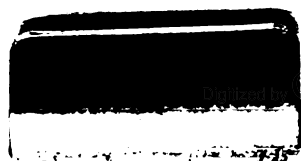
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**A DICTIONARY OF CHEMICAL SOLUBILITIES**  
**INORGANIC**





# DICTIONARY

OF

## CHEMICAL SOLUBILITIES

### INORGANIC

#### Actinium emanation.

Solubility coefficient of actinium emanation in  $H_2O$  at room temp. is 2.

If the solubility of actinium emanation in  $H_2O$  is made = 1, the relative solubility of the emanation in sat.  $KCl + Aq = 0.9$ ; in conc.  $H_2SO_4 = 0.95$ ; in ethyl alcohol = 1.1; in amyl alcohol = 1.8; in benzaldehyde = 1.7; in benzene = 1.8; in toluene = 1.8; in petroleum = 1.9; in  $CS_2 = 2.1$  at  $18^\circ$ .

(Hevesy, Phys. Zeit. 1911, 12. 1221.)

#### Air, Atmospheric.

See also Nitrogen and Oxygen.

100 vols.  $H_2O$  at  $15^\circ$  and 760 mm. absorb about 5 vols. atmospheric air. (Sausure.)

1 vol.  $H_2O$  at  $t^\circ$  and 760 mm. pressure absorbs V vols. atmospheric air reduced to 760 mm. and  $0^\circ$ .

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.02471	7	0.02080	14	0.01822
1	0.02406	8	0.02034	15	0.01795
2	0.02345	9	0.01192	16	0.01771
3	0.02287	10	0.01953	17	0.01750
4	0.02237	11	0.01916	18	0.01732
5	0.02179	12	0.01882	19	0.01717
6	0.02128	13	0.01851	20	0.01701

(Bunsen's Gasometry.)

1 l.  $H_2O$  absorbs cc. N and O from air at  $t^\circ$  and 760 mm. pressure.

$t^\circ$	cc. N	cc. O	cc. N+O
0	16.09	8.62	24.71
5	14.18	7.60	21.78
10	12.70	6.79	19.49
15	11.67	6.25	17.92
20	11.08	5.93	17.01

(Bunsen, Gasometr. Methoden, 2te Aufl. 209, 220.)

1 l.  $H_2O$  absorbs cc. N and O from air at  $t^\circ$  and 760 mm. pressure (dry).

$t^\circ$	cc. N	cc. O	N+O	%O
10	15.47	7.87	23.34	33.74
15	13.83	7.09	20.92	33.86
20	12.76	6.44	19.20	33.55
25	11.78	5.91	17.69	33.40

(Roscoe and Lunt, Chem. Soc 55. 568.)

1 l.  $H_2O$  absorbs cc. N and O from air at  $t^\circ$  and 760 mm.

$t^\circ$	cc. N	cc. O	%O
0	19.53	10.01	33.88
6.0	16.34	8.28	33.60
6.32	16.60	8.39	33.35
9.18	15.58	7.90	33.60
13.70	14.16	7.14	33.51
14.10	14.16	7.05	33.24

(Pettersson and Söndén, B. 22. 1439.)

1 l.  $H_2O$  absorbs cc. N ( $0^\circ$  and 760 mm.) from atmospheric air at  $t^\circ$  and 760 mm. pressure (dry).

$t^\circ$	cc. N	$t^\circ$	cc. N	$t^\circ$	cc. N
0	19.14	10	15.14	20	12.63
2	18.20	12	14.53	22	12.27
4	17.34	14	13.98	24	11.95
6	16.54	16	13.48	25	11.81
8	15.81	18	13.03	..	..

(Hamberg, J. pr. (2) 33. 447.)

1 l.  $H_2O$  absorbs cc. N from air at  $t^\circ$  and 760 mm. pressure.

$t^\circ$	cc. N	$t^\circ$	cc. N	$t^\circ$	cc. N
0	19.29	10	15.36	20	12.80
5	17.09	15	13.95	25	11.81

(Dittmar, Challenger Expedition, vol. 1, pt. 1.)

1 l. H<sub>2</sub>O sat. with air at t° and 760 mm. contains cc. O (red. to 0° and 760 mm.);

t°	cc. O	t°	cc. O	t°	cc. O
0	10.187	11	7.692	22	6.114
1	9.910	12	7.518	23	5.999
2	9.643	13	7.352	24	5.886
3	9.387	14	7.192	25	5.776
4	9.142	15	7.038	26	5.669
5	8.907	16	6.891	27	5.564
6	8.682	17	6.730	28	5.460
7	8.467	18	6.614	29	5.357
8	8.260	19	6.482	30	5.255
9	8.063	20	6.356	..	..
10	7.873	21	6.233	..	..

(Winkler, B. 22. 1773.)

1 vol. H<sub>2</sub>O absorbs 0.01748 vol. air at 24.05° and 760 mm. pressure. (Winkler, B. 21. 2851.)

Composition of the absorbed air between 0° and 24° is 34.91% O and 65.09% N (Bunsen); between 15° and 16°, 32.17% O and 67.83% N (König and Kranch, Z. anal. 19. 259); 32% O and 68% N (Regnault); at 0°, 35.1% O; 10°, 34.8% O; 20°, 34.3% O; 25°, 33.7% O (Winkler, B. 21. 2483). See also Roscoe and Lunt, and Pettersson and Söndén, page 1.

Solubility of atmos. oxygen and nitrogen in 1000 cc. H<sub>2</sub>O at 760 mm. pressure (calc.).

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc.	cc.		cc.	cc.
0°	10.19	18.45	29°	5.33	10.30
1	9.91	17.99	30	5.24	10.15
2	9.64	17.55	31	5.15	9.99
3	9.39	17.12	32	5.07	9.83
4	9.14	16.71	33	4.99	9.67
5	8.91	16.30	34	4.91	9.52
6	8.68	15.91	35	4.83	9.37
7	8.47	15.54	36	4.76	9.22
8	8.26	15.18	37	4.69	9.08
9	8.06	14.83	38	4.62	8.94
10	7.87	14.50	39	4.55	8.81
11	7.69	14.19	40	4.48	8.67
12	7.52	13.89	41	4.42	8.55
13	7.35	13.61	42	4.35	8.43
14	7.19	13.33	43	4.28	8.31
15	7.04	13.07	44	4.22	8.20
16	6.89	12.83	45	4.15	8.09
17	6.75	12.57	46	4.09	7.97
18	6.61	12.34	47	4.03	7.87
19	6.48	12.12	48	3.97	7.76
20	6.35	11.91	49	3.91	7.65
21	6.23	11.71	50	3.85	7.55
22	6.10	11.52	51	3.79	7.45
23	5.98	11.33	52	3.74	7.34
24	5.86	11.14	53	3.68	7.24
25	5.75	10.96	54	3.62	7.13
26	5.64	10.79	55	3.56	7.03
27	5.54	10.62	56	3.51	6.92
28	5.43	10.46	57	3.45	6.81

Solubility of atmos. etc.—Continued

Temp	Oxygen	Nitrogen	Temp	Oxygen	Nitrogen
	cc.	cc.		cc.	cc.
58°	3.39	6.71	80°	1.97	4.03
59	3.34	6.60	81	1.89	3.88
60	3.28	6.50	82	1.81	3.73
61	3.22	6.39	83	1.73	3.57
62	3.16	6.27	84	1.65	3.41
63	3.10	6.16	85	1.57	3.24
64	3.04	6.05	86	1.48	3.07
65	2.98	5.94	87	1.39	2.89
66	2.92	5.82	88	1.30	2.71
67	2.85	5.70	89	1.21	2.52
68	2.79	5.59	90	1.11	2.32
69	2.73	5.47	91	1.02	2.12
70	2.66	5.35	92	0.92	1.91
71	2.60	5.23	93	0.81	1.70
72	2.53	5.10	94	0.71	1.48
73	2.47	4.98	95	0.60	1.25
74	2.40	4.85	96	0.48	1.01
75	2.33	4.72	97	0.37	0.77
76	2.26	4.59	98	0.27	0.52
77	2.19	4.45	99	0.13	0.27
78	2.12	4.32	100	0.00	0.00
79	2.04	4.18			

(Winkler, B. 1901, 34. 1440.)

Absorption of atmospheric air by H<sub>2</sub>O at t° and 760 mm. pressure.  $\beta$  = coefficient of absorption.  $\beta_1$  = "Solubility." (See under oxygen.)

t°	$\beta$	$\beta_1$	t°	$\beta$	$\beta_1$
0	0.02881	0.02864	55	0.01253	0.01059
5	2543	2521	60	1216	0978
10	2264	2237	65	1182	0892
15	2045	2011	70	1156	0801
20	1869	1826	75	1137	0705
25	1724	1671	80	1126	0600
30	1606	1539	85	1119	0481
35	1503	1420	90	1113	0343
40	1418	1315	95	1109	0185
45	1351	1224	100	1105	0000
50	1297	1140			

(Winkler, B. 1901, 34. 1409.)

Sea-water absorbs less O and N from air than pure H<sub>2</sub>O, but the ratio between O and N remains constant. In sea-water sat. with air at 6.22° the oxygen was 33.50% of the total gas absorbed. (Pettersson and Söndén.)

1 l. sea-water absorbs cc. N and O from air at t° and 760 mm. pressure.

t°	cc. N	cc. O	N+O	% O
0	14.41	7.77	22.18	35.03
5	13.22	6.93	20.15	34.39
10	12.08	6.29	18.37	34.24
15	11.01	5.70	16.71	34.11

(Tornøe, Norwegian North Atlantic Exped. Chem. 18.)

1 l. sea water absorbs cc. N from air at  $t^{\circ}$  and 760 mm.

$t^{\circ}$	cc. N	$t^{\circ}$	cc. N	$t^{\circ}$	cc. N
0	15.60	10	12.47	20	10.41
5	13.86	15	11.34	25	9.62

(Dittmar.)

1 l. sea-water absorbs cc. N ( $0^{\circ}$  and 760 mm.) from atmospheric air at  $t^{\circ}$  and 760 mm. pressure (dry).

$t^{\circ}$	cc. N	$t^{\circ}$	cc. N	$t^{\circ}$	cc. N
0	14.85	10	12.06	20	10.25
2	14.20	12	11.62	22	9.98
4	13.60	14	11.23	24	9.73
6	13.04	16	10.87	25	9.62
8	12.53	18	10.54	..	...

(Hamberg.)

Absorption of air which is free from carbonic acid by  $\text{H}_2\text{SO}_4$  at  $18^{\circ}$  and 760 mm.  $\alpha$  = coefficient of solubility.

$\text{H}_2\text{SO}_4$	$\alpha$	$\text{H}_2\text{SO}_4$	$\alpha$
98%	0.0173	70%	0.0055
90%	0.0107	60%	0.0059
80%	0.0069	50%	0.0076

(Tower, Z. anorg. 1906, 50, 388.)

Absolute alcohol absorbs 0.11 vol. gas from air,  $\frac{1}{8}$  of which is O and  $\frac{1}{8}$ , N. On mixing with an equal vol.  $\text{H}_2\text{O}$ ,  $\frac{1}{8}$  of the dissolved gas is given off. (Döbereiner.)  
100 vols. alcohol (95.1 %) absorb 14.1 vols. air. (Robinet, C. R. 58. 608.)

100 vols. petroleum absorb 6.8 vols. air.

" " oil of lavender " 6.89 " "

" " benzene " 14.0 " "

" " oil of turpentine " 24.18 " "

(Robinet, Lc.)

1 vol. ether at 760 mm. pressure absorbs 0.290 vols. air at  $0^{\circ}$ ; 0.287 vols. at  $10^{\circ}$ ; 0.286 vols. at  $15^{\circ}$ . (Christoff, Z. phys. Ch. 1912, 79. 459.)

### Alcohol. $\text{C}_2\text{H}_5\text{OH}$ .

Sp. gr. of pure ethyl alcohol + Aq. at  $25^{\circ}$ .

% alcohol	Sp. gr.	% alcohol	Sp. gr.
0	0.997077	55	0.898502
2	0.993359	60	0.886990
5	0.988166	65	0.875269
6	0.986563	70	0.863399
10	0.980434	75	0.851336
15	0.973245	80	0.839114
20	0.966392	85	0.826596
25	0.958946	90	0.813622
30	0.950672	95	0.799912
35	0.941459	98	0.791170
40	0.931483	99	0.788135
45	0.920850	100	0.785058
50	0.909852	—	—

(Osborne, McKelvy and Bearce, Bureau of Standards, Sci. Paper No. 197.)

### Alum, Ammonia.

See Sulphate, aluminum ammonium.

### Alum, Chrome.

See Sulphate, aluminum chromium.

### Alum, Iron.

See Sulphate, aluminum ferric.

### Alum, Potash.

See Sulphate, aluminum potassium.

### Alumina.

See Aluminum oxide.

### Aluminic acid, $\text{H}_2\text{Al}_2\text{O}_4 = \text{Al}_2\text{O}_3, \text{H}_2\text{O}$ .

Aluminum hydroxide possesses acid properties, and salts corresponding to an acid of the above formula exist.

See Aluminum hydroxide.

### Aluminates.

All aluminates are insol. in  $\text{H}_2\text{O}$  except those of K and Na (Fremy) and Ba (Beckmann, J. pr. (2) 26. 385).

### Barium aluminate, $\text{BaAl}_2\text{O}_4 + 4\text{H}_2\text{O}$ .

Sol. in 10 pts.  $\text{H}_2\text{O}$ ; can be recryst. from alcohol. (Deville, J. pr. 87. 299.)

+  $5\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Allen, Am. Ch. J. 1900, 24. 313.)

+  $7\text{H}_2\text{O}$ . Sl. sol. in cold, not completely sol. in hot  $\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{HCl} + \text{Aq}$ . (Beckmann, J. pr. (2) 26. 385.)

$\text{Ba}_2\text{Al}_2\text{O}_7 + 5\text{H}_2\text{O}$ . Sol. in 20 pts.  $\text{H}_2\text{O}$  by boiling. (Beckmann, B. 14. 2151.)

Insol. in alcohol.

Sl. sol. in  $\text{H}_2\text{O}$  with decomp.; insol. in alcohol. (Allen, Am. Ch. J. 1900, 24. 311.)

$\text{Ba}_2\text{Al}_2\text{O}_7 + 7 - 11\text{H}_2\text{O}$ . Sol. in 15 pts.  $\text{H}_2\text{O}$  with decomp. into  $\text{Ba}_2\text{Al}_2\text{O}_7 + 5\text{H}_2\text{O}$ ; insol. in alcohol. (Beckmann.)

### Barium aluminate bromide, $\text{BaAl}_2\text{O}_4, \text{BaBr}_2 + 11\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Beckmann, J. pr. (2) 26. 385, 474.)

### Barium aluminate chloride, $\text{BaAl}_2\text{O}_4, 3\text{BaCl}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Beckmann, l.c.)

$\text{BaAl}_2\text{O}_4, \text{BaCl}_2 + 11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Beckmann, l.c.)

### Barium aluminate iodide, $\text{BaAl}_2\text{O}_4, \text{BaI}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Beckmann, l.c.)

### Calcium aluminate, $\text{CaO}, \text{Al}_2\text{O}_3$ .

Decomp. by  $\text{H}_2\text{O}$  but does not "set." Sol. in  $\text{HCl}$ ; insol. in  $\text{HNO}_3, \text{H}_2\text{SO}_4$ , and  $\text{HF}$ . (Dufau, C. R. 1900, 131. 543.)

$\text{Ca}_2\text{Al}_2\text{O}_7 + 7\text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{H}_2\text{O}$ . (Allen, Am. Ch. J. 1900, 24. 316.)

$\text{Ca}_2\text{Al}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; not decomp. by  $\text{KOH} + \text{Aq}$ ; sol. in acids. (Tissier, C. R. 48. 627.)

+6H<sub>2</sub>O. Ppt; sl. sol. in H<sub>2</sub>O; insol. in alcohol. (Allen, Am. Ch. J. 1900, 24. 316.)

3Al<sub>2</sub>O<sub>3</sub>.4CaO+3H<sub>2</sub>O. Ppt. (Friedel, Bull. Soc. Min. 1903, 26. 121; C. C. 1904, I. 430.)

#### Cobalt aluminate.

"Thenard's or Leithner's blue." Insol. in H<sub>2</sub>O.

CoAl<sub>2</sub>O<sub>4</sub>. Insol. in H<sub>2</sub>O and acids. (Ebelmen.)

#### Cobalt magnesium aluminate, [MgCo]Al<sub>2</sub>O<sub>4</sub>.

"Spinel Blue." Insol. in H<sub>2</sub>O or HCl+Aq. (Ebelmen.)

#### Glucinum aluminate, GlAl<sub>2</sub>O<sub>4</sub>.

Min. *Chrysoberyll*. Not attacked by acids, but decomp. by KOH+Aq.

#### Iron (ferrous) aluminate, FeAl<sub>2</sub>O<sub>4</sub>.

Min. *Hercynite*. Not attacked by acids.

#### Lithium aluminate, LiAlO<sub>2</sub>.

Sol. in H<sub>2</sub>O. (Weyberg, C. C. 1906, II. 1659.)

#### Lithium hydrogen aluminate, LiHAL<sub>2</sub>O<sub>4</sub>+5H<sub>2</sub>O.

Sl. sol. in H<sub>2</sub>O; decomp. on boiling. (Allen, Am. Ch. J. 1900, 24. 310.)

#### Magnesium aluminate, MgAl<sub>2</sub>O<sub>4</sub>.

Min. *Spinel*. Insol. in H<sub>2</sub>O.

Insol. in HNO<sub>3</sub>+Aq; very sl. sol. in HCl+Aq; partly sol. in H<sub>2</sub>SO<sub>4</sub> at boiling temp. (Abich, Pogg. 23. 316.)

Sol. by standing 2 hours at 210° with a mixture of 3 pts. H<sub>2</sub>SO<sub>4</sub> and 1 pt. H<sub>2</sub>O, or by boiling with this mixture together with HF. (Mitscherlich, J. pr. 81. 108.)

Sl. sol. in HCl, HF, and H<sub>2</sub>SO<sub>4</sub>; insol. in HNO<sub>3</sub>. (Dufau, Bull. Soc. 1901, (3) 25. 669.)

#### Manganous aluminate.

Insol. in H<sub>2</sub>O and acids. (Ebelmen, A. ch. (3) 22. 225.)

MnAl<sub>2</sub>O<sub>4</sub>. Insol. in HCl+Aq; readily attacked by HF, HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>.

Decomp. by fusion with alkali chlorate, nitrate, oxide or carbonate. (Dufau, C. R. 1902, 135. 963.)

#### Nickel aluminate.

Insol. in H<sub>2</sub>O.

#### Potassium aluminate, K<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>+3H<sub>2</sub>O.

Decomp. by dissolving in pure H<sub>2</sub>O with separation of Al<sub>2</sub>O<sub>3</sub>. (Freymy, A. ch. (3) 12. 362.) Can be recrystallised from water containing a little alkali, without decomposition. (Freymy.)

Insol. in alcohol.

#### Sodium aluminate, Na<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>.

Easily and completely sol. in cold H<sub>2</sub>O. (Schaffgotsch, Pogg. 43. 117.)

+4H<sub>2</sub>O. Insol. in alcohol. (Allen, Am. Ch. J. 1900, 24. 308.)

Na<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>. Miscible with hot H<sub>2</sub>O, and as sol. as NaOH in cold H<sub>2</sub>O. Insol. in alcohol but decomp. thereby. (Tissier, C. R. 43. 102.)

#### Strontium aluminate, Sr<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>+6H<sub>2</sub>O.

Sl. sol. in H<sub>2</sub>O (with slow decomp. in Aq. solution). (Allen, Am. Ch. J. 1900, 24. 314.)

#### Thallium aluminate, Tl<sub>2</sub>Al<sub>2</sub>O<sub>4</sub>+7H<sub>2</sub>O.

Not completely sol. in, but slowly hydrolysed by H<sub>2</sub>O.

Readily sol. in dil. acids and in the fixed alkalis.

Insol. in abs. alcohol. (Hawley, J. Am. Chem. Soc. 1907, 29. 303.)

#### Zinc aluminate, ZnAl<sub>2</sub>O<sub>4</sub>.

Insol. in acids or alkalis.

Min. *Gahnite* (*Automolite*).

+zH<sub>2</sub>O. Sol. in KOH, and NH<sub>4</sub>OH+Aq. (Berselius.)

#### Aluminicoantimoniotungstic acid.

Ammonium aluminicoantimoniotungstate, 6(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+17H<sub>2</sub>O.

A shellac-like gum. (Daniels, J. Am. Chem. Soc. 1908, 30. 1856.)

Barium aluminicoantimoniotungstate, 5BaO, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+6H<sub>2</sub>O.

Somewhat insol. in dil. HCl. (Daniels, J. Am. Chem. Soc. 1908, 30. 1857.)

Silver aluminicoantimoniotungstate, 6Ag<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+12H<sub>2</sub>O.

Ppt.

Sol. in NH<sub>4</sub>OH+Aq but requires HNO<sub>3</sub> (1:10) to dissolve it. (Daniels, J. Am. Chem. Soc. 1908, 30. 1857.)

#### Aluminicoarseniotungstic acid.

Ammonium aluminicoarseniotungstate, 6(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+14H<sub>2</sub>O.

Sparingly sol. in H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30. 1854.)

Barium aluminicoarseniotungstate, 4BaO, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+12H<sub>2</sub>O.

Very sl. sol. in H<sub>2</sub>O.

Sol. in very dil. HCl or HNO<sub>3</sub>. (Daniels, J. Am. Chem. Soc. 1908, 30. 1855.)

Cadmium aluminicoarseniotungstate, 4CdO, 2Al<sub>2</sub>O<sub>3</sub>, 3As<sub>2</sub>O<sub>3</sub>, 18WO<sub>3</sub>+17H<sub>2</sub>O.

Sol. in dil. mineral acids and in strong NH<sub>4</sub>OH+Aq. (Daniels, J. Am. Chem. Soc. 1908, 30. 1855.)

#### Aluminicomolybdic acid.

Ammonium aluminicomolybdate, 3(NH<sub>4</sub>)<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+19H<sub>2</sub>O.

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 696.)

+20H<sub>2</sub>O. More sol. in H<sub>2</sub>O than potassium

**aluminicomolybdate.** (Struve, Bull. Acad. St. Petersb. 12. 147.)  
+22H<sub>2</sub>O. (Marckwald, Dissert. 1895.)

**Barium aluminicomolybdate,** 4BaO, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+14H<sub>2</sub>O.

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 712.)

**Lead aluminicomolybdate,** 4PbO, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+21H<sub>2</sub>O.

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 712.)

**Potassium aluminicomolybdate,** 3K<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+20H<sub>2</sub>O.

1 pt. of the salt is sol. in 40.67 pts. H<sub>2</sub>O at 17°. Very difficultly sol. in acids. (Struve.)  
H<sub>2</sub>Al(MoO<sub>4</sub>)<sub>3</sub>, 2KHMoo<sub>4</sub>. Sol. in H<sub>2</sub>O. (Parmentier, C. R. 94. 1713.)

**Silver aluminicomolybdate,** 4Ag<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+16H<sub>2</sub>O.

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 712.)

**Sodium aluminicomolybdate,** 3Na<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+22H<sub>2</sub>O.

Efflorescent. Easily sol. in H<sub>2</sub>O. (Gentile J. pr. 81. 413.)

### Aluminicophosphotungstic acid.

**Ammonium aluminicophosphotungstate,** 9(NH<sub>4</sub>)<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+13H<sub>2</sub>O.

Sl. sol. in cold and in hot H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30, 1851.)

**Barium aluminicophosphotungstate,** 4BaO, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+13H<sub>2</sub>O.

Sl. sol. in H<sub>2</sub>O. Sol. in very dil. HCl or HNO<sub>3</sub>. (Daniels, J. Am. Chem. Soc. 1908, 30. 1853.)

**Silver aluminicophosphotungstate,** 4Ag<sub>2</sub>O, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+6H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH and in dil. HNO<sub>3</sub>. Insol. in acetic acid. (Daniels, J. Am. Chem. Soc. 1908, 30. 1852.)

**Zinc aluminicophosphotungstate,** 5ZnO, 2Al<sub>2</sub>O<sub>3</sub>, 4P<sub>2</sub>O<sub>5</sub>, 9WO<sub>3</sub>+11H<sub>2</sub>O.

Sol. in dil. acids and in a large quantity of conc. ammonia when NH<sub>4</sub>Cl is present. (Daniels, J. Am. Chem. Soc. 1908, 30. 1853.)

### Aluminicotungstic acid.

**Ammonium aluminicotungstate,** 3(NH<sub>4</sub>)<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+4H<sub>2</sub>O.

Sol. in conc. HNO<sub>3</sub> and in conc. HCl. When the solution in conc. HCl was boiled, a yellow colored ppt. separated. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1230.)

**Ammonium silver aluminicotungstate,** 11Ag<sub>2</sub>O, 21(NH<sub>4</sub>)<sub>2</sub>O, 4Al<sub>2</sub>O<sub>3</sub>, 36WO<sub>3</sub>.

The dry salt is insol. in pure H<sub>2</sub>O, but

readily sol. in H<sub>2</sub>O containing NH<sub>3</sub> or HNO<sub>3</sub>. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1231.)

**Barium aluminicotungstate,** 8BaO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+7H<sub>2</sub>O.

Not sol. in acids when dry. Somewhat decomp. by boiling with conc. HCl, HNO<sub>3</sub> or aqua regia. (Daniels, J. Am. Chem. Soc. 1908, 30. 1848.)

**Copper aluminicotungstate,** 2CuO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+16½H<sub>2</sub>O.

Sol. in large quantities of H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30. 1847.)

**Mercurous aluminicotungstate,** 5Hg<sub>2</sub>O, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>.

Sl. sol. in H<sub>2</sub>O. Sol. in HNO<sub>3</sub>(1:5). (Daniels, J. Am. Chem. Soc. 1908, 30. 1849.)

**Zinc aluminicotungstate,** 1½ZnO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+8H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Daniels, J. Am. Chem. Soc. 1908, 30. 1850.)

ZnO, Al<sub>2</sub>O<sub>3</sub>, 9WO<sub>3</sub>+20H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Daniels.)

### Aluminum, Al.

Less easily attacked than ordinary metals (iron, copper, lead, zinc, tin) by air, H<sub>2</sub>O, wine, beer, coffee, milk, oil, butter, fats, etc. Vinegar dissolves 0.349 g. from a sq. decimetre in 4 months, and 5 % NaCl+Aq. only 0.045 g. in the same time. (Ballaud, C. R. 114. 1536.)

The action of various substances contained in foods and drinks on compact Al as it occurs in utensils is very slight. Hard or soft water, whether cold or hot, showed no action in 8 days; 1 % solutions of tartaric, tannic, and acetic acids had no action in same time, also 5 % boric, carbolic, and salicylic acids. 4 % and 10 % acetic acid dissolved only 0.4 mg. of Al, while 10 % acetic acid dissolved 2.1 mg. from a roughened piece of Al foil in 8 days. 1 % soda solution dissolved 15 mg. in 8 days. (Rupp, Dingl. 233. 119.)

Similar results were obtained by Arche. (Dingl. 234. 255.)

Liquids which are ordinarily contained in foods and drinks do not attack sheet Al except in a very small degree. The following losses in weight in mg. by the action of the given liquids on 100 sq. centimetres sheet aluminum for 6 days were obtained:

Liquids	Loss in mg.
Claret	2.84
Hock	3.27
Brandy	1.08
5 % alcohol	0.61
5 % tartaric acid+Aq	1.69
1 % " " "Aq	2.58
5 % acetic acid+Aq	3.58
1 % " " "Aq	4.38



KOH + Aq; slowly sol. in hot conc.  $\text{HNO}_3$  + Aq. (Hampe, l. c.)

### Aluminum bromide, $\text{AlBr}_3$ .

*Anhydrous.* Dissolved by  $\text{H}_2\text{O}$  with great violence and evolution of much heat. Very sol. in alcohol. More sol. in  $\text{CS}_2$  than  $\text{AlI}_3$ . (Weber, Pogg. 103. 264.)

Sol. in  $\text{SOCl}_2$ . (Besson, C. R. 1896, 123. 884.)

Sol. in  $\text{C}_2\text{H}_5\text{Br}$ . (Plotnikoff, C. C. 1902, II. 617.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328); (Eidmann, C. C. 1899, II. 1014.)

### Solubility of $\text{AlBr}_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzophenone	48°	0	130°	43.2	50°	66.0
	45	8.5	140	48.4	38	67.2
	42	13.8	142	50	50	70.7
	38	18.3	140	52.1	60	74.2
	50	21	130	54.5	70	78.3
	60	23.4	120	56.7	80	83.3
	70	25.7	110	58.6	85	86.7
	80	28.1	100	60.3	90	90.7
	90	30.6	90	61.7	93	94.8
	100	33.4	80	62.9	96	100
Ethylene bromide	10°	0	20°	33.9	70°	72.7
	6	8.4	30	40.1	80	82.3
	2	16.0	40	47.2	90	92.2
	-2	22.9	50	55.1	96	100
	10	28.4	60	63.6		
Benzoyl chloride	-0.5°	0	85°	47	40°	72.6
	-2.5	6.5	90	50.8	60	79.4
	-5	13.0	80	52.8	70	83.9
	10	17.4	60	56	80	89.2
	30	24.6	40	59.5	90	95.8
	50	31.8	20	63.1	96	100
	70	40	7	65.5		
	80	44.3	20	67.9		

(Menschutkin, Ann. Inst. Pol. P-le-Gr., 13. 1.)

+  $6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .

+  $15\text{H}_2\text{O}$ . (Panfiloff, J. B. 1895. 785.)

### Aluminum antimony bromide, $2\text{AlBr}_3, 5\text{SbBr}_3 + 24\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1903, 36. 258.)

### Aluminum potassium bromide, $\text{AlBr}_3, \text{KBr}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 103. 267.)

### Aluminum bromide ammonia, $\text{AlBr}_3, x\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, Pogg. 103. 267.)

### Aluminum perbromide carbon bisulphide, $\text{AlBr}_5, \text{Br}_2, \text{CS}_2$ .

Sol. in ether, ethyl bromide, ethylene bromide and benzene; decomp. by  $\text{H}_2\text{O}$ . (Plotnikoff, J. Russ. phys. Chem. Soc. 1901, 33. 91; C. C. 1901, I. 1193.)

$2\text{AlBr}_5, \text{Br}_2, \text{CS}_2$ . Sol. in ether and benzene; insol. in petroleum ether. (Plotnikoff, l. c.)

### Aluminum bromochloride, $\text{AlCl}_2\text{Br}$ .

Deliquescent. Somewhat less violently dissolved by  $\text{H}_2\text{O}$  than is  $\text{AlBr}_3$ . (v. Bartal, Z. anorg. 1907, 55. 154.)

+  $6\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  without evolution of heat. (v. Bartal, Z. anorg. 1907, 55. 155.)

### Aluminum carbide, $\text{Al}_4\text{C}_3$ .

Decomp. by fused KOH at  $100^\circ$ ; insol. in fuming  $\text{HNO}_3$  in the cold; decomp. by  $\text{H}_2\text{O}$ , and dil. acids. (Moissan, Bull. Soc. 1894, (3) 11. 1012; C. R. 1894, 119. 16-20.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

### Aluminum chloride, basic, $\text{Al}_2\text{O}_3, \text{H}_2\text{O}, \text{HCl}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Schlumberger, Bull. Soc. 1895, (3) 13. 56.)

### Aluminum chloride, $\text{AlCl}_3$ .

*Anhydrous.* Very deliquescent. Sol. in  $\text{H}_2\text{O}$  with a hissing noise and evolution of heat. Solution of  $\text{AlCl}_3$  in  $\text{H}_2\text{O}$  loses  $\text{HCl}$  on evaporation, and  $\text{AlCl}_3$  is finally wholly converted into  $\text{Al}_2\text{O}_3$ .

Sol. in 1.432 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Gerlach.)

$\text{AlCl}_3$  + Aq containing 19.15 %  $\text{AlCl}_3$  boils at  $103.4^\circ$ ;  $\text{AlCl}_3$  + Aq containing 38.3 %  $\text{AlCl}_3$  boils at  $112.8^\circ$ . (Gerlach.)

### Sp. gr. of $\text{AlCl}_3$ + Aq at $15^\circ$ .

% $\text{AlCl}_3$	Sp. gr.	% $\text{AlCl}_3$	Sp. gr.
1	1.0072	22	1.1709
2	1.0144	23	1.1795
3	1.0216	24	1.1881
4	1.0289	25	1.1968
5	1.0361	26	1.2058
6	1.0435	27	1.2149
7	1.0510	28	1.2241
8	1.0585	29	1.2331
9	1.0659	30	1.2422
10	1.0734	31	1.2518
11	1.0812	32	1.2615
12	1.0890	33	1.2711
13	1.0968	34	1.2808
14	1.1047	35	1.2905
15	1.1125	36	1.3007
16	1.1207	37	1.3109
17	1.1290	38	1.3211
18	1.1372	39	1.3313
19	1.1455	40	1.3415
20	1.1537	41	1.3522
21	1.1632		

(Gerlach, Z. anal. 8. 281.)



Sp. gr. at 20° of  $\text{AlCl}_3 + \text{Aq}$  containing mg. mols.  $\text{AlCl}_3$  per liter.

M.	Sp. gr.
0.01	1.00104
0.025	1.00282
0.05	1.00588
0.075	1.00870
0.10	1.01158
0.25	1.02911
0.55	1.05706
1.0	1.11054
1.5	1.16308
2.0	1.21378

(Jones & Pearce, Am. Ch. J. 1907, **38**, 726.)

Sol. in 1 pt. strong alcohol at 12.5° (Wenzel); easily sol. in ether; sl. sol. in  $\text{CS}_2$ ; insol. in ligroine or benzene.

Difficultly sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, **29**, 374.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, **84**, 26.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 826.)

Insol. in  $\text{CS}_2$  at ord. temp. (Arctowski, Z. anorg. 1894, **6**, 257.)

Sol. in benzonitrile. (Naumann, B. 1914, **47**, 1369.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37**, 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**, 314.)

Insol. in methylal. (Eidmann, C. C. 1899, **II**, 1014.)

#### Solubility of $\text{AlCl}_3$ in organic liquids.

Solvent	t°	Mols. per 100	t°	Mols. per 100	t°	Mols. per 100
Benzo-phenone	48°	0	130°	43.2	130°	66.0
	44	8.5	125	48.4	140	67.2
	39.5	13.8	120	50	150	70.7
	50	18.3	110	52.1	160	74.2
	60	21	100	54.5	170	78.3
	70	23.4	90	56.7	180	83.3
	80	25.7	80	58.6	185	86.7
	90	28.1	70	60.3	190	90.7
	100	30.6	60	61.7	192	94.8
	110	33.4	80	62.9	194	100
	120	36.3	100	64.1		
	125	39.6	120	65.1		
Benzoyl chloride	-0.5°	0	60°	33.0	80°	52.9
	-4	7.9	70	37.5	70	55.1
	-7.5	12.7	80	42.2	60	57.2
	0	14.1	90	47.1	40	61.0
	20	18.8	93	48.7		
	40	25.0	90	50.6		

(Menschutkin, Ann. Inst. Pol. P.-le-Gr., **13**, 1.)

+6H<sub>2</sub>O. Very deliquescent; very sol. in H<sub>2</sub>O. Sol. in 0.25 pt. H<sub>2</sub>O. (Thomson.)

Sol. in 2 pts. abs. alcohol at ordinary temp., and 1.5 pts. at b.-pt. (Thomson.)

Completely insol. in a solution of ether in H<sub>2</sub>O sat. with HCl. (Havens, Am. J. Sci. 1898, (4) **6**, 46.)

**Aluminum ammonium chloride**,  $\text{AlCl}_3 \cdot \text{NH}_4\text{Cl}$ . (Baud, A. ch. 1904, (8) **1**, 46.)

**Aluminum antimony chloride**.

See Chlorantimonate, aluminum.

**Aluminum barium chloride**,  $2\text{AlCl}_3 \cdot \text{BaCl}_2$ . (Baud, C. R. 1901, **133**, 869.)

**Aluminum calcium chloride, basic**.

$3\text{CaO} \cdot \text{CaCl}_2 \cdot \text{Al}_2\text{O}_3 + 10\text{H}_2\text{O}$ . (Steinmets, Z. phys. Ch. 1905, **53**, 466.)

$10\text{CaO} \cdot \text{CaCl}_2 \cdot 6\text{Al}_2\text{O}_3$ . Slowly decomp. by boiling H<sub>2</sub>O. (Gorgeu, Bull. Soc. 1887, (2) **48**, 51.)

**Aluminum calcium chloride**,  $4\text{AlCl}_3 \cdot 3\text{CaCl}_2$ . (Baud, A. ch. 1904, (8) **1**, 51.)

**Aluminum nitrosyl chloride**,  $\text{AlCl}_3 \cdot \text{NOCl}$ .

Deliquescent, and decomp. by H<sub>2</sub>O. (Weber Pogg, **118**, 471.)

**Aluminum palladium chloride**,  $\text{AlCl}_3 \cdot \text{PdCl}_2 + 10\text{H}_2\text{O}$ .

See Chloropalladite, aluminum.

**Aluminum phosphorus pentachloride**,  $\text{AlCl}_3 \cdot \text{PCl}_5$ .

Decomp. violently by H<sub>2</sub>O. (Baudrimont.)

**Aluminum phosphoryl chloride**,  $\text{AlCl}_3 \cdot \text{POCl}_3$ .

Deliquescent. Sol. in H<sub>2</sub>O with decomp. Sol. in warm  $\text{POCl}_3$ , from which it separates on cooling. (Casselmann, A. **98**, 220.)

**Aluminum platinum chloride**,  $\text{AlCl}_3 \cdot \text{PtCl}_2 + 15\text{H}_2\text{O}$ .

See Chloroplatinite, aluminum.

**Aluminum potassium chloride**,  $\text{AlCl}_3 \cdot \text{KCl}$ .

Slowly deliquescent. Sol. in H<sub>2</sub>O with evolution of heat and decomp. (Degen, A. **18**, 332.)

**Aluminum selenium chloride**,  $2\text{AlCl}_3 \cdot \text{SeCl}_4$ .

Sol. in H<sub>2</sub>O with evolution of heat and separation of traces of selenium. (Weber, Pogg. **104**, 427.)

**Aluminum sodium chloride**,  $\text{AlCl}_3 \cdot \text{NaCl}$ .

Much less deliquescent than  $\text{AlCl}_3$ . Sol. in H<sub>2</sub>O with evolution of heat. Upon evaporating, NaCl crystallises out. (Wöhler.)

**Aluminum strontium chloride**,  $4\text{AlCl}_3 \cdot 3\text{SrCl}_2$ . (Baud, A. ch. 1909, (8) **1**, 52.)

**Aluminum sulphur chloride**,  $2\text{AlCl}_3 \cdot \text{SCl}_2$ .

Decomp. by H<sub>2</sub>O with evolution of much

heat and separation of some sulphur. (Weber, Pogg, 104. 421.)

$\text{AlCl}_3, \text{SCl}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (Ruff, B. 1901, 34. 1757.)

**Aluminum tellurium chloride**,  $2\text{AlCl}_3, \text{TeCl}_4$ .

Very sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Weber, J. pr. 76. 313.)

**Aluminum chloride ammonia**,  $\text{AlCl}_3, \text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg, 24. 248.)

Completely sol. in  $\text{H}_2\text{O}$ . (Baud, C. R. 1901, 132. 135.)

$\text{AlCl}_3, 2\text{NH}_3$ . Very hygroscopic. (Stillman, Am. Ch. J. 1895, 17. 750.)

$\text{AlCl}_3, 3\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ .

$\text{AlCl}_3, 5\text{NH}_3$ . M. pt.  $380^\circ$ . (Baud, C. R. 1901, 132. 135.)

$\text{AlCl}_3, 6\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Stillman, Am. Ch. J. 1895, 17. 752.) Somewhat hygroscopic. (Baud, C. R. 1901, 132. 135.)

**Aluminum chloride nitric oxide**,  $2\text{AlCl}_3, \text{NO}$ .

Very hygroscopic. Decomp. rapidly in the air. Sol. in  $\text{KOH} + \text{Aq}$ . (Thomas, C. R. 1895, 121. 130.)

**Aluminum chloride phosphine**,  $3\text{AlCl}_3, \text{PH}_3$ .

Decomp. by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rose Pogg, 24. 295.)

**Aluminum chloride hydrogen sulphide**.

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Wöhler.)

**Aluminum chloride sulphur dioxide**,  $\text{AlCl}_3, \text{SO}_2$ .

Decomp. by  $\text{H}_2\text{O}$ , alcohol, or benzene. (Adrianowski, B. 12. 688.)

$2\text{AlCl}_3, \text{SO}_2$ . (Baud, A. ch. 1904, (8) 1. 32.)

**Aluminum cobalt**,  $\text{Co}_2\text{Al}_3$ .

Sol. in strong acids. (Brunck, B. 1901, 34. 2734.)

**Aluminum copper**,  $\text{Cu}_4\text{Al}_3$ .

Sol. in aqua regia; decomp. by  $\text{HCl}$ . (Brunck, B. 1901, 34. 2733.)

**Aluminum fluoride**,  $\text{AlF}_3$ .

*Anhydrous*. Not attacked by  $\text{H}_2\text{O}$  or acids, and only very slightly by boiling conc.  $\text{H}_2\text{SO}_4$ . Insol. in boiling  $\text{KOH} + \text{Aq}$ . (Deville, C. R. 42. 49.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HF}$ . (Baud, C. R. 1902, 135. 1104.)

$+ \text{H}_2\text{O}$ . Completely but only sparingly sol. in  $\text{H}_2\text{O}$ . (Mazzucchelli, Real. Ac. Linc. 1907, (5) 16, I. 775; Chem. Soc. 1907, 92, (2). 549.)

$+ 3\frac{1}{2}\text{H}_2\text{O}$ . Two modifications: (1) Easily sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HF}$ . (2) Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HF}$ . (Baud, C. R. 1902, 135. 1104.)

$+ 7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 61. 329.)

Min. *Fluellite*.

$+ 8\frac{1}{2}\text{H}_2\text{O}$ . Very efflorescent. Sat. solution contains 3.85 g.  $\text{AlF}_3$  per 100 g. at  $11^\circ$  and 1.2 g. at  $-0.2^\circ$ . (Mazzucchelli, Real. Ac. Linc. 1907, (5) 16, I. 775; Chem. Soc. 1907, (2), 92. 549.)

**Aluminum hydrogen fluoride**,  $3\text{AlF}_3, 2\text{HF} + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; precipitated by alcohol. (Deville.)

$2\text{AlF}_3, \text{HF} + 5\text{H}_2\text{O}$ . (Deville, A. ch. (6) 61. 329.)

**Aluminum ammonium fluoride**,  $\text{AlF}_3, \text{NH}_4\text{F}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  or  $\text{NH}_4\text{F}$ . (Berzelius, Pogg. 1. 45.)

$\text{AlF}_3, 2\text{NH}_4\text{F} + 1.5\text{H}_2\text{O}$ . Sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Baud, C. R. 1902, 135. 1338.)

$\text{AlF}_3, 3\text{NH}_4\text{F}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Petersen, J. pr. (2) 40. 35.)

Quite easily sol. in  $\text{H}_2\text{O}$ , but insol. in  $\text{NH}_4\text{F} + \text{Aq}$ . (Helmholtz, Z. anorg. 3. 129.)

**Aluminum barium fluoride**.

Apparently not obtained in pure state. (Röder.)

**Aluminum calcium fluoride**,  $\text{AlF}_3, \text{CaF}_2 + \text{H}_2\text{O}$ .

Min. *Evigtokite*.

**Aluminum calcium sodium fluoride**,  $\text{AlF}_3, \text{CaF}_2, \text{NaF} + \text{H}_2\text{O}$ .

Min. *Pachnolite*.

**Aluminum cobaltous fluoride**,  $\text{AlF}_3, \text{CoF}_2 + 7\text{H}_2\text{O}$ .

Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 272.)

**Aluminum cupric fluoride**,  $2\text{AlF}_3, \text{CuF}_2$ .

Very slowly but completely sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{AlF}_3, 2\text{CuF}_2 + 11\text{H}_2\text{O}$ . Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 272-76.)

$2\text{AlF}_3, 3\text{CuF}_2 + 18\text{H}_2\text{O}$ . Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland.)

**Aluminum cupric hydrogen fluoride**,  $\text{AlF}_3, \text{CuF}_2, \text{HF} + 8\text{H}_2\text{O}$ .

Efflorescent in the air. Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 272.)

**Aluminum iron (ferrous) fluoride**,  $\text{AlF}_3, \text{FeF}_2 + 7\text{H}_2\text{O}$ .

Sl. sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 270.)

**Aluminum lithium fluoride**.

Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Aluminum magnesium fluoride**.

$2\text{AlF}_3, \text{MgF}_2$  (?). (Röder.)

**Aluminum nickel fluoride,  $\text{AlF}_3, \text{NiF}_2 + 7\text{H}_2\text{O}$ .**

Sl. sol. in dil.  $\text{HF} + \text{Aq.}$  (Weinland, Z. anorg. 1899, 22. 271.)

**Aluminum potassium fluoride,  $\text{AlF}_3, 3\text{KF}$ .**

Very sl. sol. in acid solutions, and still less in  $\text{H}_2\text{O}$ . (Gay-Lussac and Thénard.)

$\text{AlF}_3, 2\text{KF}$ . As above.

**Aluminum silicon fluoride.**

See Fluosilicate, aluminum.

**Aluminum sodium fluoride.**

$2\text{AlF}_3, 3\text{NaF}$ . Min. *Chiolite*.

$\text{AlF}_3, 2\text{NaF}$ . Min. *Chodessite*.

$\text{AlF}_3, 3\text{NaF}$ . Min. *Cryolite*. Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl} + \text{Aq.}$  Decomp. by  $\text{H}_2\text{SO}_4$ , or by boiling with  $\text{NaOH} + \text{Aq.}$

**Aluminum strontium fluoride.**

As the Ba salt. (Röder.)

**Aluminum thalious fluoride,  $2\text{AlF}_3, 3\text{TlF}$ .**

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 61. 243.)

**Aluminum zinc fluoride,  $\text{AlF}_3, \text{ZnF}_2 + 7\text{H}_2\text{O}$ .**

Sol. in dil.  $\text{HF} + \text{Aq.}$  (Weinland, Z. anorg. 1899, 22. 272.)

$2\text{AlF}_3, \text{ZnF}_2$ . Slowly but completely sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Aluminum hydroxide,  $\text{Al}_2\text{O}_3, \text{H}_2\text{O}$   
 $= \text{Al}_2\text{O}_3(\text{OH})_2$ .**

Dehydrated by conc. acids, without dissolving. (Becquerel, C. R., 67. 108.)

Min. *Diaspore*. Insol. in  $\text{HCl} + \text{Aq.}$ , and not attacked by boiling conc.  $\text{H}_2\text{SO}_4$ , unless it has been ignited.

$\text{Al}_2\text{O}_3, 2\text{H}_2\text{O} = \text{Al}_2\text{O}(\text{OH})_4$ . Pptd. Al hydroxide, when boiled twenty hours with  $\text{H}_2\text{O}$  is insol. in acids and alkalis, and has the above composition. (St. Gilles, A. ch. (3) 46. 57.)

Min. *Bauxite*.

**Soluble modifications**—(a) *Meta-aluminum hydroxide From basic Al acetate*. Sol. in  $\text{H}_2\text{O}$  and more readily in  $\text{HC}_2\text{H}_3\text{O}_2$ . The aqueous solution is coagulated by traces of alkalis, many acids, and salts, while other acids and salts have no effect. Thus, 1 pt.  $\text{H}_2\text{SO}_4$  in 1000 pts.  $\text{H}_2\text{O}$ , added to 7000 pts. of above solution containing 20 pts.  $\text{Al}_2\text{O}_3$ , converts the liquid into a nearly solid mass. Citric, tartaric, oxalic, chromic, molybdic, racemic, suberic, salicylic, benzoic, gallic, lactic, cinnamic, butyric, valeric, camphoric, picric, uric, meconic, comenic, and hemipinic acids act in the same way.  $\text{HCl}$  and  $\text{HNO}_3$  have far less action, 600 mols. being necessary to produce the same effect as 1 mol.  $\text{H}_2\text{SO}_4$ , while acetic, formic, boric, arsenious, pyro-

meconic, and opianic acids do not coagulate the solution, except when moderately conc. 1 pt.  $\text{KOH}$  in 1000 pts.  $\text{H}_2\text{O}$  coagulates 9000 pts. of the solution.  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , and  $\text{Ca}(\text{OH})_2$  have the same effect.

The solution is not coagulated by acetates, unless added in large quantity, and even then the ppt. is redissolved when treated with  $\text{H}_2\text{O}$ . Nitrates and chlorides coagulate with difficulty;  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ , and  $\text{CaSO}_4 + \text{Aq.}$ , however, have as strong an action as a liquid containing the same amount of  $\text{H}_2\text{SO}_4$ . A teaspoonful of the solution introduced into the mouth solidifies at once from the action of the saliva. The ppt. formed by acids is not sol. in an excess of the acid, but by the long continued action of conc.  $\text{H}_2\text{SO}_4$ , especially if hot, the ppt. is dissolved; boiling conc.  $\text{HCl} + \text{Aq.}$  also dissolves it, but less readily than  $\text{H}_2\text{SO}_4$ . The ppt. is sol. in boiling conc.  $\text{KOH} + \text{Aq.}$  The residue, when the solution is evaporated at  $100^\circ$ , has composition  $\text{Al}_2\text{O}_3, 2\text{H}_2\text{O}$ , and is insol. in acids. (Crum, Chem. Soc. 6. 225.)

(b) *By Dialysis*. Sol. in  $\text{H}_2\text{O}$ , from which it is separated by extremely small amounts of various substances, as acids, ammonia, salts (especially  $\text{K}_2\text{SO}_4$ ), caramel, etc. An excess of acid dissolves the coagulum. If the solution contains 0.5%  $\text{Al}_2\text{O}_3$  or less, it may be boiled without change, but the hydroxide separates out suddenly when it is reduced to  $\frac{1}{2}$  its vol., and even very dil. solutions gelatinise spontaneously in a few days. The solution is not coagulated by alcohol or sugar. (Graham, A. 121. 41.)

$\text{Al}_2\text{O}_3, 3\text{H}_2\text{O} = \text{Al}(\text{OH})_3$ . *Crystallised*. Difficultly sol. in acids and alkalis. (Cossa, N. Cim. (2) 3. 228.) Insol. in boiling  $\text{HCl} + \text{Aq.}$  (Wöhler, A. 113. 249.) Sl. sol. in  $\text{KOH} + \text{Aq.}$ ; nearly insol. in cold  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3 + \text{Aq.}$ ; very slowly sol. in hot  $\text{HCl} + \text{Aq.}$ , more readily in hot  $\text{H}_2\text{SO}_4$ . (v. Bonsdorff, Pogg. 27. 275.)

**$\alpha$ -modification**. Unstable. Changes into  **$\beta$ -modification**. Sol. in  $\text{N-H}_2\text{SO}_4$  at ord. temp. Sol. in  $\text{N-NaOH}$  and in hot  $\text{NaOH}$  of concentration  $5\text{Na}_2\text{O}, 100\text{H}_2\text{O}$ . (Russ, Z. anorg. 1904, 41. 226.)

**$\beta$ -modification**. Insol. in  $\text{N-H}_2\text{SO}_4$  at ord. temp. Difficulty sol. in warm  $\text{N-NaOH}$ , but easily sol. in hot  $\text{NaOH}$  of concentration  $5\text{Na}_2\text{O}, 100\text{H}_2\text{O}$ . Its solubility in  $\text{NaOH}$  increases with increase in concentration of the hydroxyl ions. (Russ.)

**$\delta$ -modification**. Easily sol. in conc.  $\text{H}_2\text{SO}_4$ ; only sl. sol. in  $\text{HCl}$ ,  $\text{HNO}_3$  or acetic acids, or in alkali +  $\text{Aq.}$  (Tommasi, C. C. 1905, II. 605.)

Min. *Gibbsite*. Sol. in  $\text{HCl} + \text{Aq.}$  and dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Readily sol. in conc.  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq.}$

**Precipitated**. Completely insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3 + \text{Aq.}$  Easily sol. in acids when freshly pptd., but solubility diminishes on standing.

Easily sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$  (Sonnenschein.)

Herz (Z. anorg. 25. 155) found that aluminum hydroxide which has been dried in a vacuum desiccator requires for solution in  $\text{NaOH} + \text{Aq}$ . 3 atoms Na to 1 atom Al. Slade (Z. Elektrochem. 1911, 17. 261) was unable to obtain this result. Herz says Slade's error is due to insufficient shaking of the solution. (Herz, Z. Elektrochem. 1911, 17. 403.)

New solubility determinations verify the statement of Herz (Z. anorg. 25. 155) that the solubility of  $\text{Al}(\text{OH})_3$  in  $\text{NaOH} + \text{Aq}$  is proportional to the concentration of  $\text{NaOH}$ . They do not, however, verify his statement that the ratio Na : Al in the solutions is always 3 : 1, for the author finds that the ratio Na : Al varies from 2 : 1 to 10 : 1 depending on the conditions of precipitation and the method and duration of drying of the  $\text{Al}(\text{OH})_3$ . (Slade, Z. Elektrochem. 1912, 18. 1.)

Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd., but presence of  $\text{NH}_4$  salts diminish its solubility, and it separates out completely after long standing. (Fresenius.)

Somewhat sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , the more readily the larger the vol. of  $\text{H}_2\text{O}$ . Somewhat sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , but less than in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sl. sol. in dil.  $\text{NH}_4\text{Cl} + \text{Aq}$ , unless that salt be in large excess. It is finally wholly pptd. if allowed to stand several days.

18752 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (4 %  $\text{NH}_4\text{OH}$ ) dissolve an amt. of  $\text{Al}(\text{OH})_3$  corresponding to one pt.  $\text{Al}_2\text{O}_3$ ;  $\text{NH}_4\text{Cl}$  prevents this solubility almost completely. (Hanamann, Pharm. Viertelj. 12. 527.)

$\text{Al}(\text{OH})_3$ , prepared by ppt. of a solution of  $\text{Al}(\text{NO}_3)_3$  with  $\text{NH}_4\text{OH}$ , filtered and washed, is insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

$\text{Al}(\text{OH})_3$ , prepared by pptn. of a solution of potassium aluminate with  $\text{NH}_4\text{Cl}$ , is sol. in a large excess of  $\text{NH}_4\text{OH}$  if this is added to the ppt. at once. This modification which is sol. in  $\text{NH}_4\text{OH}$  is unstable and easily goes over into the modification which is insol. in  $\text{NH}_4\text{OH}$ . (Renz, B. 1903, 36. 2751.)

Conc.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  does not dissolve  $\text{Al}(\text{OH})_3$ , and not a trace is dissolved by boiling conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Weeren, Pogg. 92. 97.)

With  $\text{NH}_4\text{F} + \text{Aq}$ , it forms a double salt,  $\text{AlF}_3 \cdot 3\text{NH}_4\text{F}$ , which is sol. in  $\text{H}_2\text{O}$ , but not in  $\text{NH}_4\text{F} + \text{Aq}$ . (Helmholtz, Z. anorg. 3. 127.)

Insol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Malaguti and Durocher, A. ch. (3) 17. 421.) Fuchs found, on the contrary, that it is not wholly insol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Fresenius, Quant.)

Insol. in  $\text{FeCl}_3 + \text{Aq}$ . (Béchamp.)

Determinations of the solubility of aluminum hydroxide in  $\text{AlCl}_3 + \text{Aq}$  show that part goes into solution to form a compound, while the greater part is in the colloidal form. (Fischer, Z. anorg. 1904, 40. 46.)

Only sl. sol. in conc.  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$ , but solubility increases with decrease in concentration of  $\text{Al}_2(\text{SO}_4)_3$ , until it reaches a maximum at a concentration of 32 %  $\text{Al}_2(\text{SO}_4)_3$  at 20°, 28 % at 40°, and 38 % at 60°. With further decrease in concentration of  $\text{Al}_2(\text{SO}_4)_3$ ,

the solubility of  $\text{Al}(\text{OH})_3$  in  $\text{Al}_2(\text{SO}_4)_3$  diminishes. (Kremann, C. A. 1909. 2422.)

Sol. in  $\text{Ba}(\text{OH})_2 + \text{Aq}$ . (Rose.)

Sol. in boiling  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Cr}(\text{NO}_3)_3$ ,  $\text{Bi}(\text{NO}_3)_3$ ,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgNO}_3$ ,  $\text{SnCl}_4$ , and  $\text{SbCl}_5 + \text{Aq}$ . (Persoz.)

Insol. in  $\text{HCN}$  or cold  $\text{KCN} + \text{Aq}$ ; but sl. sol. in hot  $\text{KCN} + \text{Aq}$ . (Rose.)

Insol. in  $\text{K}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Osann, 1821.)

When moist, sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , from which it is reprecipitated on boiling. (Berthier, A. ch. (3) 7. 76.)

Somewhat sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Mercer.)

Not pptd. by  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of Na citrate. (Spiller.)

Sol. in ethyl amine, amyl amine, sinkaline, ethyl picoline hydroxide, stibethylum hydroxide, triethyltoluyl ammonium hydroxide +  $\text{Aq}$ . (Friedländer.)

Sol. in alkyl amines. (Renz, B. 1903, 36. 2751.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sol. to a considerable extent in  $\text{K}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Very sl. sol. in cane sugar +  $\text{Aq}$ . (Ramsey.) Solubility in glycerine +  $\text{Aq}$  containing about 60 % by vol. of glycerine. 100 cc. of the solution contain 0.25 g.  $\text{Al}_2\text{O}_3$ . (Müller, Z. anorg. 1905, 43. 322.)

$\text{Al}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and alcohol. Sol. in  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ . (Zunino, Gazz. ch. it. 1900, 30 (1). 194.)

$\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , "Trialuminum hydroxide."

Not sol. in conc. acids in the cold; not sol. in  $\text{KOH}$  (cold) and only sl. sol. in hot  $\text{KOH}$ . Characterized by its solubility in exactly one mol. dil.  $\text{HCl}$ . Dil. solutions do not gelatinize even on long standing. Conc. solution of  $\text{NH}_4\text{Cl}$  and other salts cause ppt. which redissolves on addition of  $\text{H}_2\text{O}$ .

Alkalies and alkali carbonates decomp. the salt with  $\text{HCl}$  and ppt. trialuminum hydroxide.  $\text{H}_2\text{SO}_4$  and sol. sulphates give insol. compds. with the hydrate.  $\text{HNO}_3$  like  $\text{HCl}$  gives soluble compds. with the hydrate. (Structural formula given.) (Schlumberger, Bull. Soc. 1895, (5) 13. 41-65; C. C. 1896, I. 421.)

#### Aluminum iodide, $\text{AlI}_3$ .

*Anhydrous*. Fumes on air and deliquesces. Sol. in  $\text{H}_2\text{O}$  with evolution of much heat. Sol. in  $\text{CS}_2$  and crystallizes from the hot sat. solution on cooling. (Weber.) Sol. in alcohol (Weber); ether and tetrachloromethane. (Gustavson.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 26.)

+  $6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .

#### Aluminum mercuric iodide, $\text{AlI}_3 \cdot \text{HgI}_2 \cdot 8\text{H}_2\text{O}$ .

Very deliquescent; sol. in  $\text{H}_2\text{O}$  without decomp. (Duboin, C. R. 1908, 146. 1028.)

**Aluminum potassium iodide,  $AlI_3$ , KI.**

Sol. in  $H_2O$  with evolution of much heat. (Weber, Pogg. 101. 469.)

**Aluminum iodide ammonia,  $AlI_3$ ,  $3NH_3$ .**

Decomp. by  $H_2O$ . (Weber, Pogg. 103. 263.)

**Aluminum iodide mercuric oxyiodide,  $2AlI_3$ ,  $HgO$ ,  $3HgI_2$ ,  $+15H_2O$ .**

(Duboin, C. R. 1907, 145. 714.)

**Aluminum iron,  $FeAl_3$ .**

Readily sol. in strong  $HNO_3$ . (Brunck, B. 1901, 34. 2734.)

**Aluminum manganese,  $Mn_3Al_7$ .**

Sol. in strong  $HCl$ . (Brunck, B. 1901, 34. 2735.)

**Aluminum molybdenum,  $Al_4Mo$ .**

Easily sol. in hot  $HNO_3$  or  $HCl$ . (Wöhler, A. 1860, 115. 103.)

$Al_4Mo$ . (Guillet, C. R. 1901, 133. 293.)

$AlMo$ . (Guillet.)

$AlMo_4$ . Not attacked by dil.  $HCl$  + Aq. (Guillet.)

$AlMo_{10}$ . Not attacked by  $HCl$  + Aq. (Guillet.)

**Aluminum nickel,  $Al_3Ni$ .**

Sol. in strong acids. (Brunck, B. 1901, 34. 2734.)

**Aluminum nitride,  $Al_3N_2$ .**

Slowly attacked by hot or cold  $H_2O$ . Decomp. by acids and aqueous solutions of the alkalis, especially when they are concentrated. (Mallet, A. 186. 155.)

Easily decomp.  $H_2O$  when finely powdered. (Rossil, C. R. 1895, 121. 942.)

Decomp. by moist air and by boiling  $H_2O$  and by alkalis + Aq. (Franck, Ch. Z. 1897, 21. 263.)

**Aluminum oxide,  $Al_2O_3$ .**

*Crystalline.* Min. *Corundum*, *sapphire*, *ruby*, *emery*. Insol. in acids.

*Amorphous.* Ignited  $Al_2O_3$  is insol. in acids except that it dissolves slowly when heated with a mixture of 1 pt.  $H_2SO_4$  and 1 pt.  $H_2O$ . (Berzelius.) Slowly sol. in boiling  $HCl$  + Aq. (Rose, Pogg. 52. 595.)

Sol. in 22 pts. of a mixture of 8 pts.  $H_2SO_4$  and 1 pt.  $H_2O$ . (Mitscherlich.) The lower the temperature at which  $Al_2O_3$  has been heated, the more sol. is it in acids and alkalis.

Solubility in (calcium succrate + sugar) + Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g.  $CaO$  dissolves 1.35 g.  $Al_2O_3$ ; 1 l. solution containing 296.5 g. sugar and 24.2 g.  $CaO$  dissolves 0.32 g.  $Al_2O_3$ ; 1 l. solution containing 174.4 g. sugar and 14.1 g.  $CaO$  dis-

solves 0.19 g.  $Al_2O_3$ . (Bodenbender, J. B. 1865. 600.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

See also Aluminum hydroxide.

**Aluminum peroxide,  $Al_2O_3$ ,  $Al_2O_4$ ,  $+10H_2O$ .**

Ppt.; sol. in acids with decomp. (Terni, C. A. 1912. 3068.)

**Aluminum oxybromide.**

Basic aluminum bromides containing three equivalents or less of  $Al_2O_3$  to one of  $AlBr_3$  are sol. in  $H_2O$ . Those containing more than three equivalents are insol. (Ordway, Am. J. Sci. (2) 26. 203.)

**Aluminum oxychloride.**

Sol. in dil. acids or alkalis. Decomp. by  $H_2O$ . (Hautefeuille and Perrey, C. R. 100. 1220.)

Basic aluminum chlorides containing two equivalents or less of  $Al_2O_3$  to one of  $AlCl_3$  are sol. in  $H_2O$ . Those containing more than two equivalents are insol. (Ordway.)

$Al_2O_3$ ,  $3AlCl_3$ ,  $+3H_2O$ . (Tommasi, Bull. Soc. (2) 37. 443.)

$Al_2O_3$ ,  $8AlCl_3$ ,  $+3H_2O$ . (Tommasi.)

$3Al_2O_3$ ,  $AlCl_3$ ,  $+15H_2O$ . (Tommasi.)

**Aluminum phosphide,  $Al_3P$ .**

Unstable. (Franck, Ch. Z. 1898, 22. 240.)

$Al_3P_2$ . Decomp. by  $H_2O$ . (Fonze-Diacon, C. R. 1900, 130. 1315.)

Unstable. (Franck, Ch. Z. 1898, 22. 240.)

$Al_3P_7$ . Decomp. by  $H_2O$  and acids. (Franck.)

$Al_3P_7$ . Decomp. by  $H_2O$  and acids. (Franck, Ch. Z. 1898, 22. 288.)

$Al_3P_3$ . Unstable. (Franck, Ch. Z. 1898, 22. 240.)

**Aluminum platinum,  $Pt_2Al_{10}$ .**

The Al is dissolved out by  $HCl$ . (Brunck, B. 1901, 34. 2735.)

**Aluminum selenide,  $Al_2Se_3$ .**

Decomp. by  $H_2O$ . (Fonze-Diacon, C. R. 1900, 130. 1315.)

**Aluminum silicide,  $Al_3Si_4$ .**

More easily sol. in acids than Al. (Winkler, J. pr. 91. 193.)

**Aluminum chromium silicide,  $Al_2Cr_2Si_4$ .**

Insol. in hot conc.  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ , and aqua regia. Sol. in cold  $HF$  or in  $HF + HNO_3$ . Sol. in molten alkali. Insol. in  $NaOH$  + Aq,  $KOC$  + Aq or fused  $KClO_4$  or  $KHSO_4$ . (Manchot and Kieser, A. 1904, 337. 356.)

$Al_2Cr_2Si_4$ . Insol. in hot conc.  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ , and aqua regia. Sol. in  $HF$  and in molten alkali. (Manchot and Kieser, A. 1904, 337. 358.)

**Aluminum tungsten silicide.**

Insol. in most acids and aqua regia. Easily sol. in HF, HNO<sub>3</sub> and in molten alkali. Not attacked by dil. NaOH + Aq. (Manchot and Kieser, A. 1904, 337. 360.)

**Aluminum vanadium silicide, Al<sub>3</sub>V<sub>2</sub>Si<sub>11</sub>.**

Sol. in HF. Not attacked by hot conc. HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub> or aqua regia. Decomp. by fusing with NaOH. Stable toward fused KClO<sub>3</sub>. (Manchot, A. 1907, 357. 134.)

**Aluminum sulphide, AlS.**

Decomp. by H<sub>2</sub>O. Sol. in acids and alkalis. (Regelsberger, Z. Elektrochem, 1898, 4. 548.)

Al<sub>2</sub>S<sub>3</sub>. Decomp. in moist air and by H<sub>2</sub>O. (Wöhler.) Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Aluminum chromium sulphide, Al<sub>2</sub>S<sub>3</sub>CrS.**

Sl. attacked by HCl + Aq. Gradually decomp. by HNO<sub>3</sub>. (Houdard, C. R. 1907, 144. 1115.)

**Aluminum magnesium sulphide, Al<sub>2</sub>S<sub>3</sub>, MgS.**

Decomp. by H<sub>2</sub>O, alcohol and acids. (Houdard, C. R. 1907, 144. 1116.)

**Aluminum potassium sulphide.**

Violently decomposed by H<sub>2</sub>O. (St. Claire Deville, J. pr. 71. 293.)

Does not exist. (Gratama, R. t. c. 3. 4.)

**Aluminum silver sulphide, 5Al<sub>2</sub>S<sub>3</sub>, 4Ag<sub>2</sub>S.**

(Cambi, Real. Ac. Linc. (5) 21, II. 838.)

**Aluminum telluride.**

Decomp. by H<sub>2</sub>O. (Wöhler, Pogg. 11. 160.)

**Aluminum titanide, Al<sub>2</sub>Ti.**

Not attacked by H<sub>2</sub>O or by cold HNO<sub>3</sub>. Sl. sol. in warm HNO<sub>3</sub>. Sol. in cold conc. H<sub>2</sub>SO<sub>4</sub> or HCl. Sol. in warm KOH + Aq. (Levy, A. ch. 1902, (6) 25. 449.)

Sl. in HCl and in aqua regia. (Guillet.)

Al<sub>2</sub>Ti. Sol. in hot dil. H<sub>2</sub>SO<sub>4</sub> and in hot KOH + aq. Sol. in hot conc. acids. (Manchot, A. 1907, 357. 142.)

Al<sub>2</sub>Ti<sub>3</sub>. Aluminothermic product is sol. in HCl and aqua regia. (Guillet.)

**Aluminosulphuric acid, Al<sub>2</sub>(SO<sub>4</sub>H)<sub>3</sub> + 7 H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O with decomp. into Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. (Silberberger, M. 1904, 25. 222.)

**Diamide, N<sub>2</sub>H<sub>4</sub>.**

See Hydrazine.

**Amidochromic acid.****Amidochromates.**

Do not exist. Those described by Darm-

städter and Löwenthal are impure bichromates. (Wyrouboff, Bull. Soc. 1894, (3) 11. 845-53; C. C. 1894, II. 610.)

**Ammonium amidochromate, (NH<sub>4</sub>)NH<sub>2</sub>CrO<sub>3</sub>.**

Very sol. in H<sub>2</sub>O. (Löwenthal, Z. anorg. 1894, 6. 363.)

Is ammonium dichromate. (Wyrouboff, Bull. Soc. (3) 11. 845.)

**Lithium amidochromate, LiNH<sub>2</sub>CrO<sub>3</sub>.**

Very sol. in H<sub>2</sub>O and acids. (Löwenthal, Z. anorg. 1894, 6. 364.)

**Potassium amidochromate, KCrO<sub>3</sub>NH<sub>2</sub>.**

Sol. only in H<sub>2</sub>O. Sat. solution in H<sub>2</sub>O contains 13 % of the salt. (Heintze, J. pr. (2) 4. 214.)

**Amidophosphoric acid, HPO<sub>3</sub>(NH<sub>2</sub>) = PO(NH<sub>2</sub>)(OH)<sub>2</sub>.**

Sol. in H<sub>2</sub>O, but decomp. on standing or by heat. (Stokes, Am. Ch. J. 15. 198.)

**Aluminum amidophosphate.**

Ppt. Sol. in NH<sub>4</sub>OH + Aq. (Stokes.)

**Ammonium amidophosphate, NH<sub>4</sub>HPO<sub>3</sub>(NH<sub>2</sub>).**

Very sol. in H<sub>2</sub>O. (Stokes.)

**Barium amidophosphate, BaPO<sub>3</sub>(NH<sub>2</sub>) + H<sub>2</sub>O.**

Very sl. sol. in H<sub>2</sub>O. (Stokes.)  
BaH<sub>2</sub>(PO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub> + 2½ H<sub>2</sub>O. Quite diffi-  
cultly sol. in H<sub>2</sub>O. (Stokes.)

**Calcium amidophosphate, CaPO<sub>3</sub>(NH<sub>2</sub>).**

Much less sol. in H<sub>2</sub>O than Ba salt. (Stokes.)

CaH<sub>2</sub>(PO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub>. Much less sol. in H<sub>2</sub>O than the Ba salt. (Stokes.)

**Chromic amidophosphate.**

Ppt. Sol. in warm NH<sub>4</sub>OH + Aq. (Stokes.)

**Cobalt amidophosphate.**

Neutral. Ppt.

Acid. Sl. sol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH + Aq.

**Cupric amidophosphate.**

Neutral. Sl. sol. in H<sub>2</sub>O.

Acid. Nearly insol. in H<sub>2</sub>O.

**Ferrous amidophosphate.**

Neutral. Sol. in much H<sub>2</sub>O, and in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, or NH<sub>4</sub>OH + Aq.

Acid. Nearly insol. in H<sub>2</sub>O or NH<sub>4</sub>Cl + Aq. Sol. in NH<sub>4</sub>OH + Aq.

**Ferric amidophosphate.**

Neutral. Ppt. Sol. in excess of alkali

amidophosphate and in  $\text{NH}_4\text{OH} + \text{Aq.}$  Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$

*Acid.* As the neutral salt.

**Hydroxylamine amidophosphate,**  $(\text{NH}_2\text{O})\text{HPO}_2(\text{NH}_2).$

Sl. sol. in  $\text{H}_2\text{O}$ . (Stokes.)

**Lithium amidophosphate,**  $\text{LiHPO}_2(\text{NH}_2).$

Sl. sol. in  $\text{H}_2\text{O}$ . (Stokes.)

**Magnesium amidophosphate,**  $\text{MgPO}_2(\text{NH}_2) + 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ ; quite easily sol. in dil.  $\text{NH}_4\text{Cl} + \text{Aq.}$  Sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Stokes.)

$\text{MgH}_2(\text{PO}_2\text{NH}_2)_2 + 3\frac{1}{4}\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Stokes.)

**Manganese amidophosphate.**

*Neutral.* Ppt.

*Acid.* Sl. sol. in  $\text{H}_2\text{O}$ .

**Nickel amidophosphate.**

*Neutral.* Ppt. Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{NH}_4\text{OH} + \text{Aq.}$

*Acid.* Sl. sol. in  $\text{H}_2\text{O}$ .

**Potassium amidophosphate,**  $\text{K}_2\text{PO}_2(\text{NH}_2).$

Very sol. in  $\text{H}_2\text{O}$  and not decomp. by boiling. (Stokes.)

$\text{KHPO}_2(\text{NH}_2)$ . Easily sol. in cold  $\text{H}_2\text{O}$ ; insol. in alcohol. (Stokes.)

**Silver amidophosphate,**  $\text{Ag}_3\text{PO}_2(\text{NH}_2).$

Almost insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  or  $\text{NH}_4\text{OH} + \text{Aq.}$

$\text{AgHPO}_2(\text{NH}_2)$ . Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in dil.  $\text{HNO}_3$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  also in  $\text{NH}_4\text{OH} + \text{Aq.}$

**Sodium amidophosphate,**  $\text{Na}_2\text{PO}_2(\text{NH}_2).$

Not deliquescent; very sol. in  $\text{H}_2\text{O}$ ; pptd. from aqueous solution by alcohol. (Stokes.)

$\text{NaHPO}_2(\text{NH}_2) + \frac{1}{4}(?)\text{H}_2\text{O}$ . Nearly insol. in cold, and decomp. by hot  $\text{H}_2\text{O}$ . Insol. in alcohol.

**Zinc amidophosphate.**

*Neutral.* Perceptibly sol. in  $\text{H}_2\text{O}$ .

*Acid.* Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$

**Diamidophosphoric acid,**  $\text{PO}(\text{NH}_2)_2\text{OH}$ .

Sol. in cold  $\text{H}_2\text{O}$ ; almost insol. in alcohol; stable in the air but decomp. when heated and by boiling in aq. solution. (Stokes, Am. Ch. J. 1894, 16. 130.)

**Barium diamidophosphate,**  $[\text{PO}(\text{NH}_2)_2\text{O}]_2\text{Ba}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol; aq. solution decomp. slowly. (Stokes, Am. Ch. J. 1894, 16. 134.)

**Magnesium diamidophosphate,**  $[\text{PO}(\text{NH}_2)_2\text{O}]_2\text{Mg}$ .

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Stokes.)

**Potassium diamidophosphate,**  $\text{PO}(\text{NH}_2)_2\text{OK}$ .

Sol. in  $\text{H}_2\text{O}$ ; not deliquescent; insol. in alcohol. (Stokes.)

**Silver diamidophosphate,**  $\text{PO}(\text{NH}_2)_2\text{OAg}$ .

Very stable; insol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Stokes.)

**Sodium diamidophosphate,**  $\text{PO}(\text{NH}_2)_2\text{ONa}$ .

Sol. in  $\text{H}_2\text{O}$ ; not deliquescent; insol. in alcohol. (Stokes.)

**Diamidotrithydroxylphosphoric acid.**

**Silver diamidotrithydroxylphosphate,**  $(\text{AgO})_2\text{P}(\text{NHAg})_2$ .

(Stokes, Am. Ch. J. 1894, 16. 147.)

$(\text{AgO})_2\text{P}(\text{NH}_2)(\text{NHAg})$ . Insol. in cold  $\text{H}_2\text{O}$ . (Stokes.)

$(\text{AgO})_2\text{P}(\text{NH}_2)_2$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Stokes.)  
+  $2\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Stokes.)

**Amidoimidophosphoric acid.**

**Amidohezimidoheptaphosphoric acid,**  $\text{OH} \cdot \text{PO}(\text{NH}_2)[\text{NH} \cdot \text{PO}(\text{OH})]_5 \cdot \text{NH} \cdot \text{PO}(\text{OH})_2$   
=  $\text{P}_7\text{N}_7\text{O}_{15}\text{H}_{18}$ .

Known only in solution in  $\text{H}_2\text{O}$ . (Stokes, Am. Ch. J. 1898, 20. 758.)

**Silver diamidopyrimidophosphate,**  $\text{NH}(\text{PO} \cdot \text{NH}_2)_2\text{OAg}_2$ .

Almost insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Stokes, Am. Ch. J. 1894, 16. 136.)

**Silver amidotetrimido pentaphosphate,**  $\text{P}_5\text{N}_7\text{O}_{11}\text{H}_5\text{Ag}_7$ .

Ppt. (Stokes, Am. Ch. J. 1898, 20. 752.)

**Silver amidohezimidoheptaphosphate,**  $\text{P}_7\text{N}_7\text{O}_{15}\text{H}_5\text{Ag}_7$ .

Ppt.; decomp. by acetic acid. (Stokes, Am. Ch. J. 1898, 20. 759.)

**Sodium amidodiamidotrithosphate,**

$\text{PO} \cdot \text{ONa} < \text{NH} \cdot \text{PO}(\text{ONa})_2$   
 $< \text{NHPO}(\text{ONa})\text{NH}_2$ .

=  $\text{P}_3\text{N}_3\text{O}_7\text{H}_4\text{Na}_4 + \text{H}_2\text{O}$ .

Unstable; sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Stokes, Am. Ch. J. 1896, 18. 643.)

**Sodium amidohezimidoheptaphosphate,**  $\text{P}_7\text{N}_7\text{O}_{15}\text{H}_5\text{Na}_7$ .

Sol. in  $\text{H}_2\text{O}$ ; pptd. by alcohol. (Stokes, Am. Ch. J. 1898, 20. 758.)

**Amidophosphimic acid.****Silver amidophosphimate,  $P(NH)NH_2(OAg)_2$ .**

Decomp. by heat; decomp. in contact with  $H_2O$ . (Stokes, Am. Ch. J. 1894, 16. 139.)

$(AgO)_2P(NAg)(NHAg)$ . (?) Sl. sol. in  $NH_4OH + Aq$ . (Stokes, Am. Ch. J. 1894, 16. 149.)

**Amidosulphonic acid,  $HOSO_2NH_2$ .**

Easily sol. in  $H_2O$ , less easily in alcohol. (Berglund, B. 9. 252 and 1896.)

Very stable; less easily sol. in  $H_2O$  than its K salt. (Raschig, A. 241. 177.)

Stable in air. Non-deliquescent when cold. Sol. in 5 pts.  $H_2O$  at  $0^\circ$  and in  $2\frac{1}{2}$  pts.  $H_2O$  at  $70^\circ$ . Solution in  $H_2O$  can be boiled several minutes without decomp. Solubility is decreased by addition of  $H_2SO_4$ , so that if  $1\frac{1}{5}$ – $1\frac{1}{4}$  pt.  $H_2SO_4$  is added to  $H_2O$ , 100 pts. of the liquid dissolve only 3 pts.  $HOSO_2NH_2$  in the cold. Pptd. from solution by  $HNO_3$  or glacial acetic acid, but not by  $HCl$ . Solubility is decreased by presence of  $NaHSO_4$ . (Divers and Haga, Chem. Soc. 1896, 69. 1641.)

**Amidosulphonates.**

Easily sol. in  $H_2O$ ; sl. sol. in alcohol.

**Aluminum amidosulphonate.**

Very sol. in  $H_2O$ . (Berglund, Bull. Soc. (2) 29. 422.)

**Ammonium amidosulphonate,  $(NH_4)NH_2SO_3$ .**

Deliquescent. Sol. in  $H_2O$ ; insol. in alcohol.

**Ammonium silver amidosulphonate,**

$NH_4SO_3(NH_3)$ ,  $AgSO_3(NH_2)$ .

(Ephraim & Gurewitsch, B. 1910, 43. 148.)

**Barium amidosulphonate,  $Ba(NH_2SO_3)_2$ .**

Sol. in 3 pts.  $H_2O$ . (Berglund, l.c.)

**Cadmium amidosulphonate,  $Cd(NH_2SO_3)_2 + 5H_2O$ .**

Very sol. in  $H_2O$ . (B.)

**Calcium amidosulphonate,  $Ca(NH_2SO_3)_2 + 4H_2O$ .**

Very sol. in  $H_2O$ . (B.)

**Cobalt amidosulphonate,  $Co(NH_2SO_3)_2 + 3H_2O$ .**

Sol. in  $H_2O$ . (B.)

**Copper amidosulphonate,  $Cu(NH_2SO_3)_2 + 2H_2O$ .**

Sol. in  $H_2O$ . (B.)

**Gold (auric) potassium amidosulphonate,  $K_3Au_2(NSO_3)_2$ .**

Very al. sol. in cold, more easily sol. in hot

$H_2O$ . Sol. in dil.  $HCl + Aq$ . (Hofmann, B. 1912, 45. 1735.)

**Lead amidosulphonate,  $Pb(NH_2SO_3)_2 + H_2O$ .**

The most sol. of all amidosulphonates. (B.)

**Lithium amidosulphonate.  $LiNH_2SO_3$ .**

Deliquescent. (B.)

**Magnesium amidosulphonate.**

Very sol. in  $H_2O$ .

**Manganese amidosulphonate,  $Mn(NH_2SO_3)_2 + 3H_2O$ .**

Very sol. in  $H_2O$ . (B.)

**Mercuric amidosulphonate, basic,**

$Hg(HgOSO_3NH_2)_2$ .

Insol. in 3.5 %  $HNO_3 + Aq$ . Very sol. in 3 %  $HCl + Aq$ . (Hofmann, B. 1912, 45. 1733. +  $2H_2O$ . Insol. in hot  $H_2O$ . Sol. in  $KOH + Aq$ . (Divers and Haga, Chem. Soc. 1896, 69. 1649.)

**Mercuric potassium amidosulphonate,**

$KHgNSO_3$ .

Very al. sol. in cold  $H_2O$  and cold dil.  $KOH + Aq$ . Sol. in 3 %  $HCl + Aq$ . (Hofmann, B. 1912, 45. 1732.)

**Mercuric sodium amidosulphonate,**

$NaHgNSO_3$ .

Nearly completely sol. in hot  $H_2O$ . (Hofmann, B. 1912, 45. 1734.)

**Nickel amidosulphonate,  $Ni(NH_2SO_3)_2 + 3H_2O$ .**

Sol. in  $H_2O$ . (B.)

**Potassium amidosulphonate,  $KNH_2SO_3$ .**

Sol. in  $H_2O$ . (Berglund.)

**Potassium silver amidosulphonate,**

$NHAgSO_3K + H_2O$ .

Decomp. by  $H_2O$ ; sol. in  $NH_4OH + Aq$ . (Hofmann, B. 1912, 45. 1734.)

**Silver amidosulphonate,  $AgNH_2SO_3$ .**

Sol. in 15 pts.  $H_2O$  at  $19^\circ$  (B.)

**Sodium amidosulphonate,  $NaNH_2SO_3$ .**

Sol. in  $H_2O$ .

**Strontium amidosulphonate,  $Sr(NH_2SO_3)_2 + 4H_2O$ .**

Sol. in  $H_2O$ .

**Thallium amidosulphonate,  $TlNH_2SO_3$ .**

Sol. in  $H_2O$ .

**Uranyl amidosulphonate.**

Sol. in  $H_2O$ .

**Zinc amidosulphonate,  $Zn(NH_2SO_3)_2 + 4H_2O$ .**

Sol. in  $H_2O$ .



**Amidosulphurous acid.****Ammonium amidosulphite,  $\text{NH}_4\text{SO}_3\cdot\text{NH}_3$ .**

Very deliquescent. Decomp. in the air with loss of  $\text{NH}_3$ . Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in anhydrous alcohol. Sl. sol. in dry. ether. (Divers, Chem. Soc. 1900, 77. 330.)

**Ammonia,  $\text{NH}_3$ .**

Very sol. in  $\text{H}_2\text{O}$ , with evolution of much heat.

1 vol.  $\text{H}_2\text{O}$  absorbs 670 vols. ( $\frac{1}{2}$  pt. by weight)  $\text{NH}_3$  at  $+10^\circ$  and 29.8 in. pressure; sp. gr. of solution = 0.875. (Davy.)

At low temperatures  $\text{H}_2\text{O}$  absorbs more than  $\frac{1}{2}$  its weight of  $\text{NH}_3$ , and sp. gr. of solution = 0.850. (Dalton.)

100 pts.  $\text{H}_2\text{O}$  absorb 8.41 pts.  $\text{NH}_3$  at  $24^\circ$ ; 5.96 pts. at  $55^\circ$ . (Osann.)

1 vol.  $\text{H}_2\text{O}$  absorbs 780 vols.  $\text{NH}_3$ , 6 vols.  $\text{H}_2\text{O}$  increasing to 10 vols. sat.  $\text{NH}_4\text{OH}+\text{Aq}$ ; 1 vol. sat.  $\text{NH}_4\text{OH}+\text{Aq}$  contains 468 vols.  $\text{NH}_3$ . (Thomson.)

1 vol.  $\text{H}_2\text{O}$  absorbs 430 vols.  $\text{NH}_3$  at  $15^\circ$ . (Dumas.)

1 vol.  $\text{H}_2\text{O}$  absorbs 700 vols.  $\text{NH}_3$  at ordinary temperature. (Otto.)

100 pts.  $\text{H}_2\text{O}$  absorb in  $\text{NH}_3$  gas 47.7 pts.  $\text{NH}_3$  by weight. (Berzelius.)

1 vol.  $\text{H}_2\text{O}$  absorbs 505 vols.  $\text{NH}_3$  and vol. is increased to 1.5 vol., and sp. gr. becomes 0.900. (Ure.)

1 vol.  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm. absorbs 1177.3 vols.  $\text{NH}_3$ . (Sims.)

1 vol.  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm. absorbs 1146 vols.  $\text{NH}_3$ . (Roscoe and Dittmar.)

1 vol.  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm. absorbs 1049.6 vols.  $\text{NH}_3$ . (Carius.)

1 vol.  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm. absorbs 1270 vols.  $\text{NH}_3$ . (Berthelot.)

1 vol.  $\text{H}_2\text{O}$  at  $0^\circ$  and 760 mm. absorbs 1050 vols.  $\text{NH}_3$ . (Bunsen.)

100 cc.  $\text{H}_2\text{O}$  absorb 64.50 g.  $\text{NH}_3$ . (Raoult.)

**Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at 760 mm. and  $t^\circ$ :**

1 g.  $\text{H}_2\text{O}$  absorbs g.  $\text{NH}_3$ , according to Roscoe and Dittmar (A. 112. 347) (RD); and according to Sims (A. 118. 345) (S).

$t^\circ$	g. $\text{NH}_3$ RD	g. $\text{NH}_3$ S	$t^\circ$	g. $\text{NH}_3$ RD	g. $\text{NH}_3$ S
0	0.875	0.899	36	0.343	0.363
2	0.833	0.853	38	0.324	0.350
4	0.792	0.809	40	0.307	0.338
6	0.751	0.765	42	0.290	0.326
8	0.713	0.724	44	0.275	0.315
10	0.679	0.684	46	0.259	0.304
12	0.645	0.646	48	0.244	0.294
14	0.612	0.611	50	0.229	0.284
16	0.582	0.578	52	0.214	0.274
18	0.554	0.546	54	0.200	0.265
20	0.526	0.518	56	0.186	0.256
22	0.499	0.490	58	.....	0.247
24	0.474	0.467	60	.....	0.238
26	0.449	0.446	70	.....	0.194
28	0.426	0.426	80	.....	0.154
30	0.403	0.408	90	.....	0.114
32	0.382	0.393	98	.....	0.082
34	0.362	0.378	100	.....	0.074

Solubility of  $\text{NH}_3$  by vol. in  $\text{H}_2\text{O}$  at 760 mm. and  $t^\circ$ : 1 vol.  $\text{H}_2\text{O}$  at 760 mm. and  $t^\circ$  dissolves V vols.  $\text{NH}_3$  gas, vols. reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V
0	1049.60	13	759.55
1	1020.78	14	743.11
2	993.26	15	727.22
3	966.98	16	711.82
4	941.88	17	696.85
5	917.90	18	682.26
6	894.99	19	667.99
7	873.09	20	653.99
8	852.14	21	640.19
9	831.98	22	626.54
10	812.76	23	612.98
11	794.32	24	599.46
12	776.60	25	585.94

(Carius, A. 99. 144.)

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at P mm. pressure and  $0^\circ$ : 1 pt.  $\text{H}_2\text{O}$  absorbs pts.  $\text{NH}_3$  at P mm. pressure and  $0^\circ$ .

P	Pts. $\text{NH}_3$	P	Pts. $\text{NH}_3$
10	0.044	900	0.968
20	0.084	950	1.101
30	0.120	1000	1.037
40	0.149	1050	1.075
50	0.175	1100	1.117
75	0.228	1150	1.161
100	0.275	1200	1.208
125	0.315	1250	1.258
150	0.351	1300	1.310
175	0.382	1350	1.361
200	0.411	1400	1.415
250	0.465	1450	1.469
300	0.515	1500	1.526
350	0.561	1550	1.584
400	0.607	1600	1.645
450	0.646	1650	1.707
500	0.690	1700	1.770
550	0.731	1750	1.835
600	0.768	1800	1.906
650	0.804	1850	1.976
700	0.840	1900	2.046
750	0.872	1950	2.120
800	0.906	2000	2.195
850	0.937	.....	.....

(Roscoe and Dittmar, A. 112. 349.)

In proportion as the temperature is higher, so much the more nearly does the solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  conform to the law of Henry and Dalton, but only obeys it completely when the temperature is  $100^\circ$ , as is seen in the following table.

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at various pressures and temperatures: P=partial pressure, i. e. total pressure minus the tension of aqueous vapour at the given temperature; G=grams  $\text{NH}_3$  dissolved in 1 g.  $\text{H}_2\text{O}$  at the given pressure; G at 760=grams  $\text{NH}_3$  that would be contained in 1 g.  $\text{H}_2\text{O}$  if the solubility was proportional to the pressure.

P	0°		20°		40°		100°	
	G at P	G at 760	G at P	G at 760	G at P	G at 760	G at P	G at 760
20	0.082	3.113	.....	.....	.....	.....	.....	.....
30	0.117	2.960	.....	.....	.....	.....	.....	.....
40	0.148	2.820	.....	.....	.....	.....	.....	.....
60	0.169	2.522	0.119	1.513	.....	.....	.....	.....
80	0.240	2.280	0.141	1.337	0.052	0.497	.....	.....
100	0.280	2.127	0.158	1.200	0.064	0.490	.....	.....
120	0.316	2.000	0.173	1.095	0.076	0.483	.....	.....
140	0.346	1.880	0.187	1.017	0.088	0.476	.....	.....
160	0.375	1.780	0.202	0.962	0.099	0.470	.....	.....
180	0.398	1.684	0.207	0.918	0.109	0.462	.....	.....
200	0.421	1.598	0.232	0.881	0.120	0.454	.....	.....
250	0.472	1.434	0.266	0.810	0.145	0.440	.....	.....
300	0.519	1.315	0.296	0.750	0.168	0.426	.....	.....
350	0.563	1.223	0.325	0.705	0.191	0.414	.....	.....
400	0.606	1.152	0.353	0.670	0.211	0.402	.....	.....
450	0.650	1.100	0.378	0.638	0.232	0.399	.....	.....
500	0.692	1.052	0.403	0.612	0.251	0.382	.....	.....
550	0.732	1.012	0.425	0.587	0.269	0.372	.....	.....
600	0.770	0.975	0.447	0.566	0.287	0.363	.....	.....
650	0.809	0.946	0.470	0.550	0.304	0.355	.....	.....
700	0.850	0.923	0.492	0.534	0.320	0.347	0.068	0.074
750	0.891	0.903	0.514	0.521	0.335	0.339	0.073	0.074
760	0.899	0.899	0.518	0.518	0.338	0.338	0.074	0.074
800	0.937	0.888	0.535	0.504	0.349	0.332	0.078	0.074
850	0.980	0.876	0.556	0.497	0.363	0.325	0.083	0.074
900	1.029	0.869	0.574	0.485	0.378	0.319	0.088	0.074
950	1.077	0.862	0.594	0.475	0.391	0.313	0.092	0.073
1000	1.126	0.855	0.613	0.466	0.404	0.307	0.096	0.073
1050	1.177	0.852	0.632	0.457	0.414	0.300	0.101	0.073
1100	1.230	0.850	0.651	0.450	0.425	0.294	0.106	0.073
1150	1.283	0.848	0.669	0.442	0.434	0.287	0.110	0.073
1200	1.336	0.846	0.685	0.433	0.445	0.282	0.115	0.073
1250	1.338	0.844	0.704	0.428	0.454	0.276	0.120	0.073
1300	1.442	0.843	0.722	0.422	0.463	0.271	0.125	0.073
1350	1.496	0.842	0.741	0.417	0.472	0.266	0.130	0.073
1400	1.549	0.841	0.761	0.413	0.479	0.260	0.135	0.073
1450	1.603	0.840	0.780	0.409	0.486	0.255	.....	.....
1500	1.656	0.839	0.801	0.406	0.493	0.250	.....	.....
1600	1.758	0.835	0.842	0.400	0.511	0.242	.....	.....
1700	1.861	0.832	0.881	0.394	0.530	0.237	.....	.....
1800	1.966	0.830	0.919	0.388	0.547	0.231	.....	.....
1900	2.070	0.828	0.955	0.382	0.565	0.226	.....	.....
2000	.....	.....	0.992	0.377	0.579	0.220	.....	.....
2100	.....	.....	.....	.....	0.594	0.215	.....	.....

(Sims, A. 118. 346.)

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  at temps. below  $0^\circ$ . One gram  $\text{H}_2\text{O}$  dissolves

grams $\text{NH}_3$	Temp.
0.947	$-3.9^\circ$
1.115	$-10^\circ$
1.768	$-20^\circ$
2.781	$-30^\circ$
2.946	$-40^\circ$

(Mallet, Am. Ch. J. 1897, 19, 807.)

The solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$  does not follow Dalton's law at ord. temp., but does at temp. near  $100^\circ$ . (Konowaloff, J. Russ. Phys. Chem. Soc. 1894, 26, 48; Chem. Soc. 1896, 70 (2), 351.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq.}$

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
32.3*	0.8750	14.53	0.9435
29.25	0.8857	13.46	0.9476
26	0.9000	12.40	0.9513
25.37*	0.9054	11.56	0.9545
22.07	0.9166	10.82	0.9573
19.54	0.9255	10.17	0.9597
17.52	0.9326	9.6	0.9616
15.88	0.9385	9.5*	0.9632

(H. Davy, Elements, 1, 241.)

\* By direct experiment. The other numbers were obtained by calculation, making no allowance for compensation.

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $16^\circ$ , according to Otto in his Lehrbuch.

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
12.000	0.9517	8.500	0.9650
11.875	0.9521	8.375	0.9654
11.750	0.9526	8.250	0.9659
11.625	0.9531	8.125	0.9664
11.500	0.9536	8.000	0.9669
11.375	0.9540	7.875	0.9673
11.250	0.9545	7.750	0.9678
11.125	0.9550	7.625	0.9683
11.000	0.9555	7.500	0.9688
10.950	0.9556	7.375	0.9692
10.875	0.9559	7.250	0.9697
10.750	0.9564	7.125	0.9702
10.625	0.9569	7.000	0.9707
10.500	0.9574	6.875	0.9711
10.375	0.9578	6.750	0.9716
10.250	0.9583	6.625	0.9721
10.125	0.9588	6.500	0.9726
10.000	0.9593	6.375	0.9730
9.875	0.9597	6.250	0.9735
9.750	0.9602	6.125	0.9740
9.625	0.9607	6.000	0.9745
9.500	0.9612	5.875	0.9749
9.375	0.9616	5.750	0.9754
9.250	0.9621	5.625	0.9759
9.125	0.9626	5.500	0.9764
9.000	0.9631	5.375	0.9768
8.875	0.9636	5.250	0.9773
8.750	0.9641	5.125	0.9778
8.625	0.9645	5.000	0.9783

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq.}$  according to Ure in Dict. of Arts.

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
27.940	0.8914	15.900	0.9363
27.633	0.8937	14.575	0.9410
27.038	0.8967	13.250	0.9455
26.751	0.8983	11.925	0.9510
26.500	0.9000	10.600	0.9564
25.175	0.9045	9.275	0.9614
23.850	0.9090	7.950	0.9662
22.525	0.9133	6.625	0.9716
21.200	0.9177	5.300	0.9768
19.875	0.9227	3.975	0.9828
18.550	0.9275	2.650	0.9887
17.225	0.9320	1.325	0.9945

Sp. gr., b.-pt., and vols. gas in  $\text{NH}_4\text{OH} + \text{Aq.}$

% $\text{NH}_3$	Sp. gr.	B.-pt.	Vols. gas in 1 vol. liquid
35.3	0.85	$-3.3^\circ$	494
32.6	0.86	$+3.3^\circ$	456
29.9	0.87	$10^\circ$	419
27.3	0.88	$16.6^\circ$	382
24.7	0.89	$23.3^\circ$	346
22.2	0.90	$30^\circ$	311
19.8	0.91	$36.6^\circ$	277
17.4	0.92	$43.3^\circ$	244
15.1	0.93	$50^\circ$	211
12.8	0.94	$56.6^\circ$	180
10.5	0.95	$63.3^\circ$	147
8.3	0.96	$70^\circ$	116
6.2	0.97	$78.3^\circ$	87
4.1	0.98	$86.1^\circ$	57
2.0	0.99	$91.1^\circ$	28

(Dalton, in New System, 2, 422.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  sat. at  $t^\circ$ .

$t^\circ$	Sp. gr.	$t^\circ$	Sp. gr.	$t^\circ$	Sp. gr.
0	0.8535	9	0.8746	18	0.8903
1	0.8561	10	0.8766	19	0.8916
2	0.8587	11	0.8785	20	0.8928
3	0.8611	12	0.8804	21	0.8940
4	0.8635	13	0.8823	22	0.8952
5	0.8658	14	0.8841	23	0.8963
6	0.8681	15	0.8858	24	0.8974
7	0.8703	16	0.8874	25	0.8984
8	0.8725	17	0.8889	..	.....

(Carius, A. 99, 141.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , according to Carius (A. 99, 148).

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
36.0	0.8844	35.2	0.8860
35.8	0.8848	35.0	0.8864
35.6	0.8852	34.8	0.8868
35.4	0.8856	34.6	0.8872

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , etc.—*Cont.*

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
34.4	0.8877	22.2	0.9185
34.2	0.8881	22.0	0.9191
34.0	0.8885	21.8	0.9197
33.8	0.8889	21.6	0.9203
33.6	0.8894	21.4	0.9209
33.4	0.8898	21.2	0.9215
33.2	0.8903	21.0	0.9221
33.0	0.8907	20.8	0.9227
32.8	0.8911	20.6	0.9233
32.6	0.8916	20.4	0.9239
32.4	0.8920	20.2	0.9245
32.2	0.8925	20.0	0.9251
32.0	0.8929	19.8	0.9257
31.8	0.8934	19.6	0.9264
31.6	0.8938	19.4	0.9271
31.4	0.8944	19.2	0.9277
31.2	0.8948	19.0	0.9283
31.0	0.8953	18.8	0.9289
30.8	0.8957	18.6	0.9296
30.6	0.8962	18.4	0.9302
30.4	0.8967	18.2	0.9308
30.2	0.8971	18.0	0.9314
30.0	0.8976	17.8	0.9321
29.8	0.8981	17.6	0.9327
29.6	0.8986	17.4	0.9333
29.4	0.8991	17.2	0.9340
29.2	0.8996	17.0	0.9347
29.0	0.9001	16.8	0.9353
28.8	0.9006	16.6	0.9360
28.6	0.9011	16.4	0.9366
28.4	0.9016	16.2	0.9373
28.2	0.9021	16.0	0.9380
28.0	0.9026	15.8	0.9386
27.8	0.9031	15.6	0.9393
27.6	0.9036	15.4	0.9400
27.4	0.9041	15.2	0.9407
27.2	0.9047	15.0	0.9414
27.0	0.9051	14.8	0.9420
26.8	0.9057	14.6	0.9427
26.6	0.9063	14.4	0.9434
26.4	0.9068	14.2	0.9441
26.2	0.9073	14.0	0.9449
26.0	0.9078	13.8	0.9456
25.8	0.9083	13.6	0.9463
25.6	0.9089	13.4	0.9470
25.4	0.9094	13.2	0.9477
25.2	0.9100	13.0	0.9484
25.0	0.9106	12.8	0.9491
24.8	0.9111	12.6	0.9498
24.6	0.9116	12.4	0.9505
24.4	0.9122	12.2	0.9512
24.2	0.9127	12.0	0.9520
24.0	0.9133	11.8	0.9527
23.8	0.9139	11.6	0.9534
23.6	0.9145	11.4	0.9542
23.4	0.9150	11.2	0.9549
23.2	0.9156	11.0	0.9556
23.0	0.9162	10.8	0.9563
22.8	0.9168	10.6	0.9571
22.6	0.9174	10.4	0.9578
22.4	0.9180	10.2	0.9586

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ , etc.—*Cont.*

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
10.0	0.9593	5.0	0.9790
9.8	0.9601	4.8	0.9799
9.6	0.9608	4.6	0.9807
9.4	0.9616	4.4	0.9815
9.2	0.9623	4.2	0.9823
9.0	0.9631	4.0	0.9831
8.8	0.9639	3.8	0.9839
8.6	0.9647	3.6	0.9847
8.4	0.9654	3.4	0.9855
8.2	0.9662	3.2	0.9863
8.0	0.9670	3.0	0.9873
7.8	0.9677	2.8	0.9882
7.6	0.9685	2.6	0.9890
7.4	0.9693	2.4	0.9899
7.2	0.9701	2.2	0.9907
7.0	0.9709	2.0	0.9915
6.8	0.9717	1.8	0.9924
6.6	0.9725	1.6	0.9932
6.4	0.9733	1.4	0.9941
6.2	0.9741	1.2	0.9950
6.0	0.9749	1.0	0.9959
5.8	0.9757	0.8	0.9967
5.6	0.9765	0.6	0.9975
5.4	0.9773	0.4	0.9983
5.2	0.9781	0.2	0.9991

Hager also gives a table in his *Commentar zur Pharmacopoea*, which is practically identical with those here given.

Strength of  $\text{NH}_4\text{OH} + \text{Aq}$  of certain sp. gr. at  $12^\circ$ .

Sp. gr.	1 kg. solution containing g. $\text{NH}_3$	1 l. solution containing g. $\text{NH}_3$	1 litre consists of $\text{H}_2\text{O}$ in cc.	liquid $\text{NH}_3$ in cc.
0.870	384.4	334.5	535.5	464.5
0.880	347.2	305.5	574.5	425.5
0.890	311.6	277.3	612.7	387.3
0.900	277.3	249.5	650.5	349.5
0.910	244.9	222.8	687.2	312.8
0.920	213.4	196.3	723.7	276.3
0.930	182.9	170.1	759.9	240.1
0.940	152.9	143.7	796.3	203.7
0.950	124.2	118.0	832.0	168.0
0.960	97.0	93.1	866.9	133.1
0.970	70.2	68.0	902.0	98.0
0.980	45.3	44.3	935.7	64.3
0.990	21.0	20.7	969.3	30.7

(Wachsmuth, Arch. Pharm. (3) 8. 510.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ .  
(Most careful experiments.)

Sp. gr.	% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$
0.990	2.15	0.926	19.50
0.974	6.10	0.916	22.50
0.950	12.54	0.910	24.40

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ —Continued

Sp. gr.	% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$
0.900	27.70	0.882	34.8
0.890	31.40	0.880	35.5
0.885	33.5	.....	.....

(Grüneberg, Chem. Ind. 12. 97.)

The following table is calculated from the above by interpolation:—

Sp. gr.	% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$
0.995	1.05	0.935	16.90
0.990	2.15	0.930	18.35
0.985	3.30	0.925	19.80
0.980	4.50	0.920	21.30
0.975	5.75	0.915	22.85
0.970	7.05	0.910	24.40
0.965	8.40	0.905	26.00
0.960	9.80	0.900	27.70
0.955	11.20	0.895	29.50
0.950	12.60	0.890	31.40
0.945	14.00	0.885	33.40
0.940	15.45	0.880	35.50

(Grüneberg.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $14^\circ$ .

% $\text{NH}_3$	Sp. gr.	% $\text{NH}_3$	Sp. gr.
31	0.8933	15.6	0.9400
23.8	0.9116	11.7	0.9536
20.4	0.9246	5.1	0.9780

(Lunge and Smith, B. 17. 777.)

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ , according to Lunge and Wiernik (Zeit. f. angew. Ch. 1889. 183).

(Most carefully worked out and calculated.)

Sp. gr.	% $\text{NH}_3$	1 l. contains g. $\text{NH}_3$	Correction for $\pm 1^\circ$
1.000	0.00	0.0	0.00018
0.998	0.45	4.5	0.00018
0.996	0.91	9.1	0.00019
0.994	1.37	13.6	0.00019
0.992	1.84	18.2	0.00020
0.990	2.31	22.9	0.00020
0.988	2.80	27.7	0.00021
0.986	3.30	32.5	0.00021
0.984	3.80	37.4	0.00022
0.982	4.30	42.2	0.00022
0.980	4.80	47.0	0.00023
0.978	5.30	51.8	0.00023
0.976	5.80	56.6	0.00024
0.974	6.30	61.4	0.00024
0.972	6.80	66.1	0.00025
0.970	7.31	70.9	0.00025
0.968	7.82	75.7	0.00026

Sp. gr. of  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ , etc.—Continued

Sp. gr.	% $\text{NH}_3$	1 l. contains g. $\text{NH}_3$	Correction for $\pm 1^\circ$
0.966	8.33	80.5	0.00026
0.964	8.84	85.2	0.00027
0.962	9.35	89.9	0.00028
0.960	9.91	95.1	0.00029
0.958	10.47	100.3	0.00030
0.956	11.03	105.4	0.00031
0.954	11.60	110.7	0.00032
0.952	12.17	115.9	0.00033
0.950	12.74	121.0	0.00034
0.948	13.31	126.2	0.00035
0.946	13.88	131.3	0.00036
0.944	14.46	136.5	0.00037
0.942	15.04	141.7	0.00038
0.940	15.63	146.9	0.00039
0.938	16.22	152.1	0.00040
0.936	16.82	157.4	0.00041
0.934	17.42	162.7	0.00041
0.932	18.03	168.1	0.00042
0.930	18.64	173.4	0.00042
0.928	19.25	178.6	0.00043
0.926	19.87	184.2	0.00044
0.924	20.49	189.3	0.00045
0.922	21.12	194.7	0.00046
0.920	21.75	200.1	0.00047
0.918	22.39	205.6	0.00048
0.916	23.03	210.9	0.00049
0.914	23.68	216.3	0.00050
0.912	24.33	221.9	0.00051
0.910	24.99	227.4	0.00052
0.908	25.65	232.9	0.00053
0.906	26.31	238.3	0.00054
0.904	26.98	243.9	0.00055
0.902	27.65	249.4	0.00056
0.900	28.33	255.0	0.00057
0.898	29.01	260.5	0.00058
0.896	29.69	266.0	0.00059
0.894	30.37	271.5	0.00060
0.892	31.05	277.0	0.00060
0.890	31.75	282.6	0.00061
0.888	32.50	288.6	0.00062
0.886	33.25	294.6	0.00063
0.884	34.10	301.4	0.00064
0.882	34.95	308.3	0.00065

$\text{NH}_3$  is much less sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .

Solubility of  $\text{NH}_3$  in  $\text{H}_2\text{O}$ , and  $\text{KOH} + \text{Aq}$  of various strengths: 100 pts. solvent absorbs g.  $\text{NH}_3$  at  $t^\circ$ .

$t^\circ$	$\text{H}_2\text{O}$	$\text{KOH} + \text{Aq}$ 11.25% $\text{K}_2\text{O}$	$\text{KOH} + \text{Aq}$ 25.25% $\text{K}_2\text{O}$
0	90.00	72.00	49.50
8	72.75	57.00	37.50
16	59.75	46.00	28.50
24	49.50	37.25	21.75

(Raoult, A. ch. (5) 1. 262.)

100 pts. sat. KOH + Aq dissolve only 1 pt.  $\text{NH}_3$ .

Solubility in NaOH + Aq is the same as in KOH + Aq of the same strength.

$\text{NH}_4\text{Cl}$  + Aq absorbs slightly less  $\text{NH}_3$  than the same vol.  $\text{H}_2\text{O}$ .  $\text{NaNO}_3$ , and  $\text{NH}_4\text{NO}_3$  + Aq absorb almost the same amount  $\text{NH}_3$  as the same vol.  $\text{H}_2\text{O}$ . (Raoult, *l.c.*)

Solubility of  $\text{NH}_3$  in 100 pts.  $\text{Ca}(\text{NO}_3)_2$  + Aq.

t°	$\text{H}_2\text{O}$	$\text{Ca}(\text{NO}_3)_2$ + Aq 23.38% $\text{Ca}(\text{NO}_3)_2$	$\text{Ca}(\text{NO}_3)_2$ + Aq 59.03% $\text{Ca}(\text{NO}_3)_2$
0	90.00	96.25	104.50
8	72.75	78.50	84.75
16	59.75	65.00	70.50

(Raoult, *l.c.*)

Solubility in salt solutions at 25°C.

Salt	Mols. $\text{NH}_3$ soluble in 1 liter of		
	.5-normal solution	1-normal solution	1.5-normal solution
KCl	0.930	0.866	0.809
KBr	0.950	0.904	0.857
KI	0.970	0.942	0.900
KOH	0.852	0.716	0.607
NaCl	0.938	0.889	0.843
NaBr	0.965	0.916	0.890
NaI	0.995	0.992	0.985
NaOH	0.876	0.789	0.716
LiCl	0.980	1.008	1.045
LiBr	1.001	1.040	1.090
LiI	1.030	1.094	1.190
LiOH	0.865	0.808	0.768
KF	0.839	0.722	0.626
KNO <sub>3</sub>	0.923	0.862	0.804
KNO <sub>2</sub>	0.920	0.855	0.798
KCN	0.926	0.858	0.802
KCNS	0.932	0.868	0.814
$\frac{1}{2}\text{K}_2\text{SO}_4$	0.875	0.772	0.678
$\frac{1}{2}\text{K}_2\text{CO}_3$	0.865	0.768	0.675
$\frac{1}{2}\text{K}_2\text{C}_2\text{O}_4$	0.788	0.650	0.554
$\frac{1}{2}\text{K}_2\text{CrO}_4$	0.866	0.771	0.675
$\text{CH}_3\text{COOK}$	0.866	0.765	0.685
HCOOK	0.868	0.760	0.678
KBO <sub>3</sub>	0.814	0.677	0.560
$\frac{1}{2}\text{K}_2\text{HPO}_4$	0.860	0.749	0.664
$\frac{1}{2}\text{Na}_2\text{S}$	0.887	0.795	0.726
KClO <sub>3</sub> , 0.25-norm.	0.927	.....	.....
KBrO <sub>3</sub> , 0.25-norm.	0.940	.....	.....
KIO <sub>3</sub> , 0.25-norm.	0.951	.....	.....

(Abegg & Riesenfeld, Z. phys. Ch. 1902, 40. 100.)

Solubility in salts + Aq at 35° C.

Salt	Concentration of the aq. solution	Mols. $\text{NH}_3$ soluble in 1 liter of solution
KCl	0.5 normal	0.923
NaCl	"	0.966
$\text{CH}_3\text{COOK}$	"	0.902
$\frac{1}{2}(\text{COOK})_2$	"	0.902
KOH	"	0.870
NaOH	"	0.896
$\frac{1}{2}\text{K}_2\text{CO}_3$	0.426 normal	0.914
$\frac{1}{2}\text{Na}_2\text{CO}_3$	"	0.932

(Riesenfeld, Z. phys. Ch. 1903, 45. 462.)

The solubility of  $\text{NH}_3$  in  $\text{NaNO}_3$ ,  $\text{NH}_4\text{NO}_3$ , and in  $\text{AgNO}_3 \cdot 2\text{NH}_3$  + Aq is nearly the same as in pure  $\text{H}_2\text{O}$ . (Konowaloff, C. C. 1898, II. 659).

Distribution-coefficient of  $\text{NH}_3$  between water and  $\text{CHCl}_3$  = 26.3 at 20°; 24.9 at 25°; 23.2 at 30°.

The distribution-coefficient of  $\text{NH}_3$  between  $\text{CHCl}_3$  and a number of salt solutions has been determined for the purpose of studying the nature of metal-ammonia compounds in aqueous solution. (Dawson, Chem. Soc. 1900, 77. 1242.)

Distribution of  $\text{NH}_3$  between  $\text{H}_2\text{O}$  and  $\text{CHCl}_3$  at 18°.

$\text{NH}_3$ concentration in aqueous solution. mols./litre	$\text{NH}_3$ concentration in $\text{CHCl}_3$ solution. mols./litre
0.9280	0.03506
1.921	0.07703
2.064	0.08350
2.274	0.09317
2.590	0.1083
3.700	0.1639
4.333	0.1996

(Dawson, Z. phys. Ch. 1909, 69. 120.)

Distribution of  $\text{NH}_3$  between hydroxides + Aq and  $\text{CHCl}_3$  at 18°.

Aqueous solution	$\text{NH}_3$ concentration in the aqueous solution. mols./litre	$\text{NH}_3$ concentration in the $\text{CHCl}_3$ solution. mols./litre.
0.2-N. KOH	1.949	0.0841
0.5-N. KOH	1.978	0.0951
0.2-N. NaOH	2.016	0.0869
0.5-N. NaOH	1.944	0.0907
0.2-N. $\frac{1}{2}\text{Ba}(\text{OH})_2$	2.076	0.08905
0.5-N. $\frac{1}{2}\text{Ba}(\text{OH})_2$	3.397	0.1560

(Dawson, *l.c.*)

Distribution of  $\text{NH}_3$  between  $\text{Cu}(\text{OH})_2 + \text{Aq}$  and  $\text{CHCl}_3$  at  $18^\circ$ 

Conc. of $\text{Cu}(\text{OH})_2$ equivalents/litre	$\text{NH}_3$ concentration in aqueous solution. mols./litre	$\text{NH}_3$ concentration in $\text{CHCl}_3$ solution. mols./litre
0.041	2.014	0.07968
0.0705	2.653	0.1067
0.081	3.011	0.1247

(Dawson, l.c.)

Sol. in alcohol and ether.

Sol. in 3 pts. alcohol of  $38^\circ$ . (Boullay.)1 vol. alcohol of 0.829 sp. gr. absorbs about 50 vols.  $\text{NH}_3$ . (Davy.)Much less sol. in ethyl, propyl, or amyl alcohol than in  $\text{H}_2\text{O}$ . (Pagliano and Emo, Gazz. ch. it. 13. 278.)Solubility of  $\text{NH}_3$  in alcohol at  $t^\circ$ : weight  $\text{NH}_3$  = weight  $\text{NH}_3$  contained in a litre of solution sat. at 760 mm. and  $t^\circ$ ; sp. gr. = sp. gr. of solution; C = coefficient of solubility.

Temp.	Degree of Alcohol	$100^\circ$	$90^\circ$	$80^\circ$	$70^\circ$	$60^\circ$	$50^\circ$
$0^\circ$	Weight $\text{NH}_3$	130.5	146.0	206.5	.....	246.0	304.5
	Sp. gr.	0.782	0.783	0.808	.....	0.830	0.835
	C	209.5	245.0	390.0	.....	504.5	697.7
$10^\circ$	Weight $\text{NH}_3$	108.5	120.0	167.0	.....	198.25	227.0
	Sp. gr.	0.787	0.803	0.800	.....	0.831	0.850
	C	164.3	186.0	288.0	.....	373.0	438.6
$20^\circ$	Weight $\text{NH}_3$	75.0	97.5	119.75	137.5	152.5	182.7
	Sp. gr.	0.791	0.788	0.821	0.829	0.842	0.869
	C	106.6	147.8	190.5	223.0	260.8	338.2
$30^\circ$	Weight $\text{NH}_3$	51.5	74.0	81.75	100.3	129.5	152.0
	Sp. gr.	0.798	0.791	0.826	.....	0.846	0.883
	C	97.0	186.7	121.6	.....	211.6	252.0

(Delépine, J. Pharm. (5) 25. 496.)

Solubility of  $\text{NH}_3$  in methyl alcohol (absolute) at  $t^\circ$ .

$t^\circ$	% $\text{NH}_3$	Pts. $\text{NH}_3$ per 100 pts. alcohol
0	29.3	41.5
6	26.0	35.2
11.7	23.5	30.7
14.7	21.8	27.9
17	20.8	26.3
22	18.3	22.4
28.4	14.8	17.4

(de Bruyn, l.c.)

Readily sol. in ether.

Sol. in 0.4 vol. petroleum from Amiano. (Saussure.)

1 vol. oil of turpentine absorbs 7.5 vols.  $\text{NH}_3$  at  $16^\circ$ .1 vol. oil of lemon absorbs 8.5 vols.  $\text{NH}_3$  at  $16^\circ$ .Solubility of  $\text{NH}_3$  in ethyl alcohol (absolute) at  $t^\circ$ .

$t^\circ$	% $\text{NH}_3$	Pts. $\text{NH}_3$ per 100 pts. alcohol
0	19.7	24.5
6	17.1	20.6
11.7	14.1	16.4
14.7	13.2	15.2
17	12.6	14.7
22	10.9	12.2
28.4	9.2	10.1

(de Bruyn, R. t. c. 11. 112.)

1 vol. abs. alcohol at  $20^\circ$  and 760 mm. pressure absorbs 340 vols.  $\text{NH}_3$  gas. (Müller, W. Ann. 1891, 43. 567.)1 l. methyl alcohol sat. with  $\text{NH}_3$  contains 218 g.  $\text{NH}_3$  at  $0^\circ$ ; sp. gr. of solution = 0.770; coefficient of solubility = 425.0. (Delépine.)1 vol. oil of rosemary absorbs 9.75 vols.  $\text{NH}_3$  at  $29^\circ$ .1 vol. oil of lavender absorbs 47 vols.  $\text{NH}_3$  at  $20^\circ$ . (Saussure.)1 vol. caoutchine absorbs 3 vols.  $\text{NH}_3$ . (Himly.)Valerol absorbs much  $\text{NH}_3$ . (Gerhardt, A. ch. (3) 7. 278.)1 vol. ether at 760 mm. pressure absorbs 17.13 vols.  $\text{NH}_3$  at  $0^\circ$ ; 12.35 vols. at  $10^\circ$  and 10.27 vols. at  $15^\circ$ . (Christoff, Z. phys. Ch. 1912, 79. 459.)+  $\text{H}_2\text{O}$ . Colorless crystals.+  $\frac{1}{2}\text{H}_2\text{O}$ . Large transparent crystals. (Rupert, J. Am. Chem. Soc. 1909, 31. 868.)

Ammonia, with metal salts.

For the ammonia addition-products of metal salts, see under the respective metal salts, except in the case of Co, Cr, Hg, and the Pt metals, for which see cobalt ammonium, chromium ammonium, etc., compounds, for

further reference. New data on Co and Cr ammonium compounds and those of the Pt metals, published since the first edition, has not been included in the present edition.

**Ammonium amalgam,  $\text{NH}_4 \cdot x\text{Hg}$ .**

Decomp. by  $\text{H}_2\text{O}$ , but more easily in presence of naphtha, alcohol, or ether.

**Ammonium azoimide,  $\text{N}_2\text{H}_4 = \text{NH}_2\text{N}_2$ .**

Easily sol. in  $\text{H}_2\text{O}$ ; sl. sol. in absolute alcohol, easily in 80% alcohol. Insol. in ether or benzene. (Curtius, B. 24. 3344.)

**Ammonium cobalt azoimide,  $\text{NH}_4\text{N}_2$ ,  $\text{CoN}_2$ .**

Rather sol. in  $\text{H}_2\text{O}$ . (Curtius and Rissom, J. pr. 1898, (2) 58. 302.)

**Ammonium bromide,  $\text{NH}_4\text{Br}$ .**

Easily sol. in  $\text{H}_2\text{O}$  with absorption of much heat.

1 pt.  $\text{NH}_4\text{Br}$  dissolves in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$
10	1.51	30	1.23	100	0.78
16	1.39	50	1.06	...	....

(Eder, W. A. B. 82. (2) 1284.)

$\text{NH}_4\text{Br} + \text{Aq}$  containing 41.09%  $\text{NH}_4\text{Br}$  is sat. at  $15^\circ$ . (Gerlach.)

Sp. gr. of  $\text{NH}_4\text{Br} + \text{Aq}$  at  $15^\circ$ .

% $\text{NH}_4\text{Br}$	Sp. gr.	% $\text{NH}_4\text{Br}$	Sp. gr.
5	1.0326	20	1.1285
10	1.0652	30	1.1921
15	1.0960	41.09	1.2920

(Eder.)

Sp. gr. of  $\text{NH}_4\text{Br} + \text{Aq}$  at  $16^\circ$ .

% $\text{NH}_4\text{Br}$	Sp. gr.	% $\text{NH}_4\text{Br}$	Sp. gr.
2	1.0119	22	1.1375
3	1.0181	23	1.1440
4	1.0242	24	1.1506
5	1.0303	25	1.1573
6	1.0364	26	1.1642
7	1.0425	27	1.1713
8	1.0486	28	1.1787
9	1.0547	29	1.1862
10	1.0609	30	1.1938
11	1.0672	31	1.2018
12	1.0735	32	1.2098
13	1.0798	33	1.2180
14	1.0862	34	1.2260
15	1.0926	35	1.2342
16	1.0988	36	1.2425
17	1.1051	37	1.2509
18	1.1115	38	1.2594
19	1.1181	39	1.2679
20	1.1246	40	1.2765
21	1.1310	41	1.2850

(Hager, Comm. 1883.)

25 g.  $\text{NH}_4\text{Br} + 50$  g.  $\text{H}_2\text{O}$  lower the temp. from  $15.1^\circ$  to  $-1.1^\circ$ . (Rüdorff.)

Sol. in liquid  $\text{NH}_3$  at  $-50^\circ$ . (Moissan C. R. 1901, 133. 713.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Sl. sol. in alcohol.

1 pt.  $\text{NH}_4\text{Br}$  dissolves in 32.3 pts. alcohol (0.806 sp. gr.) at  $15^\circ$ ; 9.5 pts. at  $78^\circ$ . (Eder, l.c.)

100 pts. absolute methyl alcohol dissolve 12.5 pts. at  $19^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 3.22 pts. at  $19^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Solubility in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

P = % methyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Br}$  in 10 cc. of the solution.

S = sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0.00	0.255	0.8065
4.37	0.299	0.8063
10.40	0.321	0.8117
41.02	0.506	0.8252
80.69	0.813	0.8501
84.77	0.847	0.8508
91.25	0.934	0.8551
100.00	0.983	0.8605

(Herz, Z. anorg. 1908, 60. 156.)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Br}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0	0.983	0.8605
11.11	0.851	0.8524
23.8	0.690	0.8426
65.2	0.308	0.8184
91.8	0.128	0.8097
93.75	0.125	0.8089
100.	0.095	0.8059

(Herz, l.c.)

Solubility in mixtures of propyl and ethyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Br}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0	0.255	0.8065
8.1	0.251	0.8062
17.85	0.237	0.8052
56.6	0.163	0.8048
88.6	0.111	0.8042
91.2	0.105	0.8049
95.2	0.104	0.8059
100	0.095	0.8059

(Herz, l.c.)



Sol. in 809 pts. ether (0.729 sp. gr.). (Eder, l.c.)

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014); (Naumann, B. 1904, 37. 4328.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethylacetate. (Naumann, B. 1910, 43. 314.)

#### Ammonium tribromide, $\text{NH}_4\text{Br}_3$ .

Gives off Br in air. Sol. in  $\text{H}_2\text{O}$ . (Rooseboom, B. 14. 2398.)

Decomp. in the air. Very sol. in  $\text{H}_2\text{O}$ . (Chattaway, Chem. Soc. 1915, 107. 106.)

#### Ammonium antimony bromide, $3\text{NH}_4\text{Br}$ , $2\text{SbBr}_3$ .

Easily sol. in abs. alcohol. (Caven, C. C. 1905. II, 293.)

$7\text{NH}_4\text{Br}$ ,  $3\text{SbBr}_3$ . Easily sol. in abs. alcohol. (Caven, C. C. 1905. II, 293.)

See also Bromantimonate, ammonium.

#### Ammonium bismuth bromide, $\text{NH}_4\text{Br}$ , $\text{BiBr}_3$ , $+\text{H}_2\text{O}$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol. (Nickles, C. R. 51. 1097.)

#### Ammonium cadmium bromide, $\text{NH}_4\text{Br}$ , $\text{CdBr}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 0.73 pt.  $\text{H}_2\text{O}$ , 5.3 pts. abs. alcohol, 280 pts. ether (sp. gr. 0.729), and 24 pts. alcohol ether (1 : 1). (Eder, Dingl. 221. 89.)

Sol. in  $\text{H}_2\text{O}$  without decomp. between  $1^\circ$  and  $110.1^\circ$ .

100 pts. of the solution contain at:

$1^\circ$  14.8° 52.2° 110.1°  
53.82 58.01 65.32 75.83 pts. of the salt.  
(Rimbach, B. 1905, 38. 1555.)

$4\text{NH}_4\text{Br}$ ,  $\text{CdBr}_2$ . Sol. in 0.96 pt.  $\text{H}_2\text{O}$ , from which it is pptd. by alcohol or ether. (Eder.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

Below  $160^\circ$  the salt is decomp. by  $\text{H}_2\text{O}$ ; at  $160^\circ$  it is sol. in  $\text{H}_2\text{O}$  without decomp.

$t^\circ$	100 pts. of the solution contain			Solid phase
	Pts. Cd	Pts. Br	Pts. $\text{NH}_4$	
0.8	14.72	50.46	6.67	Double salt + $\text{NH}_4\text{Br}$
13.0	14.94	51.48	6.85	"
44.5	15.01	53.85	7.35	"
76.4	14.60	55.28	7.80	"
123.5	15.50	59.50	8.45	"
160.0	14.70	62.67	9.43	Double salt

(Rimbach, B. 1905, 38. 1558.)

Not sol. in  $\text{HBr} + \text{Aq}$  without decomp. (Rimbach.)

Not sol. without decomp. in  $\text{LiBr} + \text{Aq}$ ,  $\text{CaBr}_2 + \text{Aq}$ ,  $\text{MgBr}_2 + \text{Aq}$ ,  $\text{NiBr}_2 + \text{Aq}$ , or

$\text{CoBr}_2 + \text{Aq}$ , even though very conc. solutions are used. Sol. without decomp. in  $\text{ZnBr}_2 + \text{Aq}$ . (Rimbach, B. 1905, 38. 1571.)

#### Ammonium chloromolybdenum bromide, $2\text{NH}_4\text{Br}$ , $\text{Cl}_2\text{Mo}_2\text{Br}_2$ .

Decomp. by pure  $\text{H}_2\text{O}$ . Can be crystallized from  $\text{HBr} + \text{Aq}$ . Apparently sol. without decomp. in alcohol. (Blomstrand.)

#### Ammonium cuprous bromide.

$4\text{NH}_4\text{Br}$ ,  $\text{Cu}_2\text{Br}_2$ . Fairly stable in air.  $2\text{NH}_4\text{Br}$ ,  $\text{Cu}_2\text{Br}_2 + \text{H}_2\text{O}$ . Fairly stable in air. (Wells, Z. anorg. 1895, 10. 159.)

#### Ammonium cuprous bromide ammonia, $\text{NH}_4\text{Br}$ , $\text{Cu}_2\text{Br}_2$ , $3\text{NH}_3$ .

(Fleurent, C. R. 1891, 113. 1047.)

#### Ammonium cupric bromide, $2\text{NH}_4\text{Br}$ , $\text{CuBr}_2 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (de Koninck, B. 21. 777 R.)

#### Ammonium iridium bromide.

See Bromiridate, ammonium.

#### Ammonium iron (ferric) bromide, $(\text{NH}_4)\text{FeBr}_4 + 2\text{H}_2\text{O}$ .

Very deliquescent; sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 7. 332.)

#### Ammonium lead bromide, $12\text{NH}_4\text{Br}$ , $7\text{PbBr}_2 + 7\text{H}_2\text{O}$ .

Decomp. on air, or with cold  $\text{H}_2\text{O}$ . (André, C. R. 96. 1502.)

$6\text{NH}_4\text{Br}$ ,  $\text{PbBr}_2 + \text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (A.)

$7\text{NH}_4\text{Br}$ ,  $\text{PbBr}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ . Stable on air; decomp. by cold  $\text{H}_2\text{O}$ . (A.)

None of the above compounds exist. (Wells, Sill. Am. J. 146. 25.)

$2\text{NH}_4\text{Br}$ ,  $\text{PbBr}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{KOH} + \text{Aq}$  and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) 17.351.)

$\text{NH}_4\text{Br}$ ,  $3\text{PbBr}_2$ . (Wells.)

#### Ammonium magnesium bromide, $\text{NH}_4\text{Br}$ , $\text{MgBr}_2 + 6\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Lerch, J. pr. (2) 28. 338.)

#### Ammonium mercuric bromide, $2\text{HgBr}_2$ , $\text{NH}_4\text{Br}$ .

Decomp. by  $\text{H}_2\text{O}$  into its constituent salts. (Ray, Chem. Soc. 1902, 81. 648.)

#### Ammonium molybdenum bromide, $2\text{NH}_4\text{Br}$ , $\text{MoBr}_3 + \text{H}_2\text{O}$ .

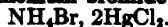
Easily sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1905, 48. 322.)

#### Ammonium molybdenum bromide chloride.

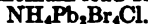
See Ammonium chloromolybdenum bromide.

**Ammonium osmium bromide.***See* Bromosmate, ammonium.**Ammonium osmyl bromide,  $(\text{NH}_4)_2\text{OsO}_2\text{Br}_4$ .**Sol. in  $\text{H}_2\text{O}$ . (Wintrebert, A. ch. 1903, (7) 28. 95.)**Ammonium osmyl oxybromide,**

(Wintrebert, A. ch. 1903, (7) 28. 117.)

**Ammonium palladium bromide.***See* Bromopalladate, ammonium, and Bromopalladite, ammonium.**Ammonium platinum bromide.***See* Bromoplatinate, ammonium.**Ammonium rhodium bromide.***See* Bromorhodite, ammonium.**Ammonium selenium bromide.***See* Bromoselenate, ammonium.**Ammonium tellurium bromide.***See* Bromotellurate, ammonium.**Ammonium thallic bromide,  $\text{NH}_4\text{Br}$ ,  $\text{TlBr}_3$ , +  $2\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Willm.)+  $4\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Nicklès.)+  $5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nicklès.)**Ammonium stannous bromide (ammonium bromostannite),  $\text{NH}_4\text{Br}$ ,  $\text{SnBr}_2$ , +  $\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Benas, C. C. 1894. 958.)+  $2\text{NH}_4\text{Br}$ ,  $\text{SnBr}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis, A. 223. 323.)+  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Benas, l.c.)+  $2\text{H}_2\text{O}$ . (Richardson, Am. Ch. J. 14. 96.) $\text{NH}_4\text{Br}$ ,  $2\text{SnBr}_2$  (?). (Benas.)**Ammonium stannic bromide,  $2\text{NH}_4\text{Br}$ ,  $\text{SnBr}_4$ .***See* Bromostannate, ammonium.**Ammonium uranyl bromide,  $2\text{NH}_4\text{Br}$ ,  $\text{UO}_2\text{Br}_2$ , +  $2\text{H}_2\text{O}$ .**Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Sendtner.)**Ammonium zinc bromide,  $2\text{NH}_4\text{Br}$ ,  $\text{ZnBr}_2$ .**Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Bödeker, J. B. 1860. 17.)+  $\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (André, A. ch. (8) 3. 104.)+  $2\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1908, 59. 66.) $3\text{NH}_4\text{Br}$ ,  $\text{ZnBr}_2$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. only by great dilution. (Jones & Knight, Am. Ch. J. 1899, 22. 136.)+  $\text{H}_2\text{O}$ . Not hygroscopic. (Ephraim, Z. anorg. 1908, 59. 66.)**Ammonium bromide arsenic trioxide.***See* Arsenite bromide, ammonium.**Ammonium bromide mercuric chloride,**

Ppt. (Rây, Chem. Soc. 1902, 81. 649.)

**Ammonium bromide mercuric iodide,**Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol without decomp. (Grossmann, B. 1903, 36. 1602.) $3\text{NH}_4\text{Br}$ ,  $2\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol without decomp. (Grossmann, B. 1903, 36. 1602.)**Ammonium lead bromochloride,**Decomp. by  $\text{H}_2\text{O}$ . (Fonzes-Diacon, Bull. Soc. 1897, (3) 17. 350.) $\text{NH}_4\text{Pb}_2\text{Cl}_4\text{Br}$ . Decomp. by  $\text{H}_2\text{O}$ . (Fonzes-Diacon, Bull. Soc. 1897, (3) 17. 349.)**Ammonium bromochloriodide,  $\text{NH}_4\text{ClBrI}$ .**Very stable; sol. in  $\text{H}_2\text{O}$ . (Chattaway, Chem. Soc. 1915, 107. 108.)**Ammonium lead bromiodide,  $\text{NH}_4\text{PbBrI}_2$ , +  $2\text{H}_2\text{O}$  and  $\text{NH}_4\text{Pb}_2\text{BrI}_4$ .**Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{KOH}$  +  $\text{Aq}$  and in strong acids. (Fonzes-Diacon, Bull. Soc. 1897, (3) 17. 352.)**Ammonium bromiodobromide,  $\text{NH}_4\text{BrIBr}$ .**

Decomp. in the air. Sol. in ether. (Jackson, Am. Ch. J. 1900, 24. 28.)

**Ammonium chloride,  $\text{NH}_4\text{Cl}$ .**(Sal-ammoniac.) Not deliquescent. Sol. in  $\text{H}_2\text{O}$  with reduction of temp.Sol. in 2.24 pts.  $\text{H}_2\text{O}$ . (Wenzel.) $\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at  $10^\circ$  has sp. gr. = 1.072. (T.)Sol. in 2.72 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (M. R., and P.)Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abl.)Sol. in 6 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)100 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  dissolve 36.75 pts.  $\text{NH}_4\text{Cl}$ . $\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at its b.-pt. ( $114.2^\circ$ ) contains 58.9pts.  $\text{NH}_4\text{Cl}$  in 100 pts. of the solution. (Berzelius.)100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 33-36 pts.; and at  $100^\circ$ ,100 pts.  $\text{NH}_4\text{Cl}$ . (Ure's Diet.) $\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at  $15^\circ$  has sp. gr. = 1.075209, andcontains at least 31.83 pts.  $\text{NH}_4\text{Cl}$  dissolved in every100 pts.  $\text{H}_2\text{O}$ . (Michel and Kraft, A. ch. (3) 41. 478.) $\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. at  $10^\circ$  contains 23.8%  $\text{NH}_4\text{Cl}$ .

(Eller.)

 $\text{NH}_4\text{Cl}$  +  $\text{Aq}$  sat. in the cold contains 14.3%  $\text{NH}_4\text{Cl}$ .

(Fourcroy.)

Sol. in 1 pt.  $\text{H}_2\text{O}$  at  $113.5^\circ$ , b.-pt. of sat. solution.

(Griffiths.)

Sol. in 2.7 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ , forming a liquid of 1.08

sp. gr. (Karsten, 1840.)

Sol. in 2.727 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Gren's Handbush.)100 pts.  $\text{H}_2\text{O}$  at 718 mm. pressure and  $t^\circ$  dissolve pts. $\text{NH}_4\text{Cl}$ .

$t^\circ$	Pts. $\text{NH}_4\text{Cl}$	$t^\circ$	Pts. $\text{NH}_4\text{Cl}$	$t^\circ$	Pts. $\text{NH}_4\text{Cl}$	$t^\circ$	Pts. $\text{NH}_4\text{Cl}$
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0	28.40	30	41.72	60	55.04	90	68.36
10	32.84	40	46.16	70	59.48	100	72.80
20	37.28	50	50.60	80	63.92	110	77.24

(Alluard, C. R. 89. 500)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NH <sub>4</sub> Cl	t°	Pts. NH <sub>4</sub> Cl	t°	Pts. NH <sub>4</sub> Cl
0	29.7	30	41.4	60	55.2
1	30.0	31	41.8	61	55.7
2	30.3	32	42.2	62	56.2
3	30.6	33	42.7	63	56.7
4	31.0	34	43.1	64	57.2
5	31.4	35	43.6	65	57.7
6	31.8	36	44.0	66	58.2
7	32.2	37	44.4	67	58.7
8	32.6	38	44.9	68	59.2
9	33.0	39	45.3	69	59.7
10	33.3	40	45.8	70	60.2
11	33.7	41	46.2	71	60.7
12	34.1	42	46.7	72	61.2
13	34.5	43	47.1	73	61.7
14	34.8	44	47.6	74	62.3
15	35.2	45	48.0	75	62.8
16	35.6	46	48.5	76	63.4
17	36.0	47	49.0	77	63.9
18	36.4	48	49.5	78	64.5
19	36.8	49	49.9	79	65.1
20	37.2	50	50.4	80	65.6
21	37.6	51	50.9	81	66.2
22	38.0	52	51.3	82	66.7
23	38.4	53	51.8	83	67.3
24	38.8	54	52.3	84	67.8
25	39.3	55	52.8	85	68.4
26	39.7	56	53.2	86	69.0
27	40.1	57	53.7	87	69.6
28	40.5	58	54.2	88	70.2
29	40.9	59	54.7	89	70.7

(Mulder, calculated from his own and other observations. Scheik. Verhandel. 1864. 57.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NH <sub>4</sub> Cl	t°	Pts. NH <sub>4</sub> Cl	t°	Pts. NH <sub>4</sub> Cl
0	29.7	10.8	33.9	64.9	57.9
6.2	32.2	31.6	42.2	90.6	67.2

(Lindström, Pogg. 136. 315.)

NH<sub>4</sub>Cl + Aq sat. at 13–16° contains 26.16% NH<sub>4</sub>Cl. (v. Hauer, J. pr. 103. 114.)

Sol. in 2.72 pts. H<sub>2</sub>O at 19°. (Schiff, A. 109. 326.)

Sol. in 2.803 pts. H<sub>2</sub>O at 15°. (Gerlach.)

Sat. NH<sub>4</sub>Cl + Aq at 75° contains 38.23% NH<sub>4</sub>Cl. (Tschugaeff, Z. anorg. 1914. 86. 161.)

NH<sub>4</sub>Cl + Aq sat. at 30° contains 29.5% NH<sub>4</sub>Cl. (Meerburg, C. C. 1904. II, 1362.)

Solubility in H<sub>2</sub>O at t°.

t°	1000 mols. H <sub>2</sub> O dissolve mols. NH <sub>4</sub> Cl	100 g. H <sub>2</sub> O dissolve g. NH <sub>4</sub> Cl
3.5	105.2	31.25
25.0	129.7	38.5
50.0	167.0	49.6

(Biltz and Marcus, Z. anorg. 1911. 71. 169.)

Solubility of NH<sub>4</sub>Cl in H<sub>2</sub>O at t°.

t°	g. NH <sub>4</sub> Cl in 100 g. of the solution	Solid phase
— 0.45	0.7 <sup>a</sup>	Ice
— 1.25	1.9 <sup>a</sup>	"
— 1.70	2.7 <sup>a</sup>	"
— 3.05	4.6	"
— 4.45	6.6 <sup>b</sup>	"
— 6.4	9.2 <sup>b</sup>	"
— 8.25	11.4	"
— 9.7	13.1	"
— 11.9	15.3	"
— 13.25	16.7	"
— 14.70	18.1 <sup>b</sup>	"
— 15.4	18.9	"
± — 16.0	± 19.5	Ice + NH <sub>4</sub> Cl
— 15.0	19.7	NH <sub>4</sub> Cl
— 12.2	20.0	"
— 10.9	20.3	"
— 7.4	21.1	"
— 5.7	21.7	"
— 2.3	22.3	"
± — 1.1	22.6	"
0	22.7	"

(Meerburg, Z. anorg. 1903. 37. 203.)

100 g. H<sub>2</sub>O dissolve 29.5 g. NH<sub>4</sub>Cl at 30°. (Schreinemakers, Arch. neer. Sc. (2) 15. 17.)

Spec. gravity of NH<sub>4</sub>Cl + Aq. G = according to Gerlach at 15° (Z. anal. 8. 281); S = according to Schiff at 19° (A. 110. 74).

% NH <sub>4</sub> Cl	Sp. gr.		% NH <sub>4</sub> Cl	Sp. gr.	
	G	S		G	S
1	1.00316	1.0029	17	1.05086	1.0495
2	1.00632	1.0058	18	1.05367	1.0523
3	1.00948	1.0087	19	1.05648	1.0551
4	1.01264	1.0116	20	1.05929	1.0579
5	1.01580	1.0145	21	1.06204	1.0606
6	1.01880	1.0174	22	1.06479	1.0633
7	1.02180	1.0203	23	1.06754	1.0660
8	1.02481	1.0233	24	1.07029	1.0687
9	1.02781	1.0263	25	1.07304	1.0714
10	1.03081	1.0293	26	1.07375	1.0741
11	1.03370	1.0322	26.297	1.07658	.....
12	1.03658	1.0351	27	.....	1.0768
13	1.03947	1.0380	28	.....	1.0794
14	1.04325	1.0409	29	.....	1.0802
15	1.04524	1.0438	30	.....	1.0846
16	1.04805	1.0467	.....	.....	.....

For older determinations, see Storer's Dict.

Sp. gr. of NH<sub>4</sub>Cl + Aq at 18°.

% NH <sub>4</sub> Cl	Sp. gr.	% NH <sub>4</sub> Cl	Sp. gr.
5	1.0142	20	1.0571
10	1.0289	25	1.0710
15	1.0430	..	.....

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. at  $20^{\circ}/4^{\circ}$  of a normal solution of  $\text{NH}_4\text{Cl}$  = 1.01454. (Haigh, J. Am. Chem. Soc. 1912, **34**, 1151.)

$\text{NH}_4\text{Cl}$  + Aq containing 6.52%  $\text{NH}_4\text{Cl}$  has sp. gr.  $20^{\circ}/20^{\circ}$  = 1.0195. (Le Blanc & Rohland, Z. phys. Ch. 1896, **19**, 272.)

Temp. of maximum density of $\text{NH}_4\text{Cl}$ + Aq	g. mol. $\text{NH}_4\text{Cl}$ in 1000 g. $\text{H}_2\text{O}$
$2.640^{\circ}$	0.1899
$0.055^{\circ}$	0.5407

(de Coppet, C. R. 1900, **131**, 178.)

Sp. gr. of dil.  $\text{NH}_4\text{Cl}$  + Aq at  $20.004^{\circ}$  and 731 mm. (corr.)

Conc. = g. equiv.  $\text{NH}_4\text{Cl}$  per l. at  $20.004^{\circ}$ .

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,001,8
0.0002	1.000,003,7
0.0005	1.000,009,3
0.0010	1.000,018,5
0.0020	1.000,036,9
0.0050	1.000,091,3
0.0100	1.000,180,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, **35**, 1688.)

Sp. gr. of dil.  $\text{NH}_4\text{Cl}$  + Aq.

$\text{NH}_4\text{Cl}$ g. in 1000 g. of solution	Sp. gr. $16^{\circ}/16^{\circ}$
0	1.000000
0.4431	1.000150
0.9061	1.000304
1.8085	1.000606
3.5947	1.001196
7.7845	1.002562
15.3425	1.004994
31.2364	1.010018

(Dijken, Z. phys. Ch. 1897, **24**, 107.)

B.-pt. of  $\text{NH}_4\text{Cl}$  + Aq, containing pts.  $\text{NH}_4\text{Cl}$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. **26**, 439); L = according to Legrand (A. ch. (2) **59**, 436).

B.-pt.	G	L	B.-pt.	G	L
101°	6.5	7.8	109°	50.6	53.5
102	12.8	13.9	110	56.2	59.9
103	19.0	19.7	111	61.9	66.4
104	24.7	25.2	112	67.8	73.3
105	29.7	30.5	113	74.2	80.5
106	34.6	35.7	114	81.3	88.1
107	39.6	41.3	114.2	...	88.9
108	45.0	47.3	114.8	87.1	...

Sat.  $\text{NH}_4\text{Cl}$  + Aq boils at  $115.8^{\circ}$  at 718 mm. pressure. (Alluard, C. R. **59**, 500.)

$\text{NH}_4\text{Cl}$  + Aq containing 74.2 pts.  $\text{NH}_4\text{Cl}$  to 100 pts.  $\text{H}_2\text{O}$  forms a crust at  $113^{\circ}$ ; highest temperature observed,  $114.8^{\circ}$ . (Gerlach, Z. anal. **26**, 426.)

$\text{NH}_4\text{Cl}$  + Aq containing 10%  $\text{NH}_4\text{Cl}$  boils at  $101.7^{\circ}$ ; 20%  $\text{NH}_4\text{Cl}$ , at  $104.4^{\circ}$ . (Gerlach.)

$\text{NH}_4\text{Cl}$  + Aq containing 10.6%  $\text{NH}_4\text{Cl}$  gives off  $\text{NH}_3$  at  $37^{\circ}$ . (Leeds, Am. J. Sci. (3) **7**, 197.)

When  $\text{NH}_4\text{Cl}$  + Aq is boiled, or even evap. on water bath, a little  $\text{NH}_3$  is expelled. (Fresenius.)

30 pts.  $\text{NH}_4\text{Cl}$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temp. from  $13.3^{\circ}$  to  $-5.1^{\circ}$ , that is  $18.4^{\circ}$ . (Rüdorff, B. **2**, 68.)

Freezing-point of sat. solution is  $-15.4^{\circ}$ ; the same temp. which is caused by mixing 25 pts.  $\text{NH}_4\text{Cl}$  with 100 pts. snow. (Rüdorff, Pogg. **122**, 337.)

Conc.  $\text{HCl}$  + Aq precipitates part of  $\text{NH}_4\text{Cl}$  from sat.  $\text{NH}_4\text{Cl}$  + Aq. (Vogel, J. pr. **2**, 199.)

Solubility of  $\text{NH}_4\text{Cl}$  in  $\text{HCl}$  + Aq at  $0^{\circ}$ .  $\text{NH}_4\text{Cl}$  = mols.  $\text{NH}_4\text{Cl}$  (in milligrammes) dissolved in 10 cc. of the liquid;  $\text{HCl}$  = mols.  $\text{HCl}$  (in milligrammes) dissolved in 10 cc. of the liquid.

$\text{NH}_4\text{Cl}$	$\text{HCl}$	Sum of mols.	Sp. gr.
46.125	0.0	46.125	1.076
43.6	2.9	46.5	1.0695
41.0	5.5	46.5	1.0705
39.15	7.85	47.0	1.0715
36.45	10.85	47.30	1.073
27.37	21.4	48.77	1.078
10.875	53.0	63.875	1.106
8.8	61.0	69.8	1.114

(Engel, Bull. Soc. (2) **45**, 655.)

Solubility of  $\text{NH}_4\text{Cl}$  in  $\text{HCl}$  + Aq.

$t^{\circ}$	$\text{HCl}$ concentration, g. mol. per 100 g. $\text{H}_2\text{O}$	Weight $\text{NH}_4\text{Cl}$ dissolved in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
$0^{\circ}$	0	298.40	5.59
"	$\frac{1}{4}$	286.43	5.36
"	$\frac{1}{2}$	271.23	5.08
"	1	245.35	4.60
$25^{\circ}$	0	395.10	7.40
"	$\frac{1}{4}$	380.85	7.13
"	$\frac{1}{2}$	366.00	6.85
"	1	339.05	6.35

(Armstrong & Eyre, Proc. R. Soc. (A.) **84**, 127.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq.}$   $\text{NH}_4\text{Cl} = \text{mols.}$   
 $\text{NH}_4\text{Cl}$  (in mgs.) in 10 cc. solution;  
 $\text{NH}_3 = \text{mols.}$   $\text{NH}_3$  (in mgs.) in 10 cc.  
 solution.

$\text{NH}_4\text{Cl}$	$\text{NH}_3$	Sp. gr.
46.125	0	1.076
45.8	5.37	1.067
45.5	12.025	1.054
45.125	23.4	1.044
44.5	38.0	1.031
44.0	47	1.025
43.625	54.5	1.017
43.125	80.0	0.993
44.0	90.0	0.992
44.375	95.5	0.983
49.75	130	0.953
60.0	169.75	0.931

(Engel, Bull. Soc. (3) 6. 17.)

$\text{NH}_4\text{Cl} + \text{BaCl}_2$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 33.8  
 pts.  $\text{NH}_4\text{Cl} + 11.6$  pts.  $\text{BaCl}_2$  at  $20^\circ$ . (Rüdorff,  
 Pogg. 148. 467.)

Solubility of  $\text{NH}_4\text{Cl}$  and  $\text{BaCl}_2$  in  $\text{H}_2\text{O}$ .

$t^\circ$	Wt. per 100		Solid phase
	$\text{NH}_4\text{Cl}$	$\text{BaCl}_2$	
$-16.2^\circ$	16.10	8.07	$\text{NH}_4\text{Cl} + \text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
0	19.26	8.22	
30	24.89	8.19	
40	26.93	8.40	
50	29.53	8.55	

(Schreinemakers, Chem. Weekbl. 1910, 7. 333.)  
*See also*  $\text{BaCl}_2 + \text{NH}_4\text{Cl}$  under  $\text{BaCl}_2$ .

$\text{NH}_4\text{Cl} + \text{CdCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{CdCl}_2$ .

*See Ammonium cadmium chloride.*

$\text{NH}_4\text{Cl} + \text{CuCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  in  
 $\text{H}_2\text{O}$  at  $30^\circ$  in presence of varying amounts of  
 $\text{CuCl}_2$ .

% by wt. $\text{CuCl}_2$	% by wt. $\text{NH}_4\text{Cl}$	Solid phase
0	29.5	$\text{NH}_4\text{Cl}$
1.9	28.6	$\text{NH}_4\text{Cl} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
3.6	25.9	
7.7	19.8	$\text{CuCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O}$
10.5	16.5	"
12.3	14.9	"
15.6	12.1	"
19.9	9.4	"
24.0	7.1	"
29.4	4.9	"
35.1	3.4	"
41.4	2.1	"
43.2	2.0	$\text{CuCl}_2 \cdot 2\text{NH}_4\text{Cl} \cdot 2\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.9	0.	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$

(Meerburg, Z. anorg. 1905, 45. 3)

$\text{NH}_4\text{Cl} + \text{PbCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{PbCl}_2$  in  $\text{H}_2\text{O}$  at  $22^\circ$ .

g. equivalent in 1000 g. $\text{H}_2\text{O}$		Solid phase
$\text{NH}_4\text{Cl}$	$\text{PbCl}_2$	
0.0	0.0749	$\text{PbCl}_2$
0.1	0.0325	"
0.2	0.0194	"
0.3	0.0153	"
0.4	0.0138	"
0.5	0.0130	"
0.52	0.0127	$\text{PbCl}_2 + \text{NH}_4\text{Cl} \cdot 2\text{PbCl}_2$ $\text{NH}_4\text{Cl} \cdot 2\text{PbCl}_2$
0.55	0.0123	
0.6	0.0113	"
0.65	0.0105	"
0.7	0.0099	"
0.8	0.0087	"
0.9	0.0063	"
1.0	0.0080	"
1.2	0.0075	"
1.5	0.0073	"
2.0	0.0077	"
2.5	0.0092	"
3.0	0.0112	"
4.0	0.0182	"
5.0	0.0296	"
6.0	0.0473	"
7.0	0.0774	"
7.29	0.0898	$\text{NH}_4\text{Cl} + \text{NH}_4\text{Cl} \cdot 2\text{PbCl}_2$ $\text{NH}_4\text{Cl}$
7.29	0.0000	

(Brönstedt, Z. phys. Ch. 1911, 77. 132.)

Solubility of  $\text{NH}_4\text{Cl}$  and  $2\text{PbCl}_2$ ,  $\text{NH}_4\text{Cl}$  in  
 $\text{H}_2\text{O}$  at  $100^\circ$ .

$\text{NH}_4\text{Cl}$ g. equivalent		$\text{PbCl}_2$ g. equivalent		Solid phase
in 1000 g. solution	in 1000 g. $\text{H}_2\text{O}$	in 1000 g. solution	in 1000 g. $\text{H}_2\text{O}$	
1.277	1.404	0.180	0.176	$\text{NH}_4\text{Cl}$ $+ 2\text{PbCl}_2 \cdot \text{H}_2\text{O}$

(Brönstedt, l. c.)

$\text{NH}_4\text{Cl} + \text{MgCl}_2$ . Solubility of  $\text{NH}_4\text{Cl}$  and  
 $\text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ .

$t^\circ$	In 1000 g. mols. $\text{H}_2\text{O}$		Solid phase
	$\text{NH}_4\text{Cl}$ g. mols.	$\text{MgCl}_2$ g. mols.	
$3.5^\circ$	27.5	55.7	$\text{NH}_4\text{Cl} + \text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
25	42.1	56.4	
50	62.9	59.1	"

(Biltz and Marcus, Z. anorg. 1911, 71. 170.)

Solubility of  $\text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$  and  $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ .

t°	In 1000 g. mol. $\text{H}_2\text{O}$		Solid phase
	g. mol. $\text{NH}_4\text{Cl}$	g. mol. $\text{MgCl}_2$	
3.5°	0.5	99.5	$\text{MgCl}_2 \cdot 6\text{H}_2\text{O} + \text{NH}_4\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
25°	0.5	103.8	
50°	0.8	111.2	

(Biltz and Marcus, Z. anorg. 1911, 71. 170.)

$\text{NH}_4\text{Cl} + \text{NH}_4\text{NO}_3$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 29.1 pts.  $\text{NH}_4\text{Cl} + 173.8$  pts.  $\text{NH}_4\text{NO}_3$  at 19.5° (Rüdorff, B. 6. 482.)

$\text{NH}_4\text{Cl} + \text{Ba}(\text{NO}_3)_2$ . 100 pts.  $\text{H}_2\text{O}$  dissolve at 18.5°—

	1	2	3	4	5
$\text{NH}_4\text{Cl}$	36.7	38.6	38.06	39.18	...
$\text{Ba}(\text{NO}_3)_2$	....	8.6	16.73	17.02	8.9

2, sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  treated with  $\text{NH}_4\text{Cl}$ ; 3, sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  treated with  $\text{Ba}(\text{NO}_3)_2$ ; 4, simultaneous treatment of both salts with  $\text{H}_2\text{O}$ . (Karsten.)

$\text{NH}_4\text{Cl} + \text{KNO}_3$ . 100 pts.  $\text{H}_2\text{O}$  dissolve at 18.5°—

	1	2	3	4	5	6
$\text{KNO}_3$	29.9	30.56	37.68	38.62	....	34.2
$\text{NH}_4\text{Cl}$	....	44.33	37.98	39.84	36.7	38.8
		74.89	75.66	78.46		73.0

1 and 5, according to Mulder; 2, sat.  $\text{KNO}_3 + \text{Aq}$  treated with  $\text{NH}_4\text{Cl}$ ; 3, sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  treated with  $\text{KNO}_3$ ; 4, simultaneous treatment of  $\text{NH}_4\text{Cl}$  and  $\text{KNO}_3$  (Karsten); 6, by warming solution with excess of both salts, and cooling to 14.8°. The amount of excess of one or the other salt has no influence. (Rüdorff.)

$\text{NH}_4\text{Cl} + \text{NaNO}_3$ . Slowly sol. in sat.  $\text{NaNO}_3 + \text{Aq}$ , at first to a clear solution, but afterwards  $\text{NaCl}$  separates out. (Karsten.)

$\text{NH}_4\text{Cl} + \text{KCl}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve—

	(Rüdorff) 15°	(Karsten) 18.75°
$\text{KCl}$	16.97	34.4
$\text{NH}_4\text{Cl}$	28.90	29.83

	(Rüdorff) 22°	(Mulder) At b.-pt.
$\text{KCl}$	19.1	58.5
$\text{NH}_4\text{Cl}$	30.4	67.7

100 pts. sat. solution of  $\text{NH}_4\text{Cl} + \text{KCl}$  contain 30.61 pts. of the two salts at 13–16°. (v. Hauer, J. pr. 103. 114.)

$\text{NH}_4\text{Cl} + \text{NaCl}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve—

	10–20° (Mulder) 10°	10°	(v. Hauer) 13–16°
$\text{NH}_4\text{Cl}$	....	19.50	33.3
$\text{NaCl}$	35.8	30.00	....
		49.50	43.4–46.4

	(Karsten) 18.75°	(Rüdorff) 18.7°	(Mulder) At b.-pt.
$\text{NH}_4\text{Cl}$	22.06	37.02	22.9
$\text{NaCl}$	26.38	....	23.9
	48.44	46.8	100.8

Sp. gr. of sat. solution of  $\text{NH}_4\text{Cl} + \text{NaCl}$  is 1.179. (Karsten.)

$\text{NH}_4\text{Cl} + (\text{NH}_4)_2\text{SO}_4$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 26.8 pts.  $\text{NH}_4\text{Cl} + 46.5$  pts.  $(\text{NH}_4)_2\text{SO}_4$  at 21.5°. (Rüdorff, B. 6. 484.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 30°.

Composition of the solution		Solid phase
% by wt. $\text{NH}_4\text{Cl}$	% by wt. $(\text{NH}_4)_2\text{SO}_4$	
0	44	$(\text{NH}_4)_2\text{SO}_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{Cl}$
17.93	25.81	"
19.07	23.22	$\text{NH}_4\text{Cl}$
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, 69. 562.)

$\text{NH}_4\text{Cl} + \text{CuSO}_4$ . Sol. in sat.  $\text{CuSO}_4 + \text{Aq}$ , at first to a clear solution, but a double sulphate of  $\text{NH}_4$  and  $\text{Cu}$  soon separates. (Karsten.)

$\text{NH}_4\text{Cl} + \text{MgSO}_4$ . Slowly and difficultly sol. in sat.  $\text{MgSO}_4 + \text{Aq}$  with subsequent separation of double sulphate. (Karsten.)

$\text{NH}_4\text{Cl} + \text{K}_2\text{SO}_4$ . 100 pts.  $\text{H}_2\text{O}$  dissolve, at 18.75°—

		a	b	c	
$\text{K}_2\text{SO}_4$	10.8	11.1	13.26	13.28	....
$\text{NH}_4\text{Cl}$	....	38.2	37.94	37.92	36.7
		49.3	51.20	51.20	

In (a)  $\text{NH}_4\text{Cl}$  was added to sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . In (b)  $\text{K}_2\text{SO}_4$  was added to sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . In (c)  $\text{NH}_4\text{Cl}$  and  $\text{K}_2\text{SO}_4$  were together with  $\text{H}_2\text{O}$ . (Karsten.)

100 pts.  $\text{H}_2\text{O}$  at  $14^\circ$  dissolve 14.1 pts.  $\text{K}_2\text{SO}_4 + 36.8$  pts.  $\text{NH}_4\text{Cl} = 50.9$  pts.  $\text{K}_2\text{SO}_4 + \text{NH}_4\text{Cl}$ , under all conditions. (Rüdorff, Pogg. 148. 565.)

100 pts.  $\text{H}_2\text{O}$  dissolve at b.-pt.—

$\text{K}_2\text{SO}_4$ . . . . .	26.75	33.3–33.9	....
$\text{NH}_4\text{Cl}$ . . . . .	.....	90.4–111.8	87.3
		123.7–145.7	

(Mulder.)

$\text{NH}_4\text{Cl} + \text{Na}_2\text{SO}_4$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 28.9 pts.  $\text{NH}_4\text{Cl} + 24.7$  pts.  $\text{Na}_2\text{SO}_4$ , if  $\text{NH}_4\text{Cl} + \text{Aq}$  sat. at  $10^\circ$  is sat. with  $\text{Na}_2\text{SO}_4$  at  $11^\circ$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 31.8 pts.  $\text{NH}_4\text{Cl} + 9.0$  pts.  $\text{Na}_2\text{SO}_4$ , if  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $10^\circ$  is sat. with  $\text{NH}_4\text{Cl}$  at  $11^\circ$ . (Mulder, J. B. 1866. 68.)

Sol. in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Karsten.)

Sol. in sat.  $\text{ZnSO}_4 + \text{Aq}$ . (Karsten.)

Sl. sol. in liquid  $\text{NH}_3$  at  $-50^\circ$ . (Moissan, C. R. 1901, 133. 713.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Very sl. sol. in absolute alcohol.

100 pts. alcohol of 0.939 sp. gr. dissolve—  
at  $4^\circ$   $8^\circ$   $27^\circ$   $38^\circ$   $56^\circ$

11.2 12.6 19.4 23.6 30.1 pts.  $\text{NH}_4\text{Cl}$ .  
(Gerardin, A. ch. (4) 5. 129.)

14 pts. boiling highest rectified spirit dissolve 1 pt.  $\text{NH}_4\text{Cl}$ . (Wenzel.)

100 pts. alcohol of—

0.900 sp. gr. dissolve 6.5 pts.  $\text{NH}_4\text{Cl}$ .

0.872 " " " 4.75 " "

0.834 " " " 1.5 " "

(Kirwan.)

Though somewhat sol. in pure absolute alcohol,  $\text{NH}_4\text{Cl}$  is absolutely insol. in alcohol in presence of methyl amine chlorides. (Winkles, A. 93. 324.)

100 pts. absolute methyl alcohol dissolve 3.35 pts. at  $19^\circ$ .

100 pts. absolute ethyl alcohol dissolve 0.62 pt. at  $19^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Solubility of  $\text{NH}_4\text{Cl}$  in methyl alcohol.

$t^\circ$	Alcohol concentration, mol. g. alcohol for 1000 g. $\text{H}_2\text{O}$	Solubility in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
$0^\circ$	0	298.40	5.59
"	$\frac{1}{4}$	297.35	5.57
"	$\frac{1}{2}$	296.55	5.55
"	1	292.65	5.47
"	3	283.15	5.30
$25^\circ$	0	395.10	7.40
"	$\frac{1}{4}$	394.75	7.39
"	$\frac{1}{2}$	393.85	7.37
"	1	392.90	7.36
"	3	386.20	7.23

(Armstrong and Eyre, Proc. R. Soc. Lond. (A) 84. 127.)

Solubility of  $\text{NH}_4\text{Cl}$  in ethyl alcohol at  $0^\circ$ .

Alcohol concentration, mol. g. alcohol for 1000 g. $\text{H}_2\text{O}$	Solubility in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
0	298.40	5.59
$\frac{1}{4}$	295.50	5.53
$\frac{1}{2}$	291.95	5.47
1	286.40	5.37
3	266.25	4.99

(Armstrong and Eyre, l.c.)

See also ammonium cupric chloride.

Solubility of  $\text{NH}_4\text{Cl}$  in propyl alcohol.

$t^\circ$	Alcohol concentration, mol. g. alcohol for 1000 g. $\text{H}_2\text{O}$	Solubility in 1000 g. $\text{H}_2\text{O}$	Molecular solubility
$0^\circ$	0	298.46	5.59
"	$\frac{1}{4}$	295.40	5.53
"	$\frac{1}{2}$	291.30	5.45
"	1	284.00	5.32
$25^\circ$	0	395.10	7.40
"	$\frac{1}{4}$	393.50	7.37
"	$\frac{1}{2}$	390.80	7.32
"	1	384.80	7.21

(Armstrong and Eyre, l.c.)

Solubility in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

P = % methyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Cl}$  in 10 cc. of the solution.

S = sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0.00	0.0533	0.7908
4.37	0.0583	0.7909
10.40	0.0658	0.7910
41.02	0.118	0.7957
80.69	0.217	0.8020
84.77	0.227	0.8026
91.25	0.247	0.8040
100.00	0.276	0.8062

(Herz, Z. anorg. 1908, 60. 155.)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Cl}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ/4^\circ$ .

P	G	S
0	0.276	0.8062
11.11	0.231	0.8035
23.8	0.182	0.8008
65.2	0.071	0.8005
91.8	0.026	0.8002
93.75	0.023	0.8000
100.00	0.018	0.8009(?)

(Herz, Z. anorg. 1908, 60. 157.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.

G = g.  $\text{NH}_4\text{Cl}$  in 10 cc. of the solution.

S = Sp. gr. of the sat. solution at 25°/4°.

P	G	S
0	0.0533	0.7908
8.1	0.0505	0.7910
17.85	0.0455	0.7916
56.6	0.0312	0.7963
88.6	0.0210	0.7996
91.2	0.0203	0.8001
95.2	0.0190	0.8003
100	0.0177	0.8009

(Herz, Z. anorg. 1908, 60. 160.)

Insol. in ether and  $\text{CS}_2$ . (Fordos and Gélis, A. ch. (3) 32. 393.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. anal. appl. Ch. 6. 184.)

Solubility of  $\text{NH}_4\text{Cl}$  in acetone + Aq at 25°.

A = cc. acetone in 100 cc. acetone + Aq.  
 $\text{NH}_4\text{Cl}$  = millimols.  $\text{NH}_4\text{Cl}$  in 100 cc. of the solution.

A	$\text{NH}_4\text{Cl}$	Sp. gr.
0	585.1	1.0793
10	534.1	1.0618
20	464.6	1.0451
30	396.7	1.0263
40	328.5	0.99984
46.5	283.7	0.97998
to	} lower phases upper	
85.7		18.9
90		9.4
		0.8390
		0.8274

(Herz, Z. anorg. 1905, 45. 263.)

Solubility of  $\text{NH}_4\text{Cl}$  in glycerine + Aq at 25°.

G = g. glycerine in 100 g. glycerine + Aq.  
 $\text{NH}_4\text{Cl}$  = millimols.  $\text{NH}_4\text{Cl}$  in 100 cc. of the solution.

G	$\text{NH}_4\text{Cl}$	Sp. gr.
0	585.1	1.0793
13.28	544.6	1.0947
25.98	502.9	1.1127
45.36	434.4	1.1452
54.23	403.5	1.1606
83.84	291.4	1.2225
100	228.4	1.2617

(Herz, l.c.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.); (Eidmann, C. C. 1899, II, 1014.)

Insol. in anhydrous pyridine. Sol. in 97% pyridine + Aq, 95% pyridine + Aq and in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Insol. in  $\text{CS}_2$ . (Arcetowski, Z. anorg. 1894, 6. 257.)

Very sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sol. in formic acid. (Zanninovich-Tessarini, Z. phys. Ch. 1896, 19. 251.)

**Ammonium antimony chloride**,  $\text{SbCl}_4(\text{NH}_4)_2$ ,  $\text{SbCl}_5(\text{NH}_4)_2$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1905, 38. 1085.)

$\text{SbCl}_4(\text{NH}_4)_2$ ,  $\text{SbCl}_5$ ,  $\text{NH}_4\text{OH}$ . Very deliquescent; sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, B. 1901, 34. 2635.)

**Ammonium antimonous chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_3$ .

Deliquescent. (Dehérain, C. R. 52. 734.)

$2\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_3$  +  $2\text{H}_2\text{O}$ . Permanent in dry air; decomp. by much  $\text{H}_2\text{O}$ . (Poggiale.)

$3\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_3$  +  $3\text{H}_2\text{O}$ . As above.

**Ammonium antimonic chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . (Dehérain, C. R. 52. 734.)

$4\text{NH}_4\text{Cl}$ ,  $\text{SbCl}_5$ . Decomp. by  $\text{H}_2\text{O}$ . (D.)

See also Chlorantimonate, ammonium.

**Ammonium antimony platinum chloride**,  $(\text{Sb}, \text{Pt})\text{Cl}_6(\text{NH}_4)_2$ .

Ppt. (Weinland, B. 1905, 38. 1084.)

**Ammonium antimony tin chloride**,  $(\text{Sb}, \text{Sn})\text{Cl}_6(\text{NH}_4)_2$ .

Ppt. (Weinland, B. 1905, 38. 1085.)

**Ammonium arsenyl chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{AsOCl}_2$  +  $\frac{1}{2}\text{H}_2\text{O}$ .

(Wallace, Phil. Mag. (4) 16. 358.)

**Ammonium bismuth chloride**,  $\text{NH}_4\text{Cl}$ ,  $2\text{BiCl}_3$ .

Deliquescent. (Dehérain, C. R. 54. 724.)

$2\text{NH}_4\text{Cl}$ ,  $\text{BiCl}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe.) Pogg. 64. 237.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . (Rammelsberg.)

$3\text{NH}_4\text{Cl}$ ,  $\text{BiCl}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe.)

$5\text{NH}_4\text{Cl}$ ,  $2\text{BiCl}_3$ . (Rammelsberg.)

**Ammonium bismuth potassium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{BiCl}_3$ ,  $\text{KCl}$ .

(Dehérain, C. R. 54. 724.)

**Ammonium cadmium chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{CdCl}_2$ .

Solubility of  $\text{NH}_4\text{Cl}$ ,  $\text{CdCl}_2$  in  $\text{H}_2\text{O}$  at t°.

t°	Pts. by weight in 100 pts. of solution			g. in 100 g. solution	Grams in 100 $\text{H}_2\text{O}$	Mols. $\text{H}_2\text{O}$ free salt dissolved by 100 mols.
	Cl	Cd	$\text{NH}_4$			
2.4°	13.44	14.26	2.24	29.94	42.74	3.25
16.0	15.07	15.82	2.56	33.45	50.26	3.83
41.2	17.46	18.61	2.89	38.96	63.83	4.86
63.8	19.73	20.92	3.34	43.99	78.54	5.98
105.9	23.52	24.70	4.01	52.58	109.33	8.30

(Rimbach, B. 1897, 30. 3076.)



+ $\frac{1}{2}$ H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O, alcohol, and wood spirit. (v. Hauer, W. A. B. 13. 449.)  
 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>. Sol. in H<sub>2</sub>O. (v. Hauer.)  
 Decomp. by H<sub>2</sub>O to NH<sub>4</sub>Cl, CdCl<sub>2</sub>. Decomp. increases with decrease of temp. At 3.9° approximately wholly decomp. to NH<sub>4</sub>Cl, CdCl<sub>2</sub>. At 113.9° very nearly all is 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>. (Rimbach, B. 1897, 30. 3077.)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub> in H<sub>2</sub>O at t°.

t°	Pts. dissolved in 100 pts. by weight of solution.		
	Cd	Cl	NH <sub>4</sub>
3.9	5.75	18.17	7.37
16.1	6.93	20.26	7.97
40.2	9.91	23.84	8.92
58.5	12.50	26.53	9.35
112.9	16.66	31.79	10.78
113.9	16.51	32.71	11.30

(Rimbach, B. 1897, 30. 3071.)

Sol. without decomp. in 37.3% HCl(d=1.19) and 24.8% HCl(d=1.125). (Rimbach, B. 1905, 33. 1569.)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>+NH<sub>4</sub>Cl in H<sub>2</sub>O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH <sub>4</sub>	Mol. % NH <sub>4</sub> Cl	Mol. % Tetra-salt
1.0	2.82	17.11	7.82	59.0	41.0
13.2	2.76	18.84	8.71	74.0	26.0
40.1	3.16	22.56	10.49	71.0	29.0
58.2	3.51	25.21	11.72	69.0	31.0

(Rimbach, B. 1902, 35. 1300.)

Solubility of 4NH<sub>4</sub>Cl, CdCl<sub>2</sub>+NH<sub>4</sub>Cl, CdCl<sub>2</sub> in H<sub>2</sub>O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. NH <sub>4</sub>	Mol. % Mono-salt	Mol. % Tetra-salt
1.1	5.34	17.62	7.27	49.6	50.4
14.0	7.12	19.86	7.84	47.0	53.0
40.7	10.24	23.82	8.85	77.0	23.0
58.5	12.50	26.53	9.35	....	....

(Rimbach, B. 1902, 35. 1300.)

Sol. without decomp. in 50% LiCl+Aq, 33.3% CaCl<sub>2</sub>+Aq and 50% MgCl<sub>2</sub>+Aq. (Rimbach, B. 1905, 33. 1569.)

**Ammonium chloromolybdenum chloride,**  
 2NH<sub>4</sub>Cl, Cl<sub>2</sub>Mo<sub>2</sub>Cl<sub>2</sub>+2H<sub>2</sub>O.

Decomp. by pure H<sub>2</sub>O; can be crystallized from HCl+Aq. (Blomstrand.)

**Ammonium chromium chloride,** 2NH<sub>4</sub>Cl, CrCl<sub>3</sub>+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O with decomp. (Neumann, A. 244. 229.)

+6H<sub>2</sub>O=2NH<sub>4</sub>Cl, [CrCl<sub>3</sub>.4H<sub>2</sub>O]Cl+2H<sub>2</sub>O.

Hygroscopic. Decomp. by H<sub>2</sub>O and by alcohol. (Weinland, B. 1907, 40. 3770.)

**Ammonium cobaltous chloride,** NH<sub>4</sub>Cl, CoCl<sub>2</sub>+6H<sub>2</sub>O.

Deliquescent in moist air. Very easily sol. in H<sub>2</sub>O. (Hautz, A. 66. 284.)

**Ammonium cobaltous chloride ammonia,** NH<sub>4</sub>Cl, CoCl<sub>2</sub>, NH<sub>3</sub>. (F. Rose.)

**Ammonium cuprous chloride,** 4NH<sub>4</sub>Cl.Cu<sub>2</sub>Cl<sub>2</sub>. Decomp. in the air.

4NH<sub>4</sub>Cl, 3Cu<sub>2</sub>Cl<sub>2</sub>. Decomp. by H<sub>2</sub>O, not by alcohol. (Ritthausen, J. pr. 59. 369.)

Fairly stable in air. (Wells, Z. anorg. 1895, 10. 158.)

**Ammonium cupric chloride,** NH<sub>4</sub>Cl, CuCl<sub>2</sub>.

Solubility of NH<sub>4</sub>Cl, CuCl<sub>2</sub> in absolute alcohol at 25°.

% CuCl <sub>2</sub>	Solid phase	% CuCl <sub>2</sub>	Solid phase
4.65	NH <sub>4</sub> Cl+NH <sub>4</sub> Cl, CuCl <sub>2</sub>	12.90	NH <sub>4</sub> Cl, CuCl <sub>2</sub>
4.74	NH <sub>4</sub> Cl+NH <sub>4</sub> Cl, CuCl <sub>2</sub>	34.92	NH <sub>4</sub> Cl, CuCl <sub>2</sub> +CuCl <sub>2</sub> , C <sub>2</sub> H <sub>5</sub> OH
6.45	NH <sub>4</sub> Cl, CuCl <sub>2</sub>	34.50	"

(Foote and Walden, J. Am. Ch. Soc. 1911, 33. 1032.)

+2H<sub>2</sub>O. Sol. in 2 pts. H<sub>2</sub>O. (Hautz, A. 66. 280.)

Does not exist, (Meerburg, C. C. 1904. II. 1362.)

2NH<sub>4</sub>Cl, CuCl<sub>2</sub>+2H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O, also in alcohol, even when absolute. (Cap and Henry, J. pr. 13. 184.)

Solubility of 2NH<sub>4</sub>Cl, CuCl<sub>2</sub> in H<sub>2</sub>O at t°.

g. 2NH <sub>4</sub> Cl, CuCl <sub>2</sub> in 100 g. of the solution	t°	Solid phase
3.87	-1.5°	ice
5.88	-2.48	"
8.78	-3.95	"
9.97	-4.60	"
13.12	-6.40	"
15.84	-8.04	"
17.64	-9.24	"
20.12	-10.80	"
20.3	-11.0	ice+2NH <sub>4</sub> Cl, CuCl <sub>2</sub> .2H <sub>2</sub> O
20.46	-10	2NH <sub>4</sub> Cl, CuCl <sub>2</sub> .2H <sub>2</sub> O
21.16	-5	"
22.02	0	"
24.26	+12	"
25.95	20	"
27.70	30	"
30.47	40	"
33.24	50	"
36.13	60	"
39.25	70	"
43.36	80	"

(Meerburg, Z. anorg. 1905, 45. 8.)

Somewhat sol. in liquid  $\text{NH}_3$ . (Franklin and Kraus, Am. Ch. J. 1898, 20, 827.)

Is the only hydrate of  $2\text{NH}_4\text{Cl}$ ,  $\text{CuCl}_2$  existing between  $-11^\circ$  and  $+80^\circ$ . (Meerburg, C. C. 1904, II, 1362.)

$+3\text{H}_2\text{O}$ . (Bourgeois, Bull. Soc. 1898, (3) 19, 786.)

**Ammonium cupric chloride ammonia,**  
 $2\text{NH}_4\text{Cl}$ ,  $\text{CuCl}_2$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ , less easily by alcohol.  
Decomp. by acids. (Ritthausen.)

**Ammonium indium chloride,**  $2\text{NH}_4\text{Cl}$ ,  $\text{InCl}_3$ ,  
 $+ \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Meyer.)

**Ammonium iodine chloride,**  $\text{NH}_4\text{Cl}$ ,  $\text{ICl}_3$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{KCl}$ ,  $\text{ICl}_3$ . (Filhol, J. Pharm. 25, 441; Berz. J. B. 20, (2) 110.)

**Ammonium iridium trichloride.**

See Chloriridite, ammonium.

**Ammonium iridium tetrachloride.**

See Chloriridate, ammonium.

**Ammonium iron (ferrous) chloride,**  $\text{NH}_4\text{Cl}$ ,  
 $\text{FeCl}_2$ .

Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Winkler.)

**Ammonium iron (ferric) chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{FeCl}_3 + \text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  without decomp. (Fritzsche); sol. in 3 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abt.)

Sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 1, 332.)

**Ammonium iron (ferric) potassium chloride,**  
 $\text{NH}_4\text{Cl}$ ,  $\text{FeCl}_3$ ,  $\text{KCl} + 1\frac{1}{2}\text{H}_2\text{O}$ .

Min. *Kremersite*. Deliquescent.

**Ammonium lead chloride,**  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (?). (André, C. R. 96, 1502.)

$6\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + \text{H}_2\text{O}$ .

$9\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

$9\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ .

$10\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + \text{H}_2\text{O}$ .

$11\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ .

$18\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + 4\text{H}_2\text{O}$ .

All these salts are decomp. by  $\text{H}_2\text{O}$ . (André A. ch. (6) 3, 104.)

Of the salts prepared by André, only one  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$  exists. (Wells, Sill. Am. J. 148, 25.)

Solubility determinations show that  $\text{NH}_4\text{Cl}$ ,  $2\text{PbCl}_2$  is the only double salt formed at  $25^\circ$ . (Foote, Am. Ch. J. 1907, 37, 121.)

$\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ . (Wells, l.c.)

**Ammonium lead tetrachloride.**

See Chloroplumbate, ammonium.

**Ammonium magnesium chloride,**  $\text{NH}_4\text{MgCl}_2 + 6\text{H}_2\text{O} = \text{NH}_4\text{Cl}$ ,  $\text{MgCl}_2 + 6\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

Sol. in 6 pts. cold  $\text{H}_2\text{O}$ . (Fourcroy.)

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Per 1000 Mol. $\text{H}_2\text{O}$	
	Mol. $\text{NH}_4\text{Cl}$	Mol. $\text{MgCl}_2$
$3.5^\circ$	27.5	55.7
25 0	42.1	56.4
50.0	62.9	59.1

(Biltz, Z. anorg. 1911, 71, 170.)

$4\text{NH}_4\text{Cl}$ ,  $5\text{MgCl}_2 + 33\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Berthelot and André, A. ch. (6) 11, 294.)

**Ammonium manganous chloride,**  $\text{NH}_4\text{Cl}$ ,  
 $\text{MnCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $1\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at ordinary temp. (Hauts, A. 66, 280); does not exist. (Saunders, Am. Ch. J. 14, 134.)

$2\text{NH}_4\text{Cl}$ ,  $\text{MnCl}_2 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Rammelsberg); does not exist. (Saunders.)

$+2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ , but with decomp. into  $\text{NH}_4\text{Cl}$  and  $\text{MnCl}_2$ . (Saunders.)

**Ammonium manganic chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{MnCl}_3$ .

Sol. in  $\text{H}_2\text{O}$ ; less sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Unstable. (Neuman, M. 1894, 15, 490.)

$+ \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  apparently without decomp. (Rice, Chem. Soc. 1898, 73, 260.)

**Ammonium mercuric chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{HgCl}_2 + \text{H}_2\text{O}$  (sal alembroth).

Sol. in 0.66 pt.  $\text{H}_2\text{O}$  at  $10^\circ$ , and in nearly every proportion of hot  $\text{H}_2\text{O}$ .

$\text{NH}_4\text{Cl}$ ,  $\text{HgCl}_2$ . Easily sol. in  $\text{H}_2\text{O}$ .

$+ \frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Kane.)

$2\text{NH}_4\text{Cl}$ ,  $3\text{HgCl}_2 + 4\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Holmes, C. N. 5, 351.)

$\text{NH}_4\text{Cl}$ ,  $2\text{HgCl}_2$ . Very sol. in  $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1902, 81, 648.)

$\text{NH}_4\text{Cl}$ ,  $5\text{HgCl}_2$ . (Strömholm, J. pr. 1902, (2) 66, 441.)

**Ammonium mercuric sodium chloride,**  $\text{NH}_4\text{Cl}$ ,  
 $\text{HgCl}_2$ ,  $4\text{NaCl}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Kossmann, A. ch. (3) 27, 243.)

**Ammonium molybdenum chloride,**  $2\text{NH}_4\text{Cl}$ ,  
 $\text{MoCl}_5 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Nearly insol. in alcohol and ether. (Chilesotti, C. C. 1903, II, 652.)

See also Ammonium chloromolybdenum chloride.

**Ammonium molybdenum chloride iodide.**

See Ammonium chloromolybdenum iodide.

**Ammonium molybdenyl chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{MoO}_3\text{Cl}_2 + 2\text{H}_2\text{O}$ .

(Weinland, Z. anorg. 1905, 44. 98.)

$2\text{NH}_4\text{Cl}$ ,  $\text{MoOCl}_2$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  sat. with  $\text{HCl}$ . (Klason, B. 1901, 34. 149.)

**Ammonium nickel chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{NiCl}_2 + 6\text{H}_2\text{O}$ .

Deliquescent in moist air. Easily sol. in  $\text{H}_2\text{O}$ . (Hautz.)

$4\text{NH}_4\text{Cl}$ ,  $\text{NiCl}_2 + 7\text{H}_2\text{O}$  (?).

**Ammonium osmium tetrachloride.**

See Chlorosmate, ammonium.

**Ammonium osmium sesquichloride.**

See Chlorosmite, ammonium.

**Ammonium osmyl chloride**,  $(\text{NH}_4)_2\text{OsO}_2\text{Cl}_4$ .

Sol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{HCl}$ . (Wintrebert, A. ch. 1903, (7) 28. 92.)

**Ammonium osmyl oxychloride**,  $(\text{NH}_4)_2\text{OsO}_3\text{Cl}_2$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KOH} + \text{Aq}$  with decomp. (Wintrebert, A. ch. 1903, (7) 28. 116.)

**Ammonium palladium chlorides.**

See Chloropalladate, ammonium and chloropalladite, ammonium.

**Ammonium rhodium dichloride**,  $4\text{NH}_4\text{Cl}$ ,  $\text{RhCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. slowly. (Willm. B. 16. 3033.)

Does not exist. (Leidié, A. ch. (6) 17. 277.)

**Ammonium rhodium trichloride.**

See Chlororhodite, ammonium.

**Ammonium rhodium chloride ammonium nitrate**,  $\text{Rh}_2\text{Cl}_6$ ,  $6\text{NH}_4\text{Cl}$ ,  $2\text{NH}_4\text{NO}_3$ .

See Chlororhodite nitrate, ammonium.

**Ammonium ruthenium trichloride.**

See Chlororuthenite, ammonium.

**Ammonium ruthenium tetrachloride.**

See Chlororuthenate, ammonium.

**Ammonium tellurium chloride.**

See Chlorotellurate, ammonium.

**Ammonium thallic chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Willm.)

$+2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Nicklès, J. Pharm. (4) 1. 28.)

**Ammonium thorium chloride**,  $8\text{NH}_4\text{Cl}$ ,  $\text{ThCl}_4 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Chydenius.)

**Ammonium tin (stannous) chloride (ammonium chlorostannite)**,  $\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Resembles K salt. (Richardson, Am. Ch. J. 14. 93.)

$2\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (Rammelsberg.)

Contains  $2\text{H}_2\text{O}$ . (Richardson.)

$4\text{NH}_4\text{Cl}$ ,  $\text{SnCl}_2 + 3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ .

(Poggiale, C. R. 20. 1182.)

Does not exist. (Richardson.)

**Ammonium tin (stannic) chloride.**

See Chlorostannate, ammonium.

**Ammonium titanium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_4 + 2\text{H}_2\text{O}$ .

Ppt.; decomp. in moist air; sol. in fuming  $\text{HCl}$ ; insol. in ether. (Rosenheim, Z. anorg. 1901, 26. 242.)

**Ammonium titanium chloride**,  $3\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_4$ .

Sol. in  $\text{H}_2\text{O}$ .

$6\text{NH}_4\text{Cl}$ ,  $\text{TiCl}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Rose.)

**Ammonium tungsten chloride**,  $(\text{NH}_4)_2\text{W}_2\text{Cl}_8 = 3\text{NH}_4\text{Cl}$ ,  $2\text{WCl}_6$ .

Easily sol. in  $\text{H}_2\text{O}$ . Nearly insol. in most organic solvents. (Olsson, B. 1913, 46. 577.)

**Ammonium uranyl chloride.**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Peligot.)

$2\text{NH}_4\text{Cl}$ ,  $(\text{UO}_2)_2\text{Cl}_2 + 2\text{H}_2\text{O}$ . Solution at  $15^\circ$  contains in 100 g. 3.51 g.  $\text{NH}_4$ , 40.67 g.  $\text{UO}_2$  and 19.15 g.  $\text{Cl}$ , hence there is considerable decomp. (Rimbach, B. 1904, 37. 466.)

**Ammonium vanadium chloride**,  $2\text{NH}_4\text{Cl}$ ,  $\text{VCl}_3 + \text{H}_2\text{O}$ .

Difficulty sol. in  $\text{H}_2\text{O}$  and alcohol. (Stähler, B. 1904, 37. 4412.)

**Ammonium zinc chloride**,  $\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2 + 2\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Hautz, A. 66. 287.)

$2\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 94. 507.)

$+ \text{H}_2\text{O}$ . Deliquescent in moist air. Sol. in  $\frac{2}{3}$  pt. cold  $\text{H}_2\text{O}$  with absorption of heat. Sol. in 0.28 pt. hot  $\text{H}_2\text{O}$  (Golfier-Bassayre, A. ch. 70. 344); sol. in  $\frac{1}{2}$  pt. cold  $\text{H}_2\text{O}$ . (Hautz, A. 66. 287.)

$3\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

$+ \text{H}_2\text{O}$ . (Berthelot, A. ch. (6) 11. 294.)

$4\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2$ . (Dehérain.)

$6\text{NH}_4\text{Cl}$ ,  $\text{ZnCl}_2 + \frac{3}{2}\text{H}_2\text{O}$ . (Berthelot, l.c.)

**Ammonium chloride zinc oxychloride**,  $2\text{ZnCl}_2$ ,  $8\text{NH}_4\text{Cl}$ ,  $\text{ZnO}$ .

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by excess. (André.)

$3\text{ZnCl}_2$ ,  $10\text{NH}_4\text{Cl}$ ,  $\text{ZnO}$ . As above. (André, A. ch. (6) 3. 88.)

**Ammonium chloride antimony fluoride**,  $\text{NH}_4\text{Cl}$ ,  $\text{SbF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . (de Haen, B. 21. 901 R.)

**Ammonium chloride arsenic trioxide.**

See Arsenite chloride, ammonium.

**Ammonium chloride bismuth bromide,**  
 $3\text{NH}_4\text{Cl}, \text{BiBr}_3 + \text{H}_2\text{O}.$ 

Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Muir, Chem. Soc. **31**, 148.)

$2\text{NH}_4\text{Cl}, \text{BiBr}_3 + 3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Muir.)

$5\text{NH}_4\text{Cl}, 2\text{BiBr}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Muir.)

**Ammonium chloride chromic oxychloride,**  
 $2\text{NH}_4\text{Cl}, \text{CrOCl}_2.$ 

Decomp. in the air. Sol. in conc.  $\text{HCl}$  without decomp. (Weinland, B. 1906, **39**, 4045.)

**Ammonium chloride cuprocupric thiosulphate,**  
 $2\text{NH}_4\text{Cl}, \text{Cu}_2\text{O}, \text{CuO}, 3\text{S}_2\text{O}_3.$ 

See Thiosulphate ammonium chloride, cuprocupric.

**Ammonium chloride lead iodide,**  $3\text{NH}_4\text{Cl}, \text{PbI}_2.$ 

Decomp. with  $\text{H}_2\text{O}$ . (Behrens, Pogg. **62**, 232.)

$4\text{NH}_4\text{Cl}, \text{PbI}_2 + 2\text{H}_2\text{O}$ . Decomp. with  $\text{H}_2\text{O}$ . (Poggiale, C. R. **20**, 1180.)

**Ammonium chloride mercuric bromide,**  
 $\text{NH}_4\text{Cl}, \text{HgBr}_2.$ 

(Edhem-Bey, Dissert. 1885.)

**Ammonium chloride platinum sulphite.**

See Chloroplatosulphite, ammonium.

**Ammonium chloride tin (stannous) bromide,**  
 $2\text{NH}_4\text{Cl}, \text{SnBr}_2 + \text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis, A. **223**, 323.)

**Ammonium dichloriodide,**  $\text{NH}_4\text{Cl}_2\text{I}.$ 

Slowly decomp. when exposed to dry air at ord. temp. Very sol. in  $\text{H}_2\text{O}$ . (Chattaway, Chem. Soc. 1915, **107**, 107.)

**Ammonium tetrachloriodide,**  $\text{NH}_4\text{Cl}_4\text{I}.$ 

Decomp. in the air. (Chattaway, Chem. Soc. 1915, **107**, 107.)

**Ammonium lead chloriodide,**  $\text{NH}_4\text{PbClI}_2 + 2\text{H}_2\text{O}$  and  $(\text{NH}_4)_2\text{PbCl}_2\text{I}_2 + 2\text{H}_2\text{O}.$ 

Sol. in  $\text{KOH}$  +  $\text{Aq}$  and in strong acids; decomp. by  $\text{H}_2\text{O}$ . (Fonzes-Diacon, Bull. Soc. 1897, (3) **17**, 348.)

**Ammonium fluoride,**  $\text{NH}_4\text{F}.$ 

Abundantly sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Marignac, Ann. Min. (5) **15**, 221.)

Insol. in liquid  $\text{NH}_3$ . (Ruff and Geisel, B. 1903, **36**, 820.)

Almost insol. in liquid  $\text{NH}_3$  at  $50^\circ$ . (Moissan, C. R. 1901, **133**, 713.)

Sol. in methyl alcohol. (Carrara, Gazz. ch. it. 1896, **26**, 119.)

**Ammonium hydrogen fluoride,**  $\text{NH}_4\text{F}, \text{HF}.$ 

Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$ .

**Ammonium antimony fluoride,**  $2\text{NH}_4\text{F}, \text{SbF}_3.$ 

Deliquescent; sol. in 0.9 pt. cold  $\text{H}_2\text{O}$ . Insol. in alcohol or ether. (Flückinger, A. **84**, 248.)

$\text{NH}_4\text{F}, 4\text{SbF}_3$ . 3 pts. sol. in 2 pts.  $\text{H}_2\text{O}$ .

(Raad and Hauser, B. 1890, **23**, R. 125.)

$\text{NH}_4\text{F}, \text{SbF}_3$ . Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, A. **145**, 239.)

**Ammonium bismuth fluoride,**  $2\text{NH}_4\text{F}, \text{BiF}_3.$ 

Insol. in  $\text{H}_2\text{O}$ . Rather difficultly sol. in acids. (Helmholtz, Z. anorg. **3**, 115.)

**Ammonium cadmium fluoride,**  $\text{NH}_4\text{F}, \text{CdF}_2.$ 

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids on boiling. (Helmholtz, Z. anorg. **3**, 115.)

**Ammonium chromium fluoride,**  $3\text{NH}_4\text{F}, \text{CrF}_3.$ 

Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{F}$  +  $\text{Aq}$ . (Petersen, J. pr. (2) **40**, 52.)

$2\text{NH}_4\text{F}, \text{CrF}_3 + \text{H}_2\text{O}$ . (Wagner, B. **19**, 896.)

**Ammonium cobaltous fluoride,**  $2\text{NH}_4\text{F}, \text{CoF}_2 + 2\text{H}_2\text{O}.$ 

Sl. sol. in  $\text{H}_2\text{O}$ . (Wagner, B. **19**, 896.)

Easily sol. in  $\text{H}_2\text{O}$ . (Helmholtz, Z. anorg. **3**, 132.)

**Ammonium columbyl fluoride.**

See Fluoxycolumbate, ammonium.

**Ammonium columbium fluoride oxyfluoride,**  
 $3\text{NH}_4\text{F}, \text{CbF}_3, \text{CbOF}_3.$ 

See Fluoxycolumbate columbium fluoride, ammonium.

**Ammonium copper fluoride,**  $2\text{NH}_4\text{F}, \text{CuF}_2 + 2\text{H}_2\text{O}.$ 

Insol. in  $\text{H}_2\text{O}$ . (Helmholtz, Z. anorg. **3**, 115.)

Nearly insol. in  $\text{H}_2\text{O}$  but decomp. thereby. (Haas, Ch. Z. 1908, **32**, 8.)

**Ammonium glucinum fluoride,**  $2\text{NH}_4\text{F}, \text{GlF}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) **30**, 51.)

Very sol. in  $\text{H}_2\text{O}$ . (Helmholtz, Z. anorg. **3**, 130.)

**Ammonium iron (ferrous) fluoride,**  $2\text{NH}_4\text{F}, \text{FeF}_2.$  (Wagner, B. **19**, 896.)

$\text{NH}_4\text{F}, \text{FeF}_2 + 2\text{H}_2\text{O}$ . (W.)

**Ammonium iron (ferric) fluoride,**  $2\text{NH}_4\text{F}, \text{FeF}_3.$ 

More sol. in  $\text{H}_2\text{O}$  than the corresponding K compound. Decomp. by boiling. (Nicklès, J. Pharm. (4) **7**, 15.)

$3\text{NH}_4\text{F}, \text{FeF}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) **60**, 306.)

Easily sol. in acids. (Helmholtz, Z. anorg. **3**, 124.)

**Ammonium manganic fluoride,**  $2\text{NH}_4\text{F}, \text{MnF}_4.$ 

More sol. than the K salt. (Nicklès, C. R. **65**, 107.)

True composition is  $4\text{NH}_4\text{F}$ ,  $\text{Mn}_2\text{F}_7$ . (Christensen, J. pr. (2) 34. 41.)

See also Fluomanganate, ammonium.

**Ammonium manganyl fluoride.**

See Fluoxymanganate, ammonium.

**Ammonium molybdenum fluoride.**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Berzelius.)

See also Fluomolybdate, ammonium.

**Ammonium molybdenyl fluoride.**

See Fluoxymolybdate, ammonium.

**Ammonium nickel fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{NiF}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896.)

Easily sol. in  $\text{H}_2\text{O}$ . (Helmholt, Z. anorg. 3. 143.)

**Ammonium scandium fluoride**,  $(\text{NH}_4)_3\text{ScF}_6$ .

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution is not decomp. by boiling. Decomp. by acids. (R. I. Meyer, Z. anorg. 1914, 86. 275.)

**Ammonium silicon fluoride.**

See Fluosilicate, ammonium.

**Ammonium silver fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{AgF} + \text{H}_2\text{O}$ .

Not hygroscopic. Sol. in  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{NH}_4\text{F} + \text{Aq}$ . Sol. in alcohol. (Grützner, Arch. Pharm. 1900, 238. 3.)

$15\text{NH}_4\text{F}$ ,  $\text{AgF} + 4\text{H}_2\text{O}$ . More deliquescent than  $\text{NH}_4\text{F}$ . (Böhm, Dissert. 1906.)

**Ammonium tantalum fluoride.**

See Fluotantalate, ammonium.

**Ammonium tantaly fluoride.**

See Fluoxytantalate, ammonium.

**Ammonium tellurium fluoride**,  $\text{NH}_4\text{F}$ ,  $\text{TeF}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Högbom, Bull. Soc. (2) 35. 60.)

**Ammonium tin (stannous) fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{SnF}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896.)

**Ammonium tin (stannic) fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{SnF}_4$ .

See Fluostannate, ammonium.

**Ammonium titanium sesquifluoride.**

See Fluotitanate, ammonium.

**Ammonium titanyl fluoride.**

See Fluoxypertitanate, ammonium.

**Ammonium tungstyl fluoride.**

See Fluoxytungstate, ammonium.

**Ammonium uranyl fluoride.**

See Fluoxuryanate, ammonium.

**Ammonium vanadium sesquifluoride.**

See Fluovanadate, ammonium.

**Ammonium vanadyl fluoride.**

See Fluoxyvanadate, ammonium.

**Ammonium zinc fluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{ZnF}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (R. Wagner.)  
 $+ 2\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Helmholt.)

**Ammonium zirconium fluoride.**

See Fluozirconate, ammonium.

**Ammonium fluoride manganic oxyfluoride**,  $2\text{NH}_4\text{F}$ ,  $\text{MnOF}_2$ .

Precipitate. (Nicklès.)

See also Fluoxymanganate, ammonium.

**Ammonium fluoride molybdenum trioxide**,  $2\text{NH}_4\text{F}$ ,  $\text{MoO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Mauro, Gass. ch. it. 18. 120.)

**Ammonium fluoride tungsten oxyfluoride.**

See Fluoxytungstate, ammonium.

**Ammonium fluoride tungsten oxyfluoride ammonium tungstate**,  $4\text{NH}_4\text{F}$ ,  $\text{WO}_3$ ,  $(\text{NH}_4)_2\text{WO}_4$ .

See Fluoxytungstate tungstate, ammonium.

**Ammonium fluoride vanadium oxyfluoride.**

See Fluoxyvanadate, and fluoxyhypovanadate, ammonium.

**Ammonium hydroselenide**,  $\text{NH}_4\text{HSe}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Bineau, A. ch. (2) 67. 229.)

**Ammonium hydrosulphide**,  $\text{NH}_4\text{SH}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. Solutions decomp. on air.

**Ammonium hydroxide**,  $\text{NH}_4\text{OH}$ .

See Ammonia,

**Ammonium imidosulphamide**,

$(\text{S}_2\text{O}_4\text{N}_2\text{H}_4)\text{NH}_4$ .

(Hantzsch, B. 1905, 38. 1033.)

**Ammonium iodide**,  $\text{NH}_4\text{I}$ .

Very deliquescent. Sol. in 0.60 pt.  $\text{H}_2\text{O}$ . (Eder, Dingl. 221. 89.)

Sp. gr. of aqueous solution of  $\text{NH}_4\text{I}$  at  $18^\circ$  containing—

	10	20	30	40	50% $\text{NH}_4\text{I}$
	1.0652	1.1397	1.2260	1.3260	1.4415

(Kohlrausch, W. Ann. 1879. 1.)

$\text{NH}_4\text{I} + \text{Aq}$  containing 12.51%  $\text{NH}_4\text{I}$  has sp. gr.  $20^\circ/20^\circ = 1.0846$ .

$\text{NH}_4\text{I} + \text{Aq}$  containing 19.19%  $\text{NH}_4\text{I}$  has sp. gr.  $20^\circ/20^\circ = 1.1359$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Very sol. in liquid  $\text{NH}_3$ , at  $-50^\circ$  (Moissan, C. R. 1901, 133. 713.)

Sol. in  $\text{SOCl}_2$ . (Walden, Z. anorg. 1900, 25. 216.)

Sol. in liquid  $\text{SO}_2$ . (Walden, Z. anorg. 1902, 30. 160.)

Sol. in 4.0 pts. abs. alcohol. (Eder, l.c.)

" 210 " ether. (Eder, l.c.)

" 20 " alcohol-ether (1 : 1). (Eder, l.c.)

Sol. in acetone. (Eidmann, C.C. 1899, II. 1014.); (Naumann, B. 1904, 37. 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

#### Ammonium diiodide, $\text{NH}_4\text{I}_2$ .

Sol. in alcohol, ether,  $\text{CS}_2$ , and  $\text{KI} + \text{Aq}$ ; less sol. in chloroform. (Guthrie, Chem. Soc. (2) 1. 239.)

#### Ammonium triiodide, $\text{NH}_4\text{I}_3$ .

Sl. deliquescent. Sol. in little  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$ . (Johnson, Chem. Soc. 33. 397.)

#### Ammonium antimony iodide, $\text{NH}_4\text{I}$ , $\text{SbI}_3 + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 51. 1097.)

$3\text{NH}_4\text{I}$ ,  $4\text{SbI}_3 + 9\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ , with separation of  $\text{SbOI}$ . Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{HCl}$ , and  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Decomp. by  $\text{CS}_2$ . (Schäffer, Pogg. 109. 611.)

$3\text{NH}_4\text{I}$ ,  $\text{SbI}_3 + 3\text{H}_2\text{O}$ . As above.

$4\text{NH}_4\text{I}$ ,  $\text{SbI}_3 + 3\text{H}_2\text{O}$ . As above.

#### Ammonium bismuth iodide, $\text{NH}_4\text{I}$ , $\text{BiI}_3 + \text{H}_2\text{O}$ .

Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 51. 1097.)

$4\text{NH}_4\text{I}$ ,  $\text{BiI}_3 + 3\text{H}_2\text{O}$ . As above. (Linau, Pogg. 111. 240.)

$2\text{NH}_4\text{I}$ ,  $\text{BiI}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ , or  $\text{MCl}$ ,  $\text{MBr}$ , or  $\text{MI} + \text{Aq}$ . (Nicklès, J. pr. (2) 39. 116.)

#### Ammonium cadmium iodide, $2\text{NH}_4\text{I}$ , $\text{CdI}_2 + 2\text{H}_2\text{O}$ .

Deliquescent. (Croft.)

Sol. at  $15^\circ$  in 0.58 pt.  $\text{H}_2\text{O}$ , 0.70 pt. abs. alcohol, 8.9 pts. ether (sp. gr. 0.729), and 1.8 pts. alcohol-ether (1 : 1). (Eder, Dingl. 221. 89.)

100 pts. of the solution in  $\text{H}_2\text{O}$  contain 85.97 pts. of the salt at  $14.5^\circ$ . (Rimbach, B. 1905, 38. 1563.)

$\text{NH}_4\text{I}$ ,  $\text{CdI}_2 + \frac{1}{2}\text{H}_2\text{O}$ . Sol. at  $15^\circ$  in 0.90 pt.  $\text{H}_2\text{O}$ , 0.88 pt. abs. alcohol, and 2.4 pts. ether (sp. gr. 0.729). (Eder, l.c.)

$+ \text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1902, 33. 154.)

#### Ammonium chloromolybdenum iodide, $2\text{NH}_4\text{I}$ , $\text{Cl}_4\text{MoI}_2 + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from  $\text{HI} + \text{Aq}$ . (Blomstrand.)

#### Ammonium cuprous iodide, $2\text{NH}_4\text{I}$ , $\text{Cu}_2\text{I}_2 + \text{H}_2\text{O}$ .

Decomp. on the air, or by  $\text{H}_2\text{O}$ , or alcohol. (Saglier, C. R. 104. 1440.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{Cu}_2\text{I}_2$ . (Gossner, Zeit. Kryst. 1903, 38. 501.)

#### Ammonium cupric iodide ammonia, $2\text{NH}_4\text{I}$ , $\text{CuI}_2$ , $2\text{NH}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol; sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

$+ 6\text{H}_2\text{O}$ . Unstable. (Saglier, C. R. 104. 1440.)

$\text{NH}_4\text{I}$ ,  $2\text{CuI}_2$ ,  $3\text{NH}_3$ . (Fleurent, C. R. 1891, 113. 1047.)

#### Ammonium iridium diiodide, $2\text{NH}_4\text{I}$ , $\text{IrI}_2$ .

Insol. in cold or hot  $\text{H}_2\text{O}$ , and in alcohol. Sol. in warm dil. acids. (Oppler.)

#### Ammonium iridium sesquiodide.

See Iodiridite, ammonium.

#### Ammonium iridium tetraiodide.

See Iodiridate, ammonium.

#### Ammonium lead iodide, $\text{NH}_4\text{I}$ , $\text{PbI}_2 + 2\text{H}_2\text{O}$ .

Decomp. by much  $\text{H}_2\text{O}$ . (Wells, Sill. Am. J. 146. 25.)

$4\text{NH}_4\text{I}$ ,  $3\text{PbI}_2 + 6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Mosnier, C. R. 1895, 120. 444.)

Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in strong  $\text{KOH} + \text{Aq}$  and in strong acids. (Fonze-Diacon, Bull. Soc. 1897, (3) 17. 347.)

#### Ammonium magnesium iodide, $\text{NH}_4\text{I}$ , $\text{MgI}_2 + 6\text{H}_2\text{O}$ .

Very deliquescent. (Lerch, J. pr. (2) 28. 338.)

#### Ammonium mercuric iodide, $\text{NH}_4\text{I}$ , $\text{HgI}_2 + \text{H}_2\text{O}$ .

Decomp. into its constituents by  $\text{H}_2\text{O}$ . (Boullay, A. ch. (2) 34. 345.)

Sol. without decomp. in alcohol and ether.  $\text{NH}_4\text{I}$ ,  $2\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{KI} + \text{Aq}$ . Very sol. in alcohol, ether and nitrobenzol. (Löw, Zeit. Kryst. 51. 138.)

#### Ammonium silver iodide, $2\text{NH}_4\text{I}$ , $\text{AgI}$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Poggiale.)

#### Ammonium thallic iodide, $\text{NH}_4\text{I}$ , $\text{ThI}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Nicklès, J. Pharm. (4) 1. 32.)

#### Ammonium tin (stannous) iodide, $\text{NH}_4\text{I}$ , $\text{SnI}_2$ .

Decomp. by small amt.  $\text{H}_2\text{O}$  but completely sol. in a large amt. (Boullay, A. ch. (2) 34. 376.)

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . (Personne.)

#### Ammonium zinc iodide, $2\text{NH}_4\text{I}$ , $\text{ZnI}_2$ .

Extremely deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 43. 665.)

$\text{NH}_4\text{I}$ ,  $\text{ZnI}_2 + 4\frac{1}{2}\text{H}_2\text{O}$ . Hygroscopic. (Ephraim, Z. anorg. 1910, 67. 384.)

**Ammonium iodide arsenic trioxide.**

See Arsenite iodide, ammonium.

**Ammonium cobalt nitride.**

See Ammonium cobalt azoimide.

**Ammonium ruthenium dihydronitrosobromide**,  $\text{NO.Ru}_2\text{H}_2(\text{NH}_4)_2\text{Br}_2.2\text{HBr}$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 363.)

**Ammonium ruthenium nitroschloride**,  $3\text{NH}_4\text{Cl}.2\text{HCl.NORu}_2\text{H}_2\text{Cl}_2$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 354.)

**Ammonium ruthenium dihydronitroschloride**,  $\text{NO.Ru}_2\text{H}_2(\text{NH}_4)_2\text{Cl}_2.2\text{HCl}$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 358.)

**Ammonium peroxide**,  $(\text{NH}_4)_2\text{O}_2$ .

M.-pt.  $-2^\circ$ . Sl. sol. in ether without decomp. (D'Ans, B. 1913, 46. 3076.)

Sol. in alcohol; insol. in ether; decomp. slowly in aq. solution. (Melikoff, B. 1897, 30. 3145.)

**Ammonium hydrogen peroxide**,  $(\text{NH}_4)_2\text{O}_2, \text{H}_2\text{O}_2$ .

Decomp. at ordinary temp. (Melikoff, B. 1898, 31. 447.)

+  $\text{H}_2\text{O}$ . Unstable; deliquesces at ordinary temp.; sol. in alcohol; insol. in light petroleum. (Melikoff, B. 1898, 31. 152.)

**Ammonium selenide**,  $(\text{NH}_4)_2\text{Se}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Bineau, A. ch. (2) 67. 229.)

Stable in the air. Sol. in  $\text{H}_2\text{O}$ ; aq. solution decomp. slowly. (Lenher and Smith, J. Am. Chem. Soc. 1898, 20. 277.)

**Ammonium hydrogen selenide**,  $\text{NH}_4\text{HSe}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 103. 269.)

**Ammonium monosulphide**,  $(\text{NH}_4)_2\text{S}$ .

Decomp. on air. Sol. in  $\text{H}_2\text{O}$ , but solution decomposes rapidly.

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

**Ammonium disulphide**,  $(\text{NH}_4)_2\text{S}_2$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Does not exist. (Bloxam, Chem. Soc. 1895, 67. 293.)

**Ammonium tetrasulphide**,  $(\text{NH}_4)_4\text{S}_4$ .

Easily sol. in  $\text{H}_2\text{O}$ . Conc. solution is stable, dil. solution decomp. on air. Easily sol. in alcohol without decomp., but solution decomp. on the air more rapidly than the aqueous solution. (Fritzsche, J. pr. 32. 313.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . When dissolved in  $\text{H}_2\text{O}$ , it is at once dissociated with deposition of S. (Bloxam, Chem. Soc. 1895, 67. 303.)

**Ammonium pentasulphide**,  $(\text{NH}_4)_5\text{S}_5$ .

Decomp. on air. Sol. in  $\text{H}_2\text{O}$  with separation of S. Sol. in alcohol without decomp., but solution decomposes quickly on standing. (Fritzsche, J. pr. 32. 313.)

Rapidly decomp. by  $\text{H}_2\text{O}$  with separation of S. (Bloxam, Chem. Soc. 1895, 67. 298.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of S. (Bloxam, Chem. Soc. 1895, 67. 298.)

**Ammonium heptasulphide**,  $(\text{NH}_4)_7\text{S}_7$ .

More stable on air, and less easily decomposed by  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_5\text{S}_5$ .

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of S. Slowly attacked by dil.  $\text{HCl} + \text{Aq}$ . (Bloxam, Chem. Soc. 1895, 67. 307.)

**Tetrammonium heptasulphide**,  $(\text{NH}_4)_4\text{S}_7 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Solution can be kept for a long time without depositing S. (Bloxam, Chem. Soc. 1895, 67. 298.)

**Diammonium enneasulphide**,  $(\text{NH}_4)_2\text{S}_9 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomposed by  $\text{H}_2\text{O}$  with separation of S. Not attacked by boiling dil.  $\text{HCl} + \text{Aq}$  on account of formation of a hard crust of S on the crystals. (Bloxam, Chem. Soc. 1895, 67. 306.)

**Tetrammonium enneasulphide**,  $(\text{NH}_4)_4\text{S}_9$ .

Solution in  $\text{H}_2\text{O}$  deposits crystals of  $(\text{NH}_4)_4\text{S}_9$  on standing. (Bloxam, Chem. Soc. 1895, 67. 302.)

+  $3\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of S. (Bloxam, Chem. Soc. 1895, 67. 299.)

**Ammonium polysulphides.**

Conc.  $\text{NH}_3 + \text{Aq}$  dissolves  $\text{H}_2\text{S}$  to form  $(\text{NH}_4)_2\text{S}.2\text{NH}_4\text{SH}$ . On dilution more  $\text{H}_2\text{S}$  is absorbed to form  $(\text{NH}_4)_4\text{S}.4\text{NH}_4\text{SH}$ , then  $(\text{NH}_4)_6\text{S}.8\text{NH}_4\text{SH}$ , then  $(\text{NH}_4)_8\text{S}.18\text{NH}_4\text{SH}$  and finally  $\text{NH}_4\text{SH}$ . (Bloxam, Chem. Soc. 1895, 67. 284.)

**Ammonium copper sulphide**,  $(\text{NH}_4)_2\text{S}, 2\text{CuS}_2$  (?).

Sol. in warm  $\text{H}_2\text{O}$ , but decomp. on standing. Warm  $\text{KOH} + \text{Aq}$  acts similarly; sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , or absolute alcohol. Insol. in ether. Decomp. by dil. acids. (Priwoznik, B. 6. 1291.)

Correct formula is  $\text{NH}_4\text{CuS}_4$ . Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by conc. and dil. acids. Easily sol. in  $\text{NaOH}$ . Sl. sol. in alcohol. (Biltz, B. 1907, 40. 976.)

**Ammonium gold polysulphide**,  $\text{AuS}_2.\text{NH}_4$ .

Ppt. (Hofmann, B. 1903, 36. 3092; B. 1904, 37. 245.)

**Ammonium iridium pentadecasulphide**,  $\text{IrS}_{15}(\text{NH}_4)_3$ .

Ppt. (Hofmann, B. 1904, 37. 247.)

**Ammonium palladium undecasulphide,**

Ppt. (Hofmann, B. 1904, 37. 248.)

**Ammonium platinum pentadecasulphide,**

Can be washed with  $\text{CS}_2$  without decomp. Sol. in alcohol. Insol. in ether. (Hofmann, B. 1903, 36. 3091.)

**Ammonium stannic sulphide.**

See Sulphostannate, ammonium.

**Ammonium telluride,  $\text{NH}_4\text{Te}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Bineau, A. ch. (2) 67. 229.)

**Ammonium sulphide ammonia,  $(\text{NH}_4)_2\text{S}$ ,  $2\text{NH}_3$ .**

Very unstable. (Bloxam, Chem. Soc. 1895, 67. 294.)

**Ammonium acisulphomelid,  $(\text{NSO.ONH}_4)_2$  (?).**

(Hantzsch and Stuer, B. 1905, 38. 1039.)

**Ammonplatindiamine comps.**

See Platintriamine comps.

**Ammondisulphonic acid,  $\text{NH}_4(\text{SO}_3\text{H})_2$ .**

Known only in its salts. (Claus, A. 158. 52 and 194.)

Contains 2 at. H less, and is identical with imidosulphonic acid  $\text{NH}(\text{SO}_3\text{H})_2$ , which see. (Raschig, A. 241. 161.)

**Ammontrisulphonic acid,  $\text{NH}_4(\text{SO}_3\text{H})_3$ .**

Known only in its salts. (Claus, A. 158. 52 and 194.)

Contains 2 at. H less, and is nitrosulphonic acid  $\text{N}(\text{SO}_3\text{H})_2$ , which see. (Raschig, A. 241. 161.)

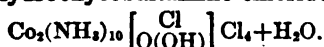
**Ammontetrasulphonic acid,  $\text{NH}(\text{SO}_3\text{H})_4$ .**

Known only in its salts. (Claus, A. 158. 52 and 194.)

Does not exist, but was impure nitrosulphonic acid, which see. (Raschig, A. 241. 161.)

**Anhydroarseniotungstic acid,  $\text{H}_3\text{AsW}_6\text{O}_{21}$ .**

See under Arseniotungstic acid.

**Anhydrooxycobaltamine chloride,**

Easily sol. in  $\text{H}_2\text{O}$ , but decomposes after a few minutes; can be recrystallized from dil.  $\text{HCl} + \text{Aq}$ . Precipitated from sat.  $\text{H}_2\text{O}$  solution by conc.  $\text{HCl} + \text{Aq}$ , or alcohol. (Vortmann, M. Ch. 6. 404.)

$\text{Co}_2(\text{NH}_3)_{10} \left( \text{O} \begin{array}{c} \text{Cl} \\ \text{OH} \end{array} \right) \text{Cl}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Vortmann.)

**Anhydrooxycobaltamine chloride mercuric chloride,  $\text{Co}_2(\text{NH}_3)_{10}(\text{ClO}_2\text{H})\text{Cl}_4, 3\text{HgCl}_2$ .**

Can be recryst. from very dil. hot  $\text{HCl} + \text{Aq}$ .

**— chloroplatinate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{ClO}_2\text{H})\text{Cl}_4, 2\text{PtCl}_4$ .**

Can be recrystallized from  $\text{H}_2\text{O}$  containing  $\text{HCl}$ .

**— chloronitrate,  $\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O.OH})(\text{NO}_2)_4 + \text{H}_2\text{O}$ .**

Can be recrystallized from dil.  $\text{HCl} + \text{Aq}$ .



More easily sol. in  $\text{H}_2\text{O}$  than the preceding comp.

**— chlorosulphate,  $\text{Co}_2(\text{NH}_3)_{10}\text{Cl}(\text{O.OH})(\text{SO}_4)_2$ .****— dichromate,  $[\text{Co}_2(\text{NH}_3)_{10}\text{O.OH}]_2(\text{Cr}_2\text{O}_7)_2 + 8\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ .

**— nitrate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{NO}_2)(\text{O.OH})(\text{NO}_2)_4 + \text{H}_2\text{O}$ .**

Sl. sol. in pure  $\text{H}_2\text{O}$  with immediate decomp. Can be recrystallized from  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ .

**— sulphate,  $[\text{Co}_2(\text{NH}_3)_{10}\text{O.OH}]_2(\text{SO}_4)_2, 2\text{H}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . When crystallized from dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , is converted into—

$[\text{Co}_2(\text{NH}_3)_{10}\text{O.OH}]_2(\text{SO}_4)_4, \text{H}_2\text{SO}_4 + 3\text{H}_2\text{O}$ , which by further recrystallization from very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  becomes—

$[\text{Co}_2(\text{NH}_3)_{10}\text{O.OH}]_2(\text{SO}_4)_6 + 8\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Vortmann.)

**Anhydrophospholuteotungstic acid,**

See under Phosphotungstic acid.

**Antimonic Acid.****Metantimonic acid,  $\text{HSbO}_3$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{HCl} + \text{Aq}$ ; sl. sol. in dil.  $\text{HNO}_3 + \text{Aq}$ ; easily sol. in tartaric acid +  $\text{Aq}$ ; easily sol. in hot  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ ; completely insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Freymy, A. ch. (3) 23. 407.)

Sl. sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{KOH}$  and  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $\text{HNO}_3 + \text{H}_2\text{SO}_4$ . Slowly sol. in cold, quickly in hot  $\text{HCl} + \text{Aq}$ . Sl. sol. in tartaric and oxalic acid and in  $\text{KHC}_2\text{O}_4 + \text{Aq}$ . (Senderens, Bull. Soc. 1899, (3) 21. 48.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Pyroantimonic acid,  $\text{H}_3\text{Sb}_2\text{O}_7$ .**

More sol. in  $\text{H}_2\text{O}$  and acids than  $\text{H}_3\text{SbO}_4$ . Sol. in cold  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Freymy.) Slowly sol. in cold  $\text{H}_2\text{O}$ .

5.88 g.  $\text{Sb}_2\text{O}_5$  in 1 l.  $\text{H}_2\text{O}$  at 15°

8.55 " " " 1 l. " " 25°

21.30 " " " 1 l. " " 60°

(Delacroix, J. Pharm. 1897, 6. 337-41.)



Sl. sol. in  $H_2O$ . Very sl. sol. in KOH and  $K_2CO_3 + Aq$ . Insol. in  $NH_4OH + Aq$ , and in  $HNO_3 + H_2SO_4$ . Slowly sol. in cold, quickly in hot  $HCl + Aq$ . Sl. sol. in tartaric acid, oxalic acid and  $KHC_2O_4 + Aq$ . (Senderens, Bull. Soc. 1899, (3) 21. 48.)

#### Orthoantimonic acid, $H_3SbO_4$ .

Sl. sol. in  $H_2O$ . Insol. in  $NH_4OH + Aq$ . Easily sol. in  $KOH + Aq$ . (Fremy.)

Does not exist. (Raschig, B. 18. 2745.)

Has, however, been prepared by Daubrawa (A. 186. 110), Conrad (C. N. 40. 198), and Beilstein and Blaesé (Bull. Ac. St. Petersb. 33. 97).

Very sol. in  $H_2O$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1049.)

Very sl. sol. in  $H_2O$ , in KOH and  $K_2CO_3 + Aq$ . Slowly sol. in cold, quickly in hot  $HCl + Aq$ . Insol. in  $NH_4OH + Aq$ , and in  $HNO_3 + H_2SO_4$ . Sl. sol. in tartaric acid, oxalic acid and  $KHC_2O_4 + Aq$ . (Senderens, Bull. Soc. 1899, (3) 21. 52.)

$+ \frac{1}{2}H_2O$ . (Beilstein and Blaesé.)

According to Beilstein and Blaesé only one antimonic acid,  $H_3SbO_4$ , exists.

#### Tetraantimonic acid, $Sb_2O_3 + 4H_2O = H_4Sb_2O_7$ .

Slowly sol. in cold  $H_2O$ .

Solution sat. at  $t^\circ$  contains g.  $Sb_2O_3$  per litre—

$t^\circ$	15°	25°	60°	70°
g. $Sb_2O_3$	5.88	8.3-8.75	21.30	53.89

Decomp. in solution by heating to  $100^\circ$  or long standing in the cold to  $Sb_2O_3$ ,  $3H_2O$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1049.)

Insol. in  $H_2O$ . Very sl. sol. in KOH and  $K_2CO_3 + Aq$ . Slowly sol. in cold, quickly in hot  $HCl + Aq$ . Insol. in  $NH_4OH + Aq$ . Insol. in  $HNO_3 + H_2SO_4$ . Sl. sol. in tartaric acid, oxalic acid and in  $KHC_2O_4 + Aq$ . (Senderens, Bull. Soc. 1899, (3) 21. 51.)

#### Hexantimonic acid, $Sb_2O_3 + 6H_2O =$



Sol. in  $H_2O$  to the extent of 22 g.  $Sb_2O_3$  per l. but on standing becomes turbid and a white powder is pptd. until finally only 3 g.  $Sb_2O_3$  are dissolved per l. (Senderens, Bull. Soc. 1899, (3) 21. 48-49.)

#### Antimonates.

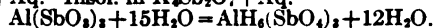
a. *Antimonates*. From  $HSbO_3$ . Some of the K and  $NH_4$  salts are sol. in  $H_2O$ , the others are slightly sol. or insol.

b. *Pyroantimonates*. From  $H_2Sb_2O_7$ . As a class, insol. in  $H_2O$ , but decomp. thereby except in presence of large excess of alkali. (Fremy, A. ch. (3) 12. 499.)

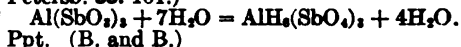
Probably do not exist. (Beilstein and Blaesé.)

#### Aluminum antimonate, $Al_2O_3, 3Sb_2O_3$ (?)

Ppt. Somewhat sol. in excess of Al salts  $+ Aq$ . Insol. in  $K_2Sb_2O_7 + Aq$ .



Ppt. (Beilstein and Blaesé, Bull. Ac. St. Petersb. 33. 101.)



Ppt. (B. and B.)

$Al_2O_3, Sb_2O_3 + 9H_2O$ . Ppt. (Ebel, B. 22. 3043.)

#### Ammonium antimonate, $NH_4SbO_3 + 2H_2O$ ,

Insol. in  $H_2O$ .

$+ 2\frac{1}{2}H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 56.)



#### Ammonium pyroantimonate, $(NH_4)_2Sb_2O_7$ .

Known only in solution.



Sol. in  $H_2O$ , but decomp. by standing or boiling into insol. salt. Insol. in alcohol. (Fremy, J. pr. 45. 215). Composition is  $NH_4SbO_3 + 6H_2O$ , according to Raschig (B. 18. 2743).

#### Barium antimonate, $Ba(SbO_3)_2$ .

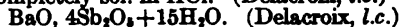
Ppt. Scarcely sol. in  $H_2O$ . Slowly sol. in  $BaCl_2 + Aq$ .

$+ 2H_2O$ . Somewhat sol. in  $H_2O$ . Easily sol. in  $HCl + Aq$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1051.)

$+ 5$ , or  $6H_2O$ . Ppt.

$BaSb_2O_7 + 5H_2O$ . Sol. in conc.  $HCl$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1051.)

$BaO, 3Sb_2O_3 + 5H_2O$ . Insol. in  $H_2O$ . Incompletely sol. in  $HCl$ . (Delacroix, l.c.)



$9BaO, 10Sb_2O_3 + 18H_2O$ . Insol. in  $HCl + Aq$ . (Delacroix, l.c.)

#### Bismuth antimonate, $BiSbO_4 + H_2O$ .

Ppt. Insol. in  $H_2O$ ; sol. in  $HCl + Aq$ . (Cavazzi, Gazz. ch. it. 15. 37.)

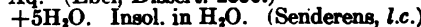
$3Bi_2O_3, Sb_2O_3 + H_2O$ . Insol. in  $H_2O$ ; sol. in  $HCl + Aq$ . (Cavazzi.)

$2Bi_2O_3, Sb_2O_3$ . As above. (Cavazzi.)

#### Cadmium antimonate, $Cd(SbO_3)_2 + 2H_2O$ .

Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 56.)

$+ 3\frac{1}{2}H_2O$ . Very sol. in  $H_2O$ . Sol. in  $HCl + Aq$ . (Ebel, Dissert. 1890.)



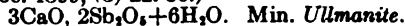
$+ 6H_2O$ . Ppt. Insol. in  $H_2O$ . (Ebel, B. 22. 3043.)

#### Calcium antimonate, $Ca(SbO_3)_2$ .

Ppt.



$+ 6H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 56.)



#### Chromic antimonate, $Cr(SbO_3)_3 + 14H_2O$ .

Ppt. (Beilstein and Blaesé.)

#### Cobaltous antimonate, $Co(SbO_3)_2 + 5H_2O$ .

Insol. in  $H_2O$ . Loses  $3H_2O$  in the presence of  $H_2SO_4$  and passes into  $Co(SbO_4)_2 + 2H_2O$ ,

also insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 55.)

+ $6H_2O$ . Ppt. (Ebel, B. 22. 3043.)  
+ $7H_2O$ . Sl. sol. in  $H_2O$ . Sl. sol. in boiling solutions of cobalt salts.

+ $12H_2O$ . Ppt. (Heffter, Pogg. 86. 448.)

**Cobaltous hydrogen antimonate**,  $CoH_2(SbO_4)_2$ , + $H_2O$ .

(Gorgeul, Ann. Phys. Beibl. 1897, 21. 198.)

**Cupric antimonate**,  $3CuO, 2Sb_2O_3$ .

Ppt. (Beilstein and Blaesé.)

$Cu(SbO_4)_2$ . Insol. in  $H_2O$ , acids, or alkalis. (Berzelius.)

+ $2H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 55.)

+ $5H_2O$ . Ppt. (Ebel, B. 22. 3043.)

Insol. in  $H_2O$ . (Senderens, l.c.)

$CuO, 2Sb_2O_3 + 9H_2O$ . Insol. in  $H_2O$ . Sol. in  $Sb_2O_3, 4H_2O + Aq$ . (Delacroix, Bull. Soc. 1899, (3) 21. 1054.)

$2CuO, 3Sb_2O_3 + 10H_2O$ . Insol. in  $H_2O$ . Sol. in  $NH_4OH$  and in triantimonic acid +  $Aq$ . (Delacroix, l.c.)

$CuO, 6Sb_2O_3 + 16H_2O$ . (Delacroix, l.c.)

**Cupric antimonate ammonia**,  $Cu(SbO_4)_2, 4NH_3 + 4H_2O$ .

Insol. in  $H_2O$  and  $NH_4OH + Aq$ . (Schiff, A. 123. 39.)

$CuSb_2N_2H_{11}O_{11} = Cu(ONH_4)OH, 2(NH_4SbO_4 + 2H_2O)$ . (Raschig, B. 18. 2743.)

$Cu(SbO_4)_2, 3NH_3 + 9H_2O$ . (Delacroix, Bull. Soc. 1901, (3) 25. 289.)

**Glucinum antimonate**,  $Gl(SbO_4)_2 + 6H_2O$ .

Somewhat sol. in hot  $H_2O$ . Easily sol. in warm  $HCl$ . (Ebel, Dissert. 1890.)

**Iron (ferrous) antimonate**.

Sl. sol. in  $H_2O$ . (Berzelius.)

**Iron (ferric) antimonate**.

Insol. in  $H_2O$ . (B.)

$Fe_2O_3, Sb_2O_3 + 7H_2O$ . Ppt. (Ebel, B. 22. 3043.)

$Fe_2O_3, 2Sb_2O_3 + 11H_2O$ . Ppt. (Beilstein and Blaesé.)

$Fe(SbO_4)_2 + 6\frac{1}{2}H_2O$ . Ppt. (B. and B.)

**Lead antimonate, basic**,  $Pb_3(SbO_4)_2(OH)_4 + 2H_2O = Pb_2(SbO_4)_2 + 4H_2O$ .

Min. *Bleinerite, Bindheimite*.

$2Pb(SbO_4)_2, PbO + 11H_2O$ . Ppt. (B. and B.)

**Lead antimonate**,  $Pb(SbO_4)_2$ .

Insol. in  $H_2O$ . Incompletely decomp. by acids. (Berzelius.)

*Naples Yellow*. Insol. in  $H_2O$ .

+ $2H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 57.)

+ $5H_2O$ . Ppt. (Ebel, B. 22. 3043.)

+ $6H_2O$ . Ppt. (Beilstein and Blaesé.)

+ $9H_2O$ . Insol. in  $H_2O$ . (Senderens, l.c.)

**Lead antimonate chloride**,  $Pb(SbO_4)_2, PbCl_2$ .

Min. *Nadorite*. Sol. in  $HCl, HNO_3$ , and tartaric acid +  $Aq$ .

**Lithium antimonate**,  $LiSbO_3$ .

Sl. sol. in cold, sol. in hot  $H_2O$ , and crystallizes on cooling. Much more sol. than  $NaSbO_3$ .

+ $3H_2O$ . Ppt. Sl. sol. in  $H_2O$ . (Beilstein and Blaesé.)

**Magnesium antimonate**,  $Mg(SbO_4)_2 + 12H_2O$ .

Sol. in hot, less sol. in cold  $H_2O$ . (Heffter.)

Sol. in  $MgSO_4 + Aq$ ; insol. in  $KSbO_3 + Aq$ . (Berzelius.)

**Manganous antimonate**,  $Mn(SbO_4)_2$ .

Difficultly sol. in  $H_2O$ .

When heated, is sol. only in strong acids.

+ $2H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 56.)

+ $5H_2O$ . Ppt. (Ebel, B. 22. 3043.)

+ $6H_2O$ . Insol. in  $H_2O$ . (Senderens, l.c.)

+ $7H_2O$ . Ppt. (Beilstein and Blaesé.)

**Mercurous antimonate**.

Insol. in  $H_2O$ . (Berzelius.)

**Mercuric antimonate**,  $Hg(SbO_4)_2$ .

Insol. in  $H_2O$ , alkalis, and most acids.

Sl. attacked by boiling  $H_2SO_4$ , and  $HCl + Aq$ .

+ $2H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 55.)

+ $5H_2O$ . Insol. in  $H_2O$ . (Senderens.)

+ $6H_2O$ . Ppt. (Beilstein and Blaesé.)

**Nickel antimonate**,  $Ni(SbO_4)_2 + 2H_2O$ .

Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 54.)

+ $5H_2O$ . Insol. in  $H_2O$ . (Senderens.)

+ $6H_2O$ . Ppt. Insol. in  $H_2O$ . (Heffter, Pogg. 86. 446.)

+ $12H_2O$ . Sl. sol. in  $H_2O$ . (Heffter.)

**Potassium antimonate**,  $KSbO_3$ .

Insol. in  $H_2O$ . Sol. in warm  $KOH + Aq$ , but separates nearly completely on cooling. By boiling with  $H_2O$ , or by standing for a long time with cold  $H_2O$ , it gradually dissolves as  $2KSbO_3 + 5H_2O$ , or  $K_2H_3Sb_2O_7 + 4H_2O$ , or  $2KH_3SbO_4 + 3H_2O$ .

Insol. in  $CS_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

+ $H_2O$ . Insol. in  $H_2O$ . (Senderens, Bull. Soc. 1899, (3) 21. 57.)

+ $1\frac{1}{2}H_2O (= 2KSbO_3 + 5H_2O$  of Fremy).

Easily sol. in  $H_2O$ , especially if warm. Solution is pptd. by  $NH_4Cl + Aq$ . (Fremy, A. ch. (3) 12. 499.)

+ $2\frac{1}{2}H_2O$ . 100 pts.  $H_2O$  at  $20^\circ$  dissolve 2.81 pts. anhydrous salt; sp. gr. of solution sat. at  $18^\circ = 1.0263$ . Composition is given as  $K_2H_3Sb_2O_7 + 4H_2O$ . (Knorre and Olschewsky, B. 20. 3043.)

+ $3\frac{1}{2}H_2O$ . Insol. in  $H_2O$ . (Senderens, l.c.)

+4½H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Delacroix, J. Pharm. 1897, (6) 6. 533.)  
 2K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+10H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. (Delacroix, J. Pharm. 1897, 6. 337.)  
 +10H<sub>2</sub>O. (Delacroix, l. c.)

**Potassium pyroantimonate, K<sub>3</sub>Sb<sub>2</sub>O<sub>7</sub>.**

Deliquescent; decomp. by boiling with H<sub>2</sub>O into K<sub>2</sub>SbO<sub>3</sub>+5H<sub>2</sub>O, by cold H<sub>2</sub>O into K<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>+6H<sub>2</sub>O. (Fremy.)

Does not exist. (Knorre and Olschewsky.)  
 Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Potassium hydrogen pyroantimonate, K<sub>2</sub>H<sub>3</sub>Sb<sub>2</sub>O<sub>7</sub>.**

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

+2½H<sub>2</sub>O. (Senderens, Bull. Soc. 1899, (3) 21. 57.)

+3½H<sub>2</sub>O. Very difficultly sol. in hot or cold H<sub>2</sub>O. (Knorre and Olschewsky, B. 18. 2358.)

+6H<sub>2</sub>O. Quite difficultly sol. in cold H<sub>2</sub>O. Not precipitated by NH<sub>4</sub>Cl+Aq. Aqueous solution gradually decomposes. (Fremy.)

+4H<sub>2</sub>O. See 2K<sub>2</sub>SbO<sub>3</sub>+5H<sub>2</sub>O.

**Potassium antimonate sulphantimonate, K<sub>2</sub>SbO<sub>3</sub>, K<sub>2</sub>SbS<sub>4</sub>+5H<sub>2</sub>O.**

Decomp. on air, and with cold H<sub>2</sub>O. Sol. in hot H<sub>2</sub>O. (Rammelsberg.)

**Silver antimonate.**

Insol. in H<sub>2</sub>O. (Berzelius.)

AgSbO<sub>3</sub>+3H<sub>2</sub>O=AgH<sub>3</sub>SbO<sub>4</sub>+2H<sub>2</sub>O. Easily sol. in NH<sub>4</sub>OH+Aq, when freshly pptd. (Beilstein and Blaesé.)

+1½H<sub>2</sub>O. Ppt. (Ebel, B. 22. 3043.)

**Silver antimonate ammonia, AgH<sub>3</sub>SbO<sub>4</sub>, 2NH<sub>3</sub>+H<sub>2</sub>O.**

(Beilstein and Blaesé.)

**Sodium antimonate, NaSbO<sub>3</sub>.**

Sol. in much H<sub>2</sub>O, but soon becomes decomposed into Na<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>.

+3½H<sub>2</sub>O, composition of Na<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>+6H<sub>2</sub>O, according to Beilstein and Blaesé.

1000 pts. H<sub>2</sub>O dissolve 0.31 pt. NaSbO<sub>3</sub>+3½H<sub>2</sub>O at 12.3°.

1000 pts. alcohol of 15.8% dissolve 0.13 pt. NaSbO<sub>3</sub>+3½H<sub>2</sub>O at 12.3°.

1000 pts. alcohol of 25.6% dissolve 0.07 pt. NaSbO<sub>3</sub>+3½H<sub>2</sub>O at 12.3°.

Somewhat more sol. when freshly precipitated.

Absolutely insol. in glacial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>.

Presence of NaOH or Na salts diminish solubility, while NH<sub>4</sub>OH or K salts increase it

slightly. (Beilstein and Blaesé, Bull. Ac. St. Petersb. 33. 201.)

+4½H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Delacroix, Bull. Soc. 1899, (3) 21. 1051.)

2Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+10H<sub>2</sub>O. (Delacroix, l. c.)

Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+11H<sub>2</sub>O. (Delacroix, l. c.)

**Sodium pyroantimonate, Na<sub>2</sub>H<sub>2</sub>SbO<sub>7</sub>+6H<sub>2</sub>O.**

Boiling H<sub>2</sub>O dissolves ¾ pt. of this salt. (Fremy.) 1000 pts. H<sub>2</sub>O dissolve 2.5 pts. salt.

(Ebel, B. 22. 3044.) See also NaSbO<sub>3</sub>+3½H<sub>2</sub>O.

+5H<sub>2</sub>O. (Knorre and Olschewsky.)

**Strontium antimonate, Sr(SbO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O.**

Ppt. Less sol. in H<sub>2</sub>O than SrSO<sub>4</sub>. (Heffter, Pogg. 86. 418.)

**Thallos antimonate, TlSbO<sub>3</sub>+2H<sub>2</sub>O=**

TlH<sub>3</sub>SbO<sub>4</sub>+H<sub>2</sub>O.

Somewhat sol. in H<sub>2</sub>O, when freshly precipitated; insol. when dried. (Beilstein and Blaesé.)

**Tin (stannous) antimonate, 2SnO, Sb<sub>2</sub>O<sub>3</sub>.**

Ppt. (Lensen, A. 114. 113.)

Sn(SbO<sub>3</sub>)<sub>2</sub>+2H<sub>2</sub>O. Attacked with difficulty by acids or alkalis, most easily by hot conc. H<sub>2</sub>SO<sub>4</sub>. (Schiff, A. 120. 55.)

2SnO, 3Sb<sub>2</sub>O<sub>3</sub>+4H<sub>2</sub>O.

SnO, 2Sb<sub>2</sub>O<sub>3</sub>.

**Tin (stannic) antimonate.**

Insol. in H<sub>2</sub>O. (Levol, A. ch. (3) 1. 504.)

**Uranium antimonate, 5UO<sub>3</sub>, 3Sb<sub>2</sub>O<sub>3</sub>+15H<sub>2</sub>O.**

Ppt. Sol. in hot conc. HCl+Aq, and in UCl<sub>3</sub>+Aq. (Rammelsberg.)

**Zinc antimonate, Zn(SbO<sub>3</sub>)<sub>2</sub>.**

Very slightly sol. in H<sub>2</sub>O (Berzelius); sol. in solutions of Zn salts.

+2H<sub>2</sub>O. (Ebel, Dissert. 1890.)

Insol. in H<sub>2</sub>O. (Senderens, Bull. Soc. 1899, (3) 21. 57.)

+5H<sub>2</sub>O. Not wholly insol. in cold, moderately sol. in hot H<sub>2</sub>O. (Ebel, Dissert. 1890.)

+6H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Senderens.)

**Antimoniomolybdic acid.**

**Ammonium antimoniomolybdate, 5(NH<sub>4</sub>)<sub>2</sub>O, 4Sb<sub>2</sub>O<sub>3</sub>, 7MoO<sub>3</sub>+12H<sub>2</sub>O.**

Readily sol. in hot H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 392.)

**Antimoniotungstic acid, 3Sb<sub>2</sub>O<sub>3</sub>, 4WO<sub>3</sub>+11H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Hallopeau, C. R. 1896, 123. 1068.)

**Potassium antimoniotungstate, 3K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>, 4WO<sub>3</sub>+4H<sub>2</sub>O.**

Much more sol. in hot than in cold H<sub>2</sub>O. Decomp. by HCl, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub>. (Hallopeau, C. R. 1896, 123. 1066.)

+16H<sub>2</sub>O. Much more easily sol. in hot than cold H<sub>2</sub>O. Decomp. by HCl, H<sub>2</sub>SO<sub>4</sub>, and HNO<sub>3</sub>. (Hallopeau, *l.c.*)  
 6K<sub>2</sub>O, 4Sb<sub>2</sub>O<sub>3</sub>, 12WO<sub>3</sub>+25H<sub>2</sub>O.  
 Sl. sol. in H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 392.)

### Antimoniuretted hydrogen.

See Antimony hydride.

### Antimonosomolybdic acid.

**Ammonium antimonosomolybdate**, 6(NH<sub>4</sub>)<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>, 17MoO<sub>3</sub>+21H<sub>2</sub>O.

Insol. in cold H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 313.)

### Antimonosophosphotungstic acid.

**Potassium antimonosophosphotungstate**, 12K<sub>2</sub>O, 5Sb<sub>2</sub>O<sub>3</sub>, 6P<sub>2</sub>O<sub>5</sub>, 22WO<sub>3</sub>+48H<sub>2</sub>O.

Nearly insol. in cold or warm H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 392.)

### Antimonosotungstic acid.

**Ammonium antimonosotungstate.**

Sol. in H<sub>2</sub>O.

**Barium antimonosotungstate**, 4BaO, 6Sb<sub>2</sub>O<sub>3</sub>, 22WO<sub>3</sub>+36H<sub>2</sub>O.

Precipitate; very sl. sol. in hot H<sub>2</sub>O. (Gibbs, Am. Ch. J. 7. 313.)

### Antimonous acid, HSbO<sub>3</sub>.

(Long, J. Am. Chem. Soc. 1895, 17. 87.)

+1½H<sub>2</sub>O. Ppt. (Schaffner, A. 51. 182.)

H<sub>2</sub>SbO<sub>3</sub>. Ppt. (Clarke and Stallo, B. 13. 1793.)

Does not exist. (Guntz, C. R. 102. 1472.)

H<sub>2</sub>SbO<sub>3</sub>. When freshly pptd., is sol. in dil. KOH, and NaOH+Aq. Scarcely sol. in NH<sub>4</sub>OH+Aq, or in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>, or KHCO<sub>3</sub>+Aq.

Completely sol. in K<sub>2</sub>CO<sub>3</sub>, and Na<sub>2</sub>CO<sub>3</sub>+Aq, especially if warm. When recently pptd. is sl. sol. in succinic acid+Aq.

**Calcium antimonite**, CaSb<sub>2</sub>O<sub>4</sub> (?).

Min. *Romeile*. Insol. in acids.

**Cobaltous antimonite** (?).

Sl. sol. in H<sub>2</sub>O. (Berzelius.)

**Cuprous antimonite**, Cu<sub>2</sub>(SbO<sub>3</sub>)<sub>2</sub>.

Insol. in H<sub>2</sub>O. Sol. in acids; most easily in conc. HCl+Aq. (Hausmann and Stromeyer, Schw. J. 19. 241.)

**Cupric antimonite** (?).

Insol. in H<sub>2</sub>O. (Berzelius.)

CuSb<sub>2</sub>O<sub>4</sub>. Min. *Ammiolite*.

CuSb<sub>2</sub>O<sub>4</sub>. Sol. in HCl+Aq, tartaric and citric acids. (Harding, Z. anorg. 1899, 20. 238.)

**Iron (ferrous) antimonite** (?).

More sol. in H<sub>2</sub>O than the antimonate. (Dumas.)

**Potassium antimonite**, K<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>.

Easily decomp. by cold H<sub>2</sub>O. Not decomp. by KOH+Aq containing over 20.9% K<sub>2</sub>O. (Corimimbœuf, C. R. 115. 1305.)  
 +3H<sub>2</sub>O. As above. (C.)

**Potassium antimonite iodide**, K<sub>2</sub>O, 8Sb<sub>2</sub>O<sub>3</sub>, 2KI.

Insol. and not decomp. by cold or hot H<sub>2</sub>O. Not decomp. by acids or alkalis. Aqua regia decomp. slowly. Tartaric acid dissolves gradually. (Grühl, Dissert. 1897.)

**Sodium antimonite**, NaSbO<sub>3</sub>+3H<sub>2</sub>O.

Difficultly sol. in H<sub>2</sub>O. (Terreil, A. ch. (4) 7. 380.)

2Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>+H<sub>2</sub>O. Decomp. by H<sub>2</sub>O, but not by NaOH+Aq containing 94.3 g. NaOH per l. (Corimimbœuf.)

Na<sub>2</sub>O, 2Sb<sub>2</sub>O<sub>3</sub>. Decomp. by H<sub>2</sub>O but not by NaOH+Aq containing 188.6 g. NaOH per l. (C.)

Na<sub>2</sub>O, 3Sb<sub>2</sub>O<sub>3</sub>. Decomp. by H<sub>2</sub>O, but not by NaOH+Aq containing 113.2 g. NaOH per l. (C.)

+2H<sub>2</sub>O=NaH<sub>2</sub>(SbO<sub>2</sub>)<sub>2</sub>. (Terreil.)

### Antimony, Sb.

Does not decomp. H<sub>2</sub>O. Not attacked by HCl+Aq (Berzelius); slowly sol. in conc. HCl+Aq (Debray); slowly sol. in conc. warm HCl+Aq (Troost). Attacked by very conc. HCl+Aq only when finely divided (Schützenberger, Willm); very sl. attacked by dil. or conc. acid (Guntz). Not attacked by boiling HCl+Aq (Gmelin). By careful experiments, pure Sb is absolutely insol. in dil. or conc., hot or cold HCl+Aq, except when in contact with oxygen. (Ditte and Metzner, A. ch. (6) 29. 889.)

Insol. in dil. or cold conc., but sol. in hot conc. H<sub>2</sub>SO<sub>4</sub>. Oxidized but not dissolved by HNO<sub>3</sub>+Aq. Easily and completely sol. in aqua regia.

Very slowly attacked by pure HNO<sub>3</sub>+Aq of 1.51–1.42 sp. gr.; weaker acid has no marked action whether it contains NO<sub>2</sub> or not. HCl+HNO<sub>3</sub> has no action if dil. or at low temp., but when even very dil. and KNO<sub>3</sub> is added, the action will begin. (Millon, A. ch. (3) 6. 101.)

Not attacked in 10 months by 2% HNO<sub>3</sub>+Aq. Sb is not dissolved by HNO<sub>3</sub>+Aq of any concentration, a white powder being always left, which is insol. in HNO<sub>3</sub>+Aq or H<sub>2</sub>O. (Montemartini, Gazz. ch. it. 22. 384.)

Insol. in alkalis+Aq.

Somewhat sol. in distilled H<sub>2</sub>O. More or less sol. in solutions of acids, alkalis and salts and in alcohol and ether. Only sl. sol. in a mixture of alcohol and ether. (Ruff and Albert, B. 1905, 38. 54.)

Alkaline H<sub>2</sub>O<sub>2</sub> converts Sb into antimonic acid, but neutral H<sub>2</sub>O<sub>2</sub> is without action. (Clark, Chem. Soc. 1893, 63. 886.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 826.)

Easily attacked by pyrosulphuryl chloride. (Heumann and Köchlin, B. 16. 479.)

Sb is sol. in a mixture of  $\text{HNO}_3$  and tartaric acid or other polybasic acids. (Czerwek, Z. anal. 1906, 45. 507.)

Not attacked by a mixture of alcohol and ether. (Cohen, Z. phys. Ch. 1904, 47. 12.)

$\frac{1}{2}$  cc. oleic acid dissolves 0.0007 g. Sb in 6 days. (Gates, J. phys. Ch. 1911, 15. 143.)

There are three modifications.

1. Ordinary gray metallic.

2. Black amorphous. Unstable at ord. temp. By boiling with  $\text{H}_2\text{O}$  is changed to metallic Sb.

3. Yellow. Very unstable. At  $-50^\circ$  goes over rapidly into the ordinary black modification. Sol. in  $\text{CS}_2$  at a little above  $-90^\circ$ . (Stock, B. 1903, 37. 898.)

Unstable above  $-90^\circ$ . (Stock, B. 1905, 38. 3837.)

**Antimony arsenide,  $\text{Sb}_2\text{As}_3$ .**

(Descamps, C. R. 86. 1065.)

**Antimony tribromide,  $\text{SbBr}_3$ .**

Deliquescent; decomp. by  $\text{H}_2\text{O}$ .

Very sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

Very sol. in warm liquid  $\text{AsBr}_3$ , forming a solution with sp. gr. = 3.685 at  $47^\circ$ . (Retgers, Z. phys. Ch. 1893, 11. 339.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

Easily sol. in  $\text{PCl}_3$  and  $\text{PBr}_3$ . (Walden, Z. anorg. 1900, 25. 211.)

Sol. in alcohol and  $\text{CS}_2$ .

Sol. in ether forming two layers. (Hayes, J. Chem. Soc. 1902, 24. 360.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Solubility of  $\text{SbBr}_3$  in organic liquids.

Data in parentheses indicate labile equilibrium.

Solvent	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100
Benzene	$5.6^\circ$	0	$65^\circ$	17.1	$91.5^\circ$	73.7
	4.5	1.9	75	24.9	90	76.7
	15	3.0	80	30.7	85	84.9
	25	4.3	85	38.4	90	91.4
	35	6.0	90	48.2	92	94.8
	45	8.6	91.5	58.1	94	100
	55	12.1	92.5	66.6		
Chlorobenzene	$-45.2^\circ$	0	$0^\circ$	7.2	$60^\circ$	37.6
	-47	1.7	10	9.2	70	50.0
	-40	2.2	20	11.8	80	66.6
	-30	3.2	30	15.4	90	89.6
	-20	4.3	40	20.8	94	100
Bromobenzene	$-31^\circ$	0	$15^\circ$	17.4	$75^\circ$	65.2
	-32	2.6	25	22.2	85	81.1
	-25	4.4	35	27.7	90	90.0
	-15	6.9	45	34.4	94	100
	-5	9.9	55	42.6		
	5	13.4	65	52.6		

Solubility of  $\text{SbBr}_3$  in organic liquids.—Cont.

Solvent	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100
Iodobenzene	$-28.6^\circ$	0	$10^\circ$	26.8	$70^\circ$	67.0
	$-30.5$	4.0	20	31.5	80	78.2
	-32	8.7	30	37.3	90	91.9
	$-20$	13.5	40	43.7	94	100
	-10	17.5	50	50.7		
	0	21.7	60	58.5		
Paradi-chlorobenzene	$54.5^\circ$	0	$65^\circ$	29.5	$85^\circ$	68.9
	51.5	6.3	70	37.0	90	85.2
	48.5	12.8	75	45.6	94	100
	55	18.7	80	56.2		
Paradi-bromobenzene	$88^\circ$	0	$65^\circ$	52.0	$90^\circ$	91.8
	85	6.8	70	59.1	92	95.4
	80	18.0	75	66.5	94	100
	75	29.5	80	74.4		
	70	41.5	85	83.0		
Nitrobenzene	$6^\circ$	0	$-5^\circ$	32.3	$55^\circ$	59.1
	1	8.6	5	35.3	65	66.4
	-4	17.0	15	38.8	75	74.9
	-9	24.0	25	42.8	85	86.0
	-15	29.7	35	47.4	90	93.0
	(-17)	(31.9)	45	53.8	94	100
Metadi-nitrobenzene	$90^\circ$	0	$55^\circ$	49.1	$70^\circ$	70.8
	85	8.1	50	53.0	75	76.0
	80	16.2	47.5	54.4	80	81.7
	75	24.2	50	56.1	85	87.8
	70	31.8	55	58.8	90	94.2
	65	38.5	60	62.2	94	100
	60	44.3	65	66.2		
Toluene	$-93^\circ$	0	$10^\circ$	28.8	$70^\circ$	69.4
	$-93.5$	0.3	20	36.7	80	79.4
	-70	1.2	30	47.5	85	85.2
	-50	2.6	(34)	(54.0)	90	92.6
	-30	5.2	40	51.5	94	100
	-10	13.3	50	56.3		
	-1	22.4	60	62.3		
Ethylbenzene	$-93^\circ$	0.1	$10^\circ$	9.8	$60^\circ$	59.8
	-60	0.4	20	19.5	70	67.4
	-40	1.0	25	28.6	80	77.4
	-20	2.3	29	37.8	85	85
	-10	3.9	40	44.6	90	92.6
	0	6.4	50	51.6	94	100
Propylbenzene	$-80^\circ$	0.4	(-1.5)	(33.3)	$50^\circ$	44.3
	-60	1.2	(-20)	(23.3)	60	51.5
	-40	3.4	0	25.8	70	61.5
	-30	5.5	10	27.8	80	73.5
	-20	9.5	20	30.5	90	90
	-10	17.2	30	34.1	94	100
	-5	24.3	40	38.6		
Isoamylbenzene	$-70^\circ$	1.9	(-13)	(24.9)	$50^\circ$	35.8
	-50	3.6	-10	17	60	43.3
	-40	5.1	0	18.2	70	54.0
	-30	7.1	10	19.9	80	68.5
	-20	13.4	20	22.5	90	90
	-17	16.4	30	25.9	94	100
	(-15)	(19.4)	40	30.3		

(Menschutkin, Ann. Inst. Pol. P. le Gr. 13. 1.)

**Antimony bromide with  $\text{MBr}$ .**

See Bromantimonate, M.

Also below.

**Antimony hydrogen bromide,  $\text{SbBr}_3 \cdot \text{HBr} + 3\text{H}_2\text{O}$ .**

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland and Feige, B. 1903, 36. 256.)

See Metabromantimonate acid.

**Antimony caesium bromide**,  $2\text{SbBr}_3 \cdot 3\text{CaBr} + 2\text{H}_2\text{O}$ .

Loses  $\text{Br}_2$  in the air. (Weinland, B. 1903, 36. 257.)

**Antimony calcium bromide**,  $\text{SbBr}_3 \cdot \text{CaBr}_2 + 8\text{H}_2\text{O}$ .

Easily decomp. (Benedict, Proc. Am. Acad. 1895, 30. 9.)

**Antimony glucinum bromide**,  $3\text{SbBr}_3 \cdot 2\text{GlBr}_3 + 18\text{H}_2\text{O}$ .

Hydroscopic. Easily decomp. (Weinland, B. 1903, 36. 258.)

**Antimony magnesium bromide**,  $\text{SbBr}_3 \cdot \text{MgBr}_2 + 8\text{H}_2\text{O}$ .

As Ca salt. (Benedict, Proc. Am. Acad. 1895, 30. 9.)

**Antimony potassium bromide**,  $10\text{SbBr}_3 \cdot 23\text{KBr} + 27\text{H}_2\text{O}$ .

(Herty, Am. Ch. J. 1894, 16. 496.)

**Antimony rubidium bromide**,  $2\text{SbBr}_3 \cdot 3\text{RbBr}$ .

Decomp. by  $\text{H}_2\text{O}$ ; can be recryst. from dil.  $\text{HBr} + \text{Aq.}$  (Wheeler, Z. anorg. 5. 258.)

$\text{SbRb}_2\text{Br}_3$ . Slowly loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1903, 36. 259.)

$10\text{SbBr}_3 \cdot 23\text{RbBr}$  (?). Cryst. from conc.  $\text{HBr} + \text{Aq.}$  (Wheeler.)

The composition assigned to this salt by Wheeler (Z. anorg. 5. 253) is incorrect. (Ephraim, B. 1903, 36. 1817.)

**Antimony vanadium bromide**,  $\text{SbBr}_3 \cdot \text{VBr}_3 + 7\text{H}_2\text{O}$ .

Hydroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and in tartaric acid. (Weinland, B. 1903, 36. 260.)

**Antimony bromide potassium chloride**,  $\text{SbBr}_3 \cdot 3\text{KCl} + 1\frac{1}{2}\text{H}_2\text{O}$ .

Slowly deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

Sat. solution contains 120.5 g. to 100 cc.  $\text{H}_2\text{O}$ , and has sp. gr. = 1.9.

Decomp. by much  $\text{H}_2\text{O}$ . (Atkinson, Chem. Soc. 43. 290.)

Does not exist. (Herty, Am. Ch. J. 1894, 16. 497.)

See also Antimony chloride potassium bromide.

**Antimony bromofluoride**,  $\text{SbF}_2\text{Br}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Ruff, B. 1906, 39. 4319.)

**Antimony trichloride**,  $\text{SbCl}_3$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  with precipitation of  $\text{SbOCl}$ . This precipitation is prevented by tartaric, citric, or hydrochloric acid, or by conc. solutions of chlorides of alkalis and alkaline earths.

Solubility in  $\text{H}_2\text{O}$ .  
100 pts.  $\text{SbCl}_3$  sol. in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_2\text{O}$
0°	16.6
15°	12.3
20°	10.9
25°	10.1
30°	9.4
35°	8.7
40°	7.3
50°	5.2
60°	2.2

(Meerburg, Z. anorg. 1903, 33. 299.)

Solubility in  $\text{HCl} + \text{Aq.}$   
100 mol.  $\text{H}_2\text{O}$  dissolve mol.  $\text{SbCl}_3$  in presence of mol.  $\text{HCl}$  at  $20^\circ$ .

Mol. $\text{HCl}$	Mol. $\text{SbCl}_3$
0	72.1–72.8
2.4	73.0
6.5	67.5
8.4	67.6
8.6	66.5
9.8	65.0
12.2	65.3
29.6	54.5

(Meerburg, Z. anorg. 1903, 33. 304.)

Solubility in  $\text{HCl} + \text{Aq.}$

Solid phase	100 mol. $\text{H}_2\text{O}$ dissolve at $20^\circ$			
	1	2	3	4
	Mol. $\text{SbCl}_3$	Mol. $\text{HCl}$	Mol. $\text{SbOCl}$	Mol. $\text{HCl}$
$\text{SbOCl}$	8.7	7.2	9.8	6.9
	8.6	7.5	16.1	7.9
	19.6	8.0	21.7	7.4
	19.8	8.9	25.0	8.8
			28.0	8.6
$(\text{SbOCl})_x(\text{SbCl}_3)_y$	37.5	8.7	32.0	7.9
	44.0	6.8	35.8	7.9
	63.7	6.2	59.5	6.4
	69.1	5.6	61.0	6.5
	66.1	4.6	62.7	4.4
	69.8	5.3		
$\text{SbCl}_3$ and $(\text{SbOCl})_x(\text{SbCl}_3)_y$	69.3	4.3		
	68.3	3.6		

1 & 2. (Meerburg, Z. anorg. 1903, 33. 302.)  
3 & 4. (Noodt, Z. anorg. 1903, 33. 302.)

Somewhat sol. in liquid  $(\text{CN})_2$ . (Centnerszwer, Bull. Soc. 1901, (3) 28. 405.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

Easily sol. in  $\text{PCl}_3$  and  $\text{PBr}_3$ . (Walden, Z. anorg. 1900, 25. 211.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29, 374.)

Sol. in alcohol without decomp. Very sol. in hot  $\text{CS}_2$ , but solubility diminishes rapidly on cooling. (Cooke, Proc. Am. Acad. 13, 72.)

1 g.  $\text{SbCl}_3$  is sol. in 0.186 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 2.216$ . (Naumann, B. 1904, 37, 4332.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37, 3601.)

1 pt. sol. in 16.97 pts. of ethyl acetate at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.7968$ . (Naumann, B. 1910, 43, 320.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol. in methylal. (Eidmann, C. C. 1899, II, 1014.)

Solubility of  $\text{SbCl}_3$  in organic liquids.  
Data in parentheses indicate labile equilibrium.

Solvent	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100
Benzene	$5.6^\circ$	0	$50^\circ$	27.2	$75^\circ$	78.5
	4	2.6	60	34.7	70	83.3
	1	7.1	70	45.2	62	89.3
	10	10.1	75	53.1	67.5	94.2
	20	13.1	77.5	58.7	73	100
	30	16.8	79	66.6		
	40	21.4	77.5	73.4		
Chlorobenzene	$-45.2^\circ$	0	$-10^\circ$	14.4	$30^\circ$	47.1
	-47	2.2	-5	19.4	40	56.2
	-40	3.6	0	28.1	50	66.6
	-30	6.0	(4)	(41.1)	60	78.7
	-20	9.0	10	32.5	70	94.3
	-15	11.6	20	38.7	73	100
Bromobenzene	$-31^\circ$	0	$-5^\circ$	21.7	$40^\circ$	59.2
	$-32.5^\circ$	3.4	0	26.6	50	68.8
	(-35)	(6.4)	3	31.8	60	80.6
	-30	4.8	(6)	(41.9)	65	87.2
	-25	7.6	(7)	(50.0)	70	95.0
	-20	10.7	10	36.4	73	100
	-15	14.1	20	43.2		
	-10	17.8	30	50.8		
Iodobenzene	$-28.6^\circ$	0	(-5)	(40.7)	$25^\circ$	53.9
	-30	2.4	$-34.5^\circ$	10.7	35	60.4
	(-35)	(11.7)	-25	16.4	45	67.5
	(-40)	(20.8)	-15	24.7	55	76.2
	(-45)	(27.2)	-5	39.1	65	87.4
	(-35)	(30.9)	(-3)	(47.2)	70	95.0
	(-25)	(33.9)	5	44.5	73	100
	(-15)	(37.2)	15	48.7		
Paradi-chlorobenzene	$54.5^\circ$	0	$39.5^\circ$	29.5	$60^\circ$	66.5
	50	6.3	45	37.5	65	78.1
	45	15.5	50	46.4	70	91.1
	40	28.0	55	56.0	73	100
Paradi-bromobenzene	$88^\circ$	0	$65^\circ$	45.4	$65^\circ$	87.1
	85	5.9	60	53.8	70	95.2
	80	15.8	49.5	64.9	73	100
	75	25.7	55	72.5		
	70	35.7	60	79.8		
Nitrobenzene	$6^\circ$	0	$-13.5^\circ$	27.3	$15^\circ$	59.2
	2	7.0	-10.5	29.8	25	63.0
	-2	12.1	-7.5	35.2	35	67.6
	-6	16.5	-0.5	40.7	45	72.8
	-10	20.3	-6	50.0	55	79.0
	-14	23.5	-6.5	52.8	65	87.2
	(-18)	(26.2)	-5	53.0	70	92.7
	-16.5	25.2	5	55.8	73	100

Solubility of  $\text{SbCl}_3$  in organic liquids—Cont.

Solvent	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100	$t^\circ$	Mols. per 100
Metadi-nitrobenzene	$90^\circ$	0	(-10)	(37.7)	(0)	(78.1)
	80	14.3	(10)	(62.4)	20	85.2
	70	25.3	(27.5)	(44.5)	30	88.8
	60	33.8	(28.5)	(50.0)	40	93.2
	40	45.6	27.5	55.0	50	97.5
	(20)	(53.0)	25	60.2	60	98.8
	(1)	(59.9)	(20)	(66.2)	70	99.2
	(-11)	(62.2)	(10)	(73.5)	73	100
Toluene	$-93^\circ$	0	$-10^\circ$	14.4	$40^\circ$	59.3
	-94	0.5	0	22.1	42.5	66.6
	-70	1.4	6	28.6	40	71.1
	-50	3.3	11	35.7	50	77.1
	-40	5.1	(-8)	(27.0)	60	83.8
	-30	7.2	20	40.5	70	94.7
	-20	10	30	47.6	73	100
Ethylbenzene	$-93^\circ$	0.1	$35^\circ$	36.4	(36.9)	(68.1)
	-50	0.6	39	50	(33)	(65.7)
	-30	1.1	37	57.7	40	70.3
	-10	3.6	35	61.8	50	77.3
	0	5.6	(33)	(65.7)	60	85.5
	10	9.4	(15)	(37.8)	65	90.3
	20	16.8	(25)	(47.5)	70	95.6
	30	27.2	37	66.6	73	100
Propylbenzene	(-70)	(0.6)	$-70^\circ$	0.2	$8.5^\circ$	53.2
	(-50)	(2.8)	-50	1.5	10	53.6
	(-40)	(5.2)	-40	3.0	20	56.9
	(-30)	(8.8)	-30	5.5	30	60.6
	(-20)	(14.8)	-20	9.7	40	65.5
	(-10)	(25.1)	-10	16.2	50	72
	(-5)	(32.4)	-5	20.5	60	81
Isoamylbenzene	(0)	(43.3)	0	26.2	65	86.8
	(1.5)	(50)	5	35.6	70	95.1
	(1)	(51.1)	7	41.6	73	100
	$-80^\circ$	3	(-45)	(17.1)	$0^\circ$	46.3
	-50	5.4	(-35)	(22.8)	10	48.8
	-60	8.4	-25	29.3	20	52.5
	-50	12.4	-15	36.6	30	57.3
	-40	17.9	-5	45.6	40	63.4
	(-30)	(27.3)	(0)	(52.3)	50	71.4
	(-25)	(34.4)	(5)	(60.3)	60	81.7
	(-22)	(40.7)	(7.5)	(66.6)	65	88
	(-20.5)	(50)	(-21)	(44.2)	70	95.5
	(-22)	(54)	(-10)	(44.9)	73	100

(Menschutkin, Ann. Inst. Pol. P.-le Gr., 13, 1.)

Antimony hydrogen trichloride,  $2\text{SbCl}_3$ ,  $\text{HCl}$  +  $2\text{H}_2\text{O}$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ .

Melts in crystal  $\text{H}_2\text{O}$  at  $16^\circ$ . (Engel, C. R. 106, 1797.)

Antimony pentachloride,  $\text{SbCl}_5$ .

Deliquesces to  $\text{SbCl}_3 + 4\text{H}_2\text{O}$ , which can be crystallized out of a little  $\text{H}_2\text{O}$ . Decomp. by more  $\text{H}_2\text{O}$  into  $\text{SbO}_2\text{Cl}$ . Sol. in a large amt. of  $\text{H}_2\text{O}$ , if it is added all at one time. Precipitation by  $\text{H}_2\text{O}$  is also hindered by presence of tartaric, or hydrochloric acid.

+  $\text{H}_2\text{O}$ . Deliquescent. Sol. in chloroform. (Anschütz and Evans, A. 239, 285.)

+  $4\text{H}_2\text{O}$ . Insol. in chloroform. (Anschütz and Evans.)

Antimony pentachloride with  $\text{MCl}$ .

See Chlorantimonate,  $\text{M}$ .  
See also below.

**Antimony hydrogen pentachloride**,  $\text{SbCl}_5$ ,  $\text{HCl} + 4\frac{1}{2}\text{H}_2\text{O}$ .

"*Metachlorantimonie acid*" according to Weinland and Schmid, (Z. anorg. 1905, 44. 43.)

Very easily sol. in  $\text{H}_2\text{O}$ , alcohol, acetone and glacial acetic acid. Aqueous solution decomp. on standing with separation of  $\text{Sb}_2\text{O}_3$ , but remains clear in presence of 10%  $\text{HCl}$ . (Weinland and Schmid, Z. anorg. 1905, 44. 43.)

$\text{SbCl}_5$ ,  $5\text{HCl} + 10\text{H}_2\text{O}$ . Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at about  $55^\circ$ . (Engel, C. R. 106. 1797.)

**Antimony antimonyl chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ .

More easily attacked by  $\text{H}_2\text{O}$  than  $\text{SbOCl}$ . (Bemmelen, Z. anorg. 1903, 33. 293.)

**Antimony antimonyl potassium chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ ,  $2\text{KCl}$ .

Not deliquescent. Immediately decomp. by hot or cold  $\text{H}_2\text{O}$ ; sol. in hot glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , or in  $\text{HCl}$ , or tartaric acid +  $\text{Aq}$ .

Insol. in  $\text{KCl} + \text{Aq}$ , hot or cold alcohol,  $\text{CS}_2$ , or ligroine. (Benedikt, Proc. Am. Acad. 29. 217.)

**Antimony antimonyl rubidium chloride**,  $\text{SbCl}_3$ ,  $\text{SbOCl}$ ,  $2\text{RbCl}$ .

Sol. in very dil.  $\text{HCl} + \text{Aq}$ . (Wells, Am. J. Sci. 1897, (4) 3. 463.)

**Antimony barium chloride**,  $\text{SbCl}_3$ ,  $\text{BaCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

**Antimony caesium chloride**,  $\text{SbCl}_3$ ,  $6\text{CsCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from dil.  $\text{HCl} + \text{Aq}$ . (Godeffroy, Arch. Pharm. (3) 12. 47.)

$2\text{SbCl}_3$ ,  $3\text{CsCl}$ . Decomp. by  $\text{H}_2\text{O}$ ; al. sol. in cold, easily in hot dil.  $\text{HCl} + \text{Aq}$ . This is identical with the above salt. (Saunders, Am. Ch. J. 14. 152.)

$\text{SbCl}_3$ ,  $2\text{CsCl}$ . Sol. in boiling conc.  $\text{HCl} + \text{Aq}$  without decomp. (Setterberg, Oef. Vet. Akad. 1882, 6. 23.)

$\text{SbCl}_3$ ,  $\text{CsCl}$ . Cryst. from  $\text{HCl} + \text{Aq}$  without decomp. Decomp. by  $\text{H}_2\text{O}$ . (Setterberg, Oef. Vet. Akad. 1882, 6. 27.)

**Antimony calcium chloride**,  $\text{SbCl}_3$ ,  $\text{CaCl}_2 + 8\text{H}_2\text{O}$ .

Easily decomp. (Benedikt, Proc. Am. Acad. 1895, 30. 9.)

$\text{SbCl}_3$ ,  $\text{CaSbCl}_6$ ,  $\text{OH} + 9\text{H}_2\text{O}$ . Deliquescent; al. sol. in  $\text{H}_2\text{O}$ . (Weinland, B. 1901, 34. 2635.)

**Antimony chromium chloride**,

$\text{CrCl}_3$ ,  $3\text{SbCl}_3 + 13\text{H}_2\text{O}$ . (Weinland.) should be

$[\text{SbCl}_4]_3[\text{Cr}(\text{OH})_3] + 7\text{H}_2\text{O}$ ;

and  $\text{CrCl}_3$ ,  $\text{SbCl}_3 + 10\text{H}_2\text{O}$  should be

$[\text{SbCl}_4]_3[\text{Cr}(\text{OH})_3\text{Cl}_3] + 6\text{H}_2\text{O}$ .

(Pfeiffer, Z. anorg. 1903, 36. 349.)

**Antimony glucinum chloride**,  $\text{SbCl}_3$ ,  $\text{GlCl}_2 + 3\text{H}_2\text{O}$ .

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Very easily sol. in  $\text{HCl}$ . (Ephraim, B. 1903, 36. 1822.)

$+4\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ . (Ephraim, B. 1903, 36. 1822.)

**Antimony hydrazine chloride**,  $\text{SbCl}_3$ ,  $3\text{N}_2\text{H}_4\text{Cl}$ .

Sol. in conc.  $\text{HCl} + \text{Aq}$ ; decomp. by  $\text{H}_2\text{O}$ . (Ferratini, C. A. 1912, 1613.)

**Antimony lithium chloride**,  $\text{SbCl}_3$ ,  $2\text{LiCl} + 5\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Very easily sol. in  $\text{HCl}$ . (Ephraim, B. 1903, 36. 1821.)

$+6\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl}$ . (Ephraim, B. 1903, 36. 1822.)

**Antimony magnesium chloride**,  $\text{SbCl}_3$ ,  $\text{MgCl}_2 + 5\text{H}_2\text{O}$ .

Hydroscopic. Decomp. by  $\text{H}_2\text{O}$ . Can be cryst. from  $\text{HCl}$  without decomp. (Ephraim, B. 1903, 36. 1823.)

$2\text{SbCl}_3$ ,  $\text{MgCl}_2$ . Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Very sol. in  $\text{HCl}$ . (Ephraim.)

$\text{SbCl}_3$ ,  $\text{MgSbCl}_6$ ,  $\text{MgOH} + 17\text{H}_2\text{O}$ . Hydroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, B. 1901, 34. 2635.)

**Antimony nitrosyl chloride**,  $\text{SbCl}_3$ ,  $\text{NOCl}$ .

Very deliquescent; decomp. by pure  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{O}$  containing tartaric acid. (Weber, Pogg. 123. 347.)

$2\text{SbCl}_3$ ,  $5\text{NOCl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Sudborough, Chem. Soc. 59. 661.)

**Antimony phosphorus chloride**,  $\text{SbCl}_3$ ,  $\text{PCl}_3$ .

Deliquescent. (Weber, Pogg. 125. 78.)

**Antimony phosphoryl chloride**,  $\text{SbCl}_3$ ,  $\text{POCl}_3$ .

Deliquescent. (Weber.)

**Antimony platinum potassium chloride**,

$(\text{Sb}, \text{Pt})\text{Cl}_6\text{K}_2$ .

Ppt. (Weinland, B. 1905, 38. 1086.)

**Antimony potassium chloride**,  $\text{SbCl}_3$ ,  $2\text{KCl}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Jacquelin, A. ch. (2) 66. 128.)

Not deliquescent. Immediately decomp. by hot or cold  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , or tartaric acid +  $\text{Aq}$ . (Benedikt, Proc. Am. Acad. 29. 219.)

$+2\text{H}_2\text{O}$ . Very efflorescent.

$\text{SbCl}_3$ ,  $3\text{KCl}$ . Deliquescent. Decomp. by hot  $\text{H}_2\text{O}$ . (Poggiale.)

$+2\text{H}_2\text{O}$ . (Romanis, C. N. 49. 273.)

Not obtained by Benedikt (*l.c.*)

$10\text{SbCl}_3$ ,  $23\text{KCl}$ . True composition of above salts. Sol. in  $\text{H}_2\text{O}$ . (Herty, Am. Ch. J. 1894, 16. 495.)

$\text{SbCl}_3$ ,  $2\text{KCl}$  is the only true compound, all



others being isomorphous mixtures. (Jordis, B. 1903, **36**, 2539.)

2SbCl<sub>3</sub>, 3KCl. Deliquescent. Decomp. by H<sub>2</sub>O. (Bosek, Chem. Soc. 1895, **67**, 516.)

SbCl<sub>3</sub>.K<sub>2</sub>SbCl<sub>5</sub>.KOH. Hydrosopic. Sol. in H<sub>2</sub>O with decomp. (Weinland, B. 1901, **34**, 2635.)

See also Antimony antimonyl potassium chloride.

**Antimony rubidium chloride**, SbCl<sub>3</sub>, RbCl.

Decomp. on air or with H<sub>2</sub>O. (Saunders, Am. Ch. J. **14**, 162.)

2SbCl<sub>3</sub>, RbCl + H<sub>2</sub>O. Decomp. on air. (Wheeler, Z. anorg. **5**, 253.)

SbCl<sub>3</sub>, 6RbCl. Decomp. by H<sub>2</sub>O. (Godefroy, Arch. Pharm. (3) **9**, 343.)

Formula is 10SbCl<sub>3</sub>, 23RbCl (?). (Saunders Am. Ch. J. **14**, 159.)

10SbCl<sub>3</sub>, 23RbCl (?). Decomp. by H<sub>2</sub>O; sol. in HCl + Aq. (Saunders.)

Formula is 3SbCl<sub>3</sub>, 7RbCl. (Wells and Foote, Am. J. Sci. 1897, (4) **3**, 461.)

Composition assigned to this salt by Saunders (Am. Ch. J. **14**, 155) is incorrect. (Ephraim, B. 1903, **36**, 1817.)

3SbCl<sub>3</sub>, 5RbCl. As above. (Saunders.)

Formula is 2SbCl<sub>3</sub>, 3RbCl. (Wheeler.)

Rb<sub>2</sub>SbCl<sub>5</sub>. Ppt. Decomp. by H<sub>2</sub>O. (Weinland, B. 1905, **38**, 1083.)

Rb<sub>2</sub>SbCl<sub>5</sub>, 2Rb<sub>2</sub>SbCl<sub>5</sub>. Ppt. Decomp. by H<sub>2</sub>O. (Weinland, B. 1901, **34**, 2635.)

**Antimony selenium chloride**, SbCl<sub>3</sub>, SeCl<sub>4</sub>.

Deliquescent. (Weber.)

**Antimony selenyl chloride**, SbCl<sub>3</sub>, SeOCl<sub>2</sub>.

Very deliquescent. (Weber, Pogg. **125**, 325.)

**Antimony sodium chloride**, SbCl<sub>3</sub>, 3NaCl (?).

Decomp. by much H<sub>2</sub>O. (Poggiale.)

**Antimony sulphur chloride**, 2SbCl<sub>3</sub>, 3SCl<sub>2</sub>.

Decomp. by H<sub>2</sub>O.

SbCl<sub>3</sub>, SCl<sub>4</sub>. Sol. in dil. HNO<sub>3</sub> + Aq.

Mpt. 125–126° in an atmos. of chlorine. Violently decomp. by H<sub>2</sub>O. (Ruff, B. 1904, **37**, 4515.)

**Antimony thallium chloride**, SbCl<sub>3</sub>, 3TlCl.

Ppt. (Ephraim, Z. anorg. 1909, **61**, 249.)

SbCl<sub>3</sub>, TlCl. (Ephraim and Barteczko, Z. anorg. 1909, **61**, 251.)

2SbCl<sub>3</sub>, 2TlCl, TlCl<sub>3</sub>. Slowly decomp. by cold H<sub>2</sub>O. (Ephraim and Barteczko, Z. anorg. 1909, **61**, 253.)

**Antimony trichloride ammonia**, SbCl<sub>3</sub>, NH<sub>3</sub>.

Not very deliquescent. Decomp. by H<sub>2</sub>O.

**Antimony pentachloride ammonia**, SbCl<sub>5</sub>, 6NH<sub>3</sub>.

Decomp. by H<sub>2</sub>O. (Persoz.)

**Antimony pentachloride cyanhydric acid**, SbCl<sub>5</sub>, 3HCN.

Deliquescent; decomp. by H<sub>2</sub>O. (Klein, A. **74**, 85.)

**Antimony pentachloride nitric oxide**, 2SbCl<sub>5</sub>, NO.

Decomp. by H<sub>2</sub>O. (Besson, C. R. **108**, 1012.)

**Antimony pentachloride nitrogen peroxide**, 3SbCl<sub>5</sub>, 2NO<sub>2</sub>.

Decomp. by H<sub>2</sub>O. (Besson.)

**Antimony pentachloride nitrogen sulphide**, SbCl<sub>5</sub>, N<sub>2</sub>S<sub>4</sub>.

Easily decomp. (Davis, Chem. Soc. 1906, **89**, 1577.)

Decomp. by cold H<sub>2</sub>O, HCl, H<sub>2</sub>SO<sub>4</sub> and warm alcohol, also by boiling with KOH + Aq. Almost insol. in organic solvents. (Wölbling, Z. anorg. 1908, **57**, 283.)

**Antimony chloride potassium bromide**, SbCl<sub>3</sub>, 3KBr + 1½H<sub>2</sub>O.

Very deliquescent. Decomp. by much H<sub>2</sub>O. (Atkinson, Chem. Soc. **45**, 289.)

2SbCl<sub>3</sub>, 3KBr + 2H<sub>2</sub>O. (Atkinson.)

SbCl<sub>3</sub>, KBr + H<sub>2</sub>O. (Atkinson.)

Above are mixtures. (Herty, Am. Ch. J. **1894**, **16**, 497.)

See Antimony bromide potassium chloride.

**Antimony chlorofluoride**, SbCl<sub>3</sub>F<sub>2</sub>.

(Swarts, Z. anorg. 1896, **12**, 71.)

**Antimony fluoiodide**, SbF<sub>3</sub>I.

Slowly decomp. by H<sub>2</sub>O. (Ruff, B. 1906, **39**, 4321.)

(SbF<sub>3</sub>)<sub>2</sub>I. Sol. in H<sub>2</sub>O with pptn. of I<sub>2</sub>. (Ruff, B. 1906, **39**, 4321.)

**Antimony trifluoride**, SbF<sub>3</sub>.

Deliquescent. Sol. in H<sub>2</sub>O.

Solubility in H<sub>2</sub>O at t°.

t°	100 g. of the solution contain g. SbF <sub>3</sub>	100 g. H <sub>2</sub> O contain g. SbF <sub>3</sub>
0°	79.37	384.7
20	81.64	444.7
22.5	81.91	452.8
25	83.12	492.4
30	84.93	563.6

(Rosenheim, Z. anorg. 1909, **61**, 189.)

Solubility in HF + Aq at 0°.

Normality of HF + Aq	100 g. H <sub>2</sub> O of the HF solution dissolve g. SbF <sub>3</sub>
2	474.9
1	432.5
0.5	404.0

(Rosenheim, Z. anorg. 1909, **61**, 192.)

Solubility of  $\text{SbF}_3$  in salts + Aq at  $0^\circ$ .

Salt	Normality of salt solution	100 g. H <sub>2</sub> O of the salt solution dissolve g. SbF <sub>3</sub>
KCl	1	461.8
	0.5	448.3
	0.25	431.9
	0.125	407.3
KBr	1	448.7
	0.5	450.0
	0.25	455.6
	0.125	417.2
KNO <sub>3</sub>	1	458.2
	0.5	451.9
	0.25	418.3
	0.125	401.4
$\frac{1}{2}$ K <sub>2</sub> SO <sub>4</sub>	1	419.9
	0.5	408.5
	0.25	406.6
$\frac{1}{2}$ K <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	1	465.7
	0.5	481.2
	0.25	451.3
	0.125	405.2
$\frac{1}{2}$ (NH <sub>4</sub> ) <sub>2</sub> C <sub>2</sub> O <sub>4</sub>	0.5	431.9
	0.25	442.3
	0.125	433.3
$\frac{1}{2}$ K <sub>2</sub> C <sub>4</sub> H <sub>4</sub> O <sub>6</sub>	1	461.4
	0.5	430.5
	0.25	430.8
	0.125	435.2

(Rosenheim, Z. anorg. 1909, 61. 192.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

**Antimony pentafluoride,  $\text{SbF}_5$ .**

Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. 145. 239.)  
 Very hygroscopic; bpt.  $155^\circ$ . Sol. in  $\text{H}_2\text{O}$  with hissing. (Ruff, B. 1904, 37. 678.)  
 $+2\text{H}_2\text{O}$ . (Ruff, B. 1904, 37. 679.)

**Antimony pentafluoride diantimony trifluoride,  $\text{Sb}_2\text{F}_{11} = 2\text{SbF}_5 \cdot \text{SbF}_3$ .**

Hygroscopic; bpt.  $390^\circ$ . Easily sol. in  $\text{H}_2\text{O}$ . (Ruff, B. 1904, 37. 680.)

**Antimony pentafluoride pentaantimony trifluoride,  $\text{SbF}_5 \cdot 5\text{SbF}_3$ .**

B pt.  $384^\circ$  (corr.). (Ruff, B. 1904, 37. 681.)

**Antimony caesium fluoride,**

$\text{CsF} \cdot 2\text{SbF}_5$ .  
 $\text{CsF} \cdot 3\text{SbF}_5$ .  
 $4\text{CsF} \cdot 7\text{SbF}_5$ .  
 $\text{CsF} \cdot \text{SbF}_5$ .  
 $2\text{CsF} \cdot \text{SbF}_5$ .  
 (Wells, Am. J. Sci. 1901, (4) 11. 451.)

**Antimony lithium fluoride,  $\text{SbF}_3 \cdot 2\text{LiF}$ .**

Sol. in more than 20 pts.  $\text{H}_2\text{O}$ . (Flückinger, Pogg. 87. 245.)

$\text{SbF}_3 \cdot \text{LiF}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Stein, Chem. Z. 13. 357.)

**Antimony potassium fluoride,  $\text{SbF}_3 \cdot 2\text{KF}$ .**

Sol. in less than 2 pts. boiling, and in 9 pts. cold  $\text{H}_2\text{O}$ . Insol. in alcohol or ether.

$\text{SbF}_3 \cdot \text{KF}$ . More sol. than  $\text{SbF}_3 \cdot 2\text{KF}$ . Sol. in 2.8 pts.  $\text{H}_2\text{O}$ . (Flückinger, Pogg. 87. 245.)

$\text{SbF}_3 \cdot \text{KF}$ . Easily sol. in  $\text{H}_2\text{O}$ .

$\text{SbF}_3 \cdot 2\text{KF} + 2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, A. 145. 239.)

**Antimony sodium fluoride,  $\text{SbF}_3 \cdot 3\text{NaF}$ .**

Sol. in 14 pts. cold, and 4 pts. boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{HF}$ . (Flückinger, Pogg. 87. 245.)

$\text{SbF}_3 \cdot \text{NaF}$ . 100 pts. cold  $\text{H}_2\text{O}$  dissolve 93 pts. 100 pts. hot  $\text{H}_2\text{O}$  dissolve 166 pts. (Stein, Wagners' J. B. 1887. 1160.)

$4\text{SbF}_3 \cdot \text{NaF}$ . As  $\text{NH}_3$  salt. (Raad and Hauser, B. 1890, 23. R. 125.)

$\text{SbF}_3 \cdot 2\text{NaF}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, A. 145. 329.)

**Antimony thallium fluoride,  $\text{TlF} \cdot \text{SbF}_3$ .**

Sol. in  $\text{H}_2\text{O}$  without decomp. (Ephraim, B. 1909, 42. 4458.)

$\text{TlF} \cdot 2\text{SbF}_3$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Ephraim.)

$\text{TlF} \cdot 3\text{SbF}_3$ . Sol. in  $\text{H}_2\text{O}$  without decomp. Decomp. by cold conc.  $\text{H}_2\text{SO}_4$ . (Ephraim.)

**Antimony trifluoride ammonia,  $\text{SbF}_3 \cdot 2\text{NH}_3$ .**

Sl. sol. in liquid  $\text{NH}_3$ . (Ruff, B. 1906, 39. 4326.)

**Antimony trifluoride ammonium chloride,  $\text{SbF}_3 \cdot \text{NH}_4\text{Cl}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (de Haen, B. 21. 901 R.)

**Antimony trifluoride ammonium sulphate,  $\text{SbF}_3 \cdot (\text{NH}_4)_2\text{SO}_4$ .**

More sol. than K or Na salt. 1 pt.  $\text{H}_2\text{O}$  dissolves 1.4 pts. at  $24^\circ$  and 15 pts. at  $100^\circ$ . (de Haen, B. 21. 902 R.)

**Antimony fluoride lithium chloride,  $\text{SbF}_3 \cdot \text{LiCl}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Stein, Chem. Z. 13. 357.)

**Antimony pentafluoride nitrosyl fluoride,  $\text{SbF}_5 \cdot \text{NOF}$ .**

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in liquid  $\text{NH}_3$  with decomp. Sl. sol. in  $\text{NOCl}$ ,  $\text{SiCl}_4$ ,  $\text{PCl}_5$ ,  $\text{AsCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{SOCl}_2$ . (Ruff, Z. anorg. 1908, 58. 334.)

**Antimony trifluoride potassium chloride,  $\text{SbF}_3 \cdot \text{KCl}$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 51 pts. at  $24^\circ$ , and 300 pts. at  $100^\circ$ . (de Haen, B. 21. 901 R.)

**Antimony trifluoride potassium sulphate,  $\text{SbF}_3, \text{K}_2\text{SO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (de Haen.)  
 $2\text{SbF}_3, \text{K}_2\text{SO}_4$ . Very sol. in  $\text{H}_2\text{O}$ . (Mayer, B. 1894, 27. R. 922.)

**Antimony trifluoride sodium chloride,  $\text{SbF}_3, \text{NaCl}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (de Haen, B. 21. 901 R.)

**Antimony trifluoride sodium sulphate,  $\text{SbF}_3, \text{Na}_2\text{SO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (de Haen.)

**Antimony fluoiodide,  $\text{SbFI}$ .**

Mpt.  $80^\circ$ ; slowly decomp. by  $\text{H}_2\text{O}$ . (Ruff, B. 1906, 39. 4321.)  
 $(\text{SbF}_2)_2\text{I}$ . Mpt.  $110-115^\circ$ ; decomp. by  $\text{H}_2\text{O}$ . (Ruff.)

**Antimony fluosulphide,  $\text{SbF}_2\text{S}$ .**

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. with decomp. in alcohol. Sol. in  $\text{CCl}_4$ . (Ruff, B. 1906, 39. 4322.)

**Antimony gold,  $\text{AuSb}$ .**

Insol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 72.)

**Antimony hydride,  $\text{SbH}_3$ .**

Scarcely sol. in  $\text{H}_2\text{O}$ . 1000 ccm.  $\text{H}_2\text{O}$  absorb 4.12 cc.  $\text{SbH}_3$  at  $10.5^\circ$ . Decomp. by long contact with  $\text{H}_2\text{O}$ ; also by conc.  $\text{H}_2\text{SO}_4$  or  $\text{KOH} + \text{Aq}$ . (Jones, Chem. Soc. 29. 641.)

**Antimony trihydroxide,  $\text{Sb}_2\text{O}_3, 2\text{H}_2\text{O} = \text{Sb}_2\text{O}(\text{OH})_4$ .**

(Schaffner, A. 51. 182.)  
 $\text{Sb}(\text{OH})_3$ . Ppt. (Clarke and Stolla, B. 13. 1787.)

Does not exist. (Guntz, C. R. 102. 1472.)  
 See Antimonous acid and antimony trioxide.

**Antimony triiodide,  $\text{SbI}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  or 80% alcohol. Sol. in  $\text{HI} + \text{Aq}$ ; sol. in boiling  $\text{CS}_2$ , and in boiling benzene, but separates out on cooling. Almost insol. in  $\text{CHCl}_3$ . (Cooke, Proc. Am. Acad. (2) 5. 72.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in warm  $\text{AsBr}_3$ . Sp. gr. of a solution sat. at  $40^\circ$ , which solidifies at  $37^\circ$ , = 3.720. This dissolves further  $\text{AsI}_3$ , whereby the mpt. sinks to  $31^\circ$  and sp. gr. rises to 3.801. By mixing the latter solution with a solution of  $\text{AsI}_3$  in  $\text{CH}_2\text{I}_2$ , a liquid can be obtained with a sp. gr. of 3.702 at  $20^\circ$ . (Retgers, Z. phys. Ch. 1893, 11. 340.)

Sol. in  $\text{PCl}_3$ . (Beckmann, Z. anorg. 1906, 51. 110.)

Sol. in  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 215.)

Sol. in  $\text{SOCl}_2$  and  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 216.)

Sol. in  $\text{AsCl}_3$ . (Walden, Z. anorg. 1900, 25. 214.)

Sol. in  $\text{SnCl}_4$ . (Walden, Z. anorg. 1900, 25. 218.)

Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)

Easily sol. in  $\text{PCl}_5$  and  $\text{PBr}_3$ . (Walden, Z. anorg. 1900, 25. 211.)

Partly sol. in, and partly decomp. by alcohol or ether. (M'Ivor, Chem. Soc. (2) 14. 328.)

Insol. in oil of turpentine and  $\text{CCl}_4$ .

100 pts. methylene iodide dissolve 11.3 pts.  $\text{SbI}_3$  at  $12^\circ$ ; sp. gr. of solution = 3.453. (Retgers, Z. anorg. 3. 343.)

Sol. in  $\text{C}_6\text{H}_6$ . (Retgers, Z. phys. Ch. 1893, 11. 334.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Antimony pentaiodide,  $\text{SbI}_5$ .**

Very unstable. (Pendleton, C. N. 48. 97.)

**Antimony barium iodide,  $\text{SbI}_3, \text{BaI}_2 + 9\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_2\text{H}_3\text{O}_4 + \text{Aq}$ .  $\text{CS}_2$  dissolves out  $\text{SbI}_3$ . (Schäffer, Pogg. 109. 611.)

**Antimony caesium iodide,  $2\text{SbI}_3, 3\text{CsI}$ .**

Sl. sol. in  $\text{HI} + \text{Aq}$ . Exists in two distinct forms. (Wells, Am. J. Sci. 1901, (4) 11. 455.)

**Antimony potassium iodide,  $2\text{SbI}_3, 3\text{KI} + 3\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_2\text{H}_3\text{O}_4 + \text{Aq}$ .  $\text{CS}_2$  dissolves out  $\text{SbI}_3$ . (Schäffer, Pogg. 109. 611.)

$\text{SbI}_3, 2\text{KI} + 2\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Nicklès, J. Pharm. (3) 39. 116.)

**Antimony rubidium iodide,  $2\text{SbI}_3, 3\text{RbI}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Wheeler, Z. anorg. 5. 259.)

**Antimony sodium iodide,  $2\text{SbI}_3, 3\text{NaI} + 12\text{H}_2\text{O}$ .**

As  $2\text{SbI}_3, 3\text{KI}$ . (Schäffer, Pogg. 109. 611.)

**Antimony thalious iodide,  $2\text{SbI}_3, 3\text{TlI}$ .**

Decomp. by  $\text{H}_2\text{O}$  and by  $\text{HCl} + \text{Aq}$ , also by alcohol. (Ephraim, Z. anorg. 1908, 58. 354.)

**Antimony nitride,  $\text{SbN}$ .**

Decomp. by heat. (Frans Fischer, B. 1910, 43. 1471.)

**Antimony trioxide,  $\text{Sb}_2\text{O}_3$ .**

Very al. sol. in  $\text{H}_2\text{O}$ . Sol. in 8900-10,000 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ ; 55,000-61,100 pts. at  $15^\circ$ . (Schulze, J. pr. (2) 27. 320.)

Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ , but not as insol. as metastannic acid. Sol. in cold fuming  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Insol. in dil., but sol. in conc. alkalies, or alkali carbonates +

Aq. Sol. in cold  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$  + Aq. Sol. in 15 pts. boiling  $\text{SbCl}_3$ . (Schneider, Pogg. 108. 407.)

Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq, and not pptd. from these solutions by  $\text{H}_2\text{O}$ . Easily sol. in benzoic acid. Insol. in pyrotartaric acid. Very sol. in  $\text{KHC}_4\text{H}_4\text{O}_6$  + Aq. Sol. in glycerine.

Somewhat sol. in  $\text{H}_3\text{PO}_4$  + Aq. (Köhler, Dingl. 1885, 258. 520.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

Sol. in lactic acid. (Kretschmar, Ch. Z. 1888, 12. 943.)

Sol. in grape sugar solution to which  $\text{Ca}(\text{OH})_2$  has been added. (Vogel, B. 1885, 18, R. 38.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Sol. in glycerine in presence of alkalies. (Köhler, Dingl. 1885, 258. 520.)

Exists in a sol. colloidal modification. (Spring, B. 16. 1142.)

Min. *Valentinite*, *Senarmontite*.

+  $\text{H}_2\text{O}$ . See Antimonous acid.

#### Antimony tetroxide, $\text{Sb}_2\text{O}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Slightly attacked by acids; hot conc.  $\text{HCl}$  + Aq acts only slightly. (Fresenius.)

Min. *Cervantite*. Sl. sol. in  $\text{HCl}$  + Aq.

#### Antimony pentoxide, $\text{Sb}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  + Aq. Sl. sol. in conc.  $\text{KOH}$  + Aq.

"Antimonoxyl" is sol. in glycerine in presence of alkalies.

100 g. glycerine, to which have been added 10 g.  $\text{NaOH}$  + Aq (1 : 1), dissolve 20.6 g. at b.-pt.; 20 g.  $\text{NaOH}$  + Aq (1 : 1), dissolve 36.0 g. at b.-pt.; 40 g.  $\text{NaOH}$  + Aq (1 : 1), dissolve 68.5 g. at b.-pt.; 80 g.  $\text{NaOH}$  + Aq (1 : 1), dissolve 93.0 g. at b.-pt.; 120 g.  $\text{NaOH}$  + Aq (1 : 1), dissolve 119.2 g. at b.-pt. (Köhler, Dingl. 258. 520.)

See also Antimonic acid.

#### Antimony nitrogen pentoxide, $2\text{Sb}_2\text{O}_5, \text{N}_2\text{O}_5$ .

Not decomp. by  $\text{H}_2\text{O}$ . (Thomas, C. R. 1895, 120. 1116.)

#### Antimony oxybromide.

See Antimonyl bromide.

#### Antimony oxychloride.

See Antimonyl chloride.

#### Antimony oxyfluoride.

See Antimonyl fluoride.

#### Antimony oxysulphide, $\text{Sb}_2\text{OS}_2$ .

Min. *Antimony blende* (*kermesite*).

Insol. in  $\text{H}_2\text{O}$  or dil. acids, except  $\text{HCl}$  + Aq. (Schneider, Pogg. 110. 147.)

#### Antimony palladium, $\text{Sb}_3\text{Pd}$ .

Sl. sol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 69.)

#### Antimony platinum, $\text{Sb}_3\text{Pt}$ .

Insol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 67.)

#### Antimony phosphide, $\text{SbP}$ .

Insol. in benzene, ether, or  $\text{CS}_2$ . (M'Ivor, B. 6. 1362.)

#### Antimony selenide, $\text{SbSe}$ .

(Chrétien, C. R. 1906, 142. 1341.)

$\text{Sb}_2\text{Se}_4$ . (Chrétien, l.c.)

$\text{Sb}_2\text{Se}_3$ . (Chrétien, l.c.)

$\text{Sb}_2\text{Se}_3$ . Sol. in  $\text{KOH}$  + Aq. (Hofacker, A. 107. 6.)

$\text{Sb}_2\text{Se}_3$ . (Hofacker.)

#### Antimony selenide, with M selenide.

See Selenoantimonates, M.

#### Antimony trisulphide, $\text{Sb}_2\text{S}_3$ (*Kermes*).

Insol. in  $\text{H}_2\text{O}$  and dil. acids.

1 l.  $\text{H}_2\text{O}$  dissolves  $5.2 \times 10^{-6}$  mols. pptd.  $\text{Sb}_2\text{S}_3$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Decomp. by conc.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{HCl}$  + Aq. Easily sol. in dil.  $\text{KOH}$ ,  $\text{NaOH}$ ,  $(\text{NH}_4)_2\text{S}$ , and  $\text{K}_2\text{S}$  + Aq. Sl. sol. in  $\text{NH}_4\text{OH}$  + Aq; very sl. sol. in  $(\text{NH}_4)_2\text{CO}_3$  + Aq; insol. in  $\text{KSH}$  + Aq. (Fresenius.)

Sol. in a mixture of 50 pts.  $\text{H}_2\text{O}$  and 18 pts.  $\text{HCl}$  (sp. gr. 1.16) even when completely sat. with  $\text{H}_2\text{S}$ . (Lang and Carson, J. Soc. Chem. Ind. 1902, 21. 1018.)

Sl. sol. in  $\text{H}_2\text{SO}_3$  + Aq. (Guerout, C. R. 1872, 75. 1276.)

Cryst.  $\text{Sb}_2\text{S}_3$  is only sl. sol. in  $\text{NH}_4\text{OH}$  + Aq (1 pt. in about 2000 pts.  $\text{NH}_3$ ).

Pptd. amorphous  $\text{Sb}_2\text{S}_3$  is appreciably more sol. (1 pt. in 600 pts.  $\text{NH}_3$ ). (Garot, J. pr. 1843, 29. 83.)

Sl. sol. in hot 2%  $\text{Na}_2\text{B}_4\text{O}_7$  + Aq, still less sol. in cold. (Materne, C. C. 1906, II. 557.)

Insol. in  $\text{NH}_4\text{Cl}$  + Aq.

Sol. in 14-15 pts. pure  $\text{SbCl}_3$ . (Schneider, Pogg. 108. 407.)

Slowly sol. in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq.

Sol. in boiling  $\text{Na}_2\text{SbS}_3$  + Aq.

Sol. in hot citric, tartaric and oxalic acids. Sl. sol. in malic, benzoic, picric and pyrogallic acids. Insol. in formic and acetic acids. Especially easily sol. in citric and oxalic acids with addition of  $\text{KNO}_3$ ,  $\text{KNO}_2$  or  $\text{KClO}_3$ . (Bolton, C. N. 1878, 37. 86 and 99.)

Sol. in ethylamine sulphhydrate + Aq.

Min. *Stibnite*. Sol. in cold citric acid + Aq. (Bolton, C. N. 37. 14.)

*Soluble modification.*  $\text{Sb}_2\text{S}_3$  may be obtained in a colloidal state in aqueous solution containing 1 pt.  $\text{Sb}_2\text{S}_3$  to 200 pts.  $\text{H}_2\text{O}$ . This can be boiled without decomp., but  $\text{Sb}_2\text{S}_3$  is pptd. by acids and salts.

Table of maximum dilution of solutions of acids and salts which cause pptn. of  $\text{Sb}_2\text{S}_3$ .

HCl	1 : 270
$\text{H}_2\text{SO}_4$	1 : 140
$\text{H}_2\text{C}_2\text{O}_4$	1 : 45
$\text{K}_2\text{SO}_4$	1 : 65
$(\text{NH}_4)_2\text{SO}_4$	1 : 130
$\text{MgSO}_4$	1 : 1720
$\text{MnSO}_4$	1 : 2060
NaCl	1 : 135
$\text{BaCl}_2$	1 : 2050
$\text{MgCl}_2$	1 : 5800
$\text{CoCl}_2$	1 : 2500
$\text{KNO}_3$	1 : 75
$\text{Fe}_2\text{Cl}_6$	1 : 2500
$\text{Ba}(\text{NO}_3)_2$	1 : 1250
$\text{K}_2\text{Al}_2(\text{SO}_4)_4$	1 : 35,000
$(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_4$	1 : 800
$\text{K}_2\text{Cr}_2(\text{SO}_4)_4$	1 : 40,000
$\text{KSbOC}_2\text{H}_3\text{O}_4$	1 : 18

(Schulze, J. pr. (2) 27. 320.)

**Antimony trisulphide with  $\text{M}_2\text{S}$ .**

See Sulphantimonites, M.

**Antimony pentasulphide,  $\text{Sb}_2\text{S}_5$ .**

Insol. in  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{S}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . Completely sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; traces dissolve in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ , or in alkali sulphides +  $\text{Aq}$ . Sol. in 50 pts. cold dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Geiger.)

Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Insol. in cold, but sol. in hot alkali carbonates +  $\text{Aq}$ . (Berzelius.)

Insol. in  $\text{Na}_2\text{SbS}_4 + \text{Aq}$ .

When boiled with alcohol, ether,  $\text{CS}_2$ , oil of turpentine, etc., portion of the S is dissolved out. (Berzelius.)

$\text{CS}_2$  dissolves about 5% of the sulphur. (Rammelsberg.)

**Antimony pentasulphide with  $\text{M}_2\text{S}$ .**

See Sulphantimonates, M.

**Antimony sulphochloride,  $\text{SbSCl}_2$ .**

Decomp. by moist air or  $\text{H}_2\text{O}$ . (Cloeze, A. ch. (3) 30. 374.)

$\text{SbS}_2\text{Cl}$ . Easily attacked by acids; insol. in  $\text{CS}_2$ . (Ouvrard, C. R. 116. 1516.)

$\text{Sb}_2\text{S}_3\text{Cl}$ . (Ouvrard.)

$2\text{SbSCl}$ ,  $3\text{Sb}_2\text{S}_3$ . Decomp. by dil.  $\text{HCl} + \text{Aq}$ . (Schneider.)

$\text{SbSCl}$ ,  $7\text{SbCl}_3$ . Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Schneider, Pogg. 108. 407.)

**Antimony sulphofluoride,  $\text{SbF}_2\text{S}$ .**

See Antimony fluosulphide.

**Antimony sulphoiodide,  $\text{SbSI}$ .**

Not attacked by  $\text{H}_2\text{O}$ , and decomp. only by conc. acids. Insol. in  $\text{CS}_2$ . (Schneider, Pogg. 110. 147.)

$\text{Sb}_2\text{S}_3\text{I}_6$ . (Henry and Garot.)

$\text{Sb}_2\text{S}_3\text{I}_3$ . Sol. in dry  $\text{CS}_2$ . Very easily decomp. (Ouvrard, C. R. 117. 108.)

**Antimony sulphur dioxide,  $\text{SbSO}_2$ .**

Ppt. (Faktor, C. C. 1900, I. 1211.)

**Antimony telluride,  $\text{SbTe}$ .**

Insol. in  $\text{H}_2\text{O}$ .

$\text{Sb}_2\text{Te}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Oppenheim, J. pr. 71. 277.)

**Antimonyl bromide,  $\text{SbOBr}$ .**

Insol. in  $\text{CS}_2$ . (Cooke, Proc. Am. Acad. 13. 104.)

Sl. sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

$\text{Sb}_2\text{O}_3\text{Br}_2$ . (M'Ivor, C. N. 29. 179.)

$10\text{Sb}_2\text{O}_3\text{Br}_3$ ,  $\text{SbBr}_3$ .

**Antimonyl chloride.**

From  $\text{SbCl}_2$ .  $\text{SbOCl}$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . Insol. in alcohol or ether; sol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , or  $\text{C}_6\text{H}_6$ . (Sabanajew, Zeit. Ch. 1871. 204.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 826.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$\text{Sb}_2\text{O}_3\text{Cl}_2$ . *Algaroth powder*. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$  (Cooke, Proc. Am. Acad. 13. 1); tartaric acid +  $\text{Aq}$ . (Schäffer, A. 152. 135.)

$\text{Sb}_2\text{O}_{11}\text{Cl}_2$ . (Cooke.)

$\text{Sb}_2\text{OCl}_2$ .

$\text{Sb}_2\text{O}_{10}\text{Cl}_2$ .

From  $\text{SbCl}_3$ .  $\text{SbOCl}_2$ . Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Daubrawa, A. 184. 118.)

Does not exist. (Anschütz and Evans, A. 239. 285.)

$\text{Sb}_2\text{OCl}_2$ . Deliquescent. Insol. in  $\text{CS}_2$ ; easily sol. in tartaric acid +  $\text{Aq}$ . (Williams, C. N. 24. 224.)

$\text{Sb}_2\text{O}_2\text{Cl}$ . (Williams.)

$\text{Sb}_2\text{O}_2\text{Cl}$ . Decomp. by hot  $\text{H}_2\text{O}$  into  $\text{HSbO}_3$ .

**Antimonyl fluoride.**

From  $\text{SbF}_3$ .  $\text{Sb}_2\text{O}_2\text{F}_4$ . Not deliquescent. (Flückiger, Pogg. 87. 249.)

**Antimonyl caesium fluoride,  $\text{SbF}_4\text{OH}$ ,  $\text{CsF}$ .**

(Wells, Am. J. Sci. 1901, (4) 11. 456.)

**Antimonyl sodium fluoride,  $\text{SbOF}_3$ ,  $\text{NaF} + \text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, A. 145. 239.)

**Antimonyl iodide,  $\text{Sb}_2\text{O}_2\text{I}_2$ .**

Difficultly sol. in solution of tartaric acid or tartrates. Decomp. by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in alkalis, or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ .

$\text{SbOI}$ . Insol. in  $\text{CS}_2$ . (Cooke, Proc. Am. Acad. (2) 5. 72.)

**Antimonyl sulphide.**

See Antimony oxyrsulphide.

**Argon, A.**

100 cc.  $H_2O$  dissolve 4.05 cc. argon at  $13.9^\circ$ . Critical t.— $121.6^\circ$  under 50.6 atmos. Bpt.— $186.9^\circ$ . Sp. gr. 19.9. (Rayleigh, C. N. 1895, 71. 51–62; 299–302; C. C. 1895. 467.)

Coefficient of absorption in  $H_2O$  at  $12^\circ = 0.0394$ ; at  $13.9^\circ = 0.0405$ . (Ramsay, Phil. Trans. 1895, 186. A. 225.)

**Absorption by  $H_2O$  at  $t^\circ$ .**

$t^\circ$	Coefficient of absorption
$0^\circ$	0.0561
10	0.0438
20	0.0379
30	0.0348
40	0.0338
50	0.0343

(Antropoff, Roy. Soc. Proc. 1910, 83. A. 480.)

**Absorption of argon by  $H_2O$  at  $t^\circ$  and 760 mm. pressure.**

$t^\circ$	Coefficient of absorption
$0^\circ$	0.05780
1	0.05612
5	0.05080
10	0.04525
15	0.04099
20	0.03790
25	0.03470
30	0.03256
35	0.03053
40	0.02865
45	0.02731
50	0.02567

(Estreicher, Z. phys. Ch. 1899, 31. 184.)

1 l.  $H_2O$  at  $38^\circ$  absorbs 25.7 cc. A.

1 l. blood absorbs 25.3 cc. A. (Regnard and Schloessing, C. R. 1897, 124. 303.)

Not absorbed by members of the fatty series of organic compounds; with members of the aromatic series absorption was observed varying from 8% of the volume employed for benzene to 1% for aniline. (Berthelot, C. R. 1899, 129. 71.)

**Arsenamide,  $As(NH_2)_3$ .**

Insol. in liquid  $NH_3$ . Decomp. by  $H_2O$ . (Hugot, C. R. 1904, 139. 55.)

**Arsenic, As.**

Unaltered by pure  $H_2O$ . Insol. in  $HCl + Aq$  if air is excluded, but sl. sol. in presence of air. Not attacked by dil.  $H_2SO_4 + Aq$ . Oxidized by conc.  $H_2SO_4$ ,  $HNO_3$ , or aqua regia. Not attacked at  $20^\circ$  by  $HNO_3$ , conc. or dil., or containing  $NO_2$ ; nor by  $HNO_3 + HCl$ , as long as they do not act on each other; but if treated with the above mixture in extremely dilute state, and a few drops of  $KNO_3 + Aq$

are added, the As is attacked at once. (Milon, A. ch. (3) 6. 101.)

Sol. in sea water; 0.009 mg. per liter off Brittany; 0.01 to 0.09 mg. per liter near Azores. (Gautier, C. R. 1903, 137. 232.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in liquid  $NH_3$ . (Hugot, A. ch. 1900, (7) 21. 31.)

Insol. in  $NaOH$ ,  $KOH$ , or  $NH_4OH + Aq$ .

Sol. in  $S_2Br_2$ . (Hannay, Chem. Soc. (2) 11. 823.)

Insol. in alcohol and ether.

Sol. in certain fatty oils.

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0032 g. As in 6 days. (Gates, J. phys. Ch. 1911, 15. 143.)

Yellow modification. Very unstable. (McLeod, C. N. 1894, 70. 139.)

Fairly stable in liquid air. (Thomson, Chem. Soc. 1906, 90. (2) 745.)

100 ccm.  $CS_2$  dissolve at:

$46^\circ$   $20^\circ$   $12^\circ$   $0^\circ$   $-15^\circ$   $-60^\circ$   
11 8 6 4 2.0–2.5 1.0 g. As.

Less sol. in benzene and ethyl acetate. (Erdmann, Z. anorg. 1902, 32. 448.)

**Arsenic acid.** See page 59.

**Arsenic bromide,  $AsBr_3$ .**

Decomp. by  $H_2O$ . Completely sol. in about 3 pts. boiling  $H_2O$ , and much less, in presence of  $HBr$ . (Wallace, Phil. Mag. (4) 17. 261.)

Sol. in  $CS_2$ .

Sol. in  $AlBr_3$ . (Isbekow, Z. anorg. 1913, 84. 26.)

Easily sol. in  $PCl_3$  and  $PBr_3$ . (Walden, Z. anorg. 1900, 25. 211.)

Sol. in  $S_2Cl_2$ . (Walden, Z. anorg. 1900, 25. 217.)

**Arsenic caesium bromide,  $2AsBr_3, 3CsBr$ .**

Decomp. by  $H_2O$ ; can be recryst. from conc.  $HBr + Aq$ . (Wheeler, Z. anorg. 4. 451.)

**Arsenic rubidium bromide,  $2AsBr_3, 3RbCl$ .**

As the corresponding Cs comp.

**Arsenic bromide ammonia,  $AsBr_3, 3NH_3$ .**

Decomp. by  $H_2O$ . (Besson, C. R. 110. 1258.)

**Arsenic bromide copper,  $2AsBr_3, 7Cu$ .**

Stable toward hot  $H_2O$ . Decomp. by  $KOH$ . (Hilpert and Herrman, B. 1913, 46. 2224.)

**Arsenic bromide silver,  $AsBr_3, 3Ag$ .**

Scarcely decomp. by cold  $H_2O$ . (Hilpert and Hermann.)

**Arsenic chloride,  $AsCl_3$ .**

Miscible with little  $H_2O$ , and with alcohol, ether, and volatile oils. Decomp. by much  $H_2O$ , or by boiling. (Gmelin.)

Miscible with oil of turpentine, and with olive oil. Somewhat sol. in  $\text{HCl} + \text{Aq}$ .

Easily sol. in  $\text{PCl}_5$  and  $\text{PBr}_5$ . (Walden, Z. anorg. 1900, **25**, 211.)

Sol. in liquid  $\text{CN}$ . (Centnerszwer, J. russ. phys. Ges. 1901, **33**, 545.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, **25**, 217.)

#### Arsenic pentachloride, $\text{AsCl}_5$ .

Fumes in the air with evolution of hydrogen chloride. Readily sol. in  $\text{CS}_2$ , and absolute ether cooled to  $-30^\circ$ . (Baskerville, J. Am. Chem. Soc. 1902, **24**, 1070.)

#### Arsenic caesium chloride, $2\text{AsCl}_3, 3\text{CsCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . 100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 0.429 pt. salt. (Wheeler, Z. anorg. **4**, 451.)

#### Arsenic iridium phosphorus chloride.

See Iridium phosphorus chloride arsenic chloride.

#### Arsenic rubidium chloride, $2\text{AsCl}_3, 3\text{RbCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . 100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 2.935 pts. salt. (Wheeler, Z. anorg. **4**, 451.)

#### Arsenic sulphur chloride, $2\text{AsCl}_3, 3\text{SCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rose.)

Above compound is a mixture. (Nilson, C. N. **81**, 81.)

#### Arsenic chloride ammonia, $2\text{AsCl}_3, 7\text{NH}_3$ .

Decomp. by cold  $\text{H}_2\text{O}$ , with evolution of  $\text{NH}_3$ . From the solution crystallizes  $\text{As}_2\text{Cl}_2, \text{N}_2\text{H}_{10}\text{O}_3$ .

Sol. in alcohol without decomp. (Rose, Pogg. **52**, 62.)

Composition is  $\text{AsCl}_3, 4\text{NH}_3$ . (Besson, C. R. **110**, 1258.)

#### Arsenic chloride copper, $2\text{AsCl}_3, 7\text{Cu}$ .

Somewhat decomp. by  $\text{H}_2\text{O}$ . Decomp. by  $\text{KOH}$ , or hot  $\text{HCl}$ . (Hilpert and Herrman, B. 1913, **46**, 2224.)

#### Arsenic chloride silver, $2\text{AsCl}_3, 7\text{Ag}$ .

$\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$  and  $\text{KOH}$  split off  $\text{Ag}$ . (Hilpert and Herrmann.)

#### Arsenic trifluoride, $\text{AsF}_3$ .

Sol. in  $\text{H}_2\text{O}$  with evolution of heat and decomposition. (Berzelius.)

Easily sol. in benzene. (Moissan, C. R. **99**, 874.)

Miscible with alcohol and ether. (M'Ivor, C. N. **30**, 169.)

#### Arsenic pentafluoride, $\text{AsF}_5$ .

Sol. in  $\text{H}_2\text{O}$ , alkalis +  $\text{Aq}$  and liquid  $\text{AsF}_3$ , with evolution of heat. Absorbed by ether, alcohol and benzene with evolution of heat. (Ruff, B. 1906, **39**, 67.)

#### Arsenic potassium fluoride, $\text{AsF}_5, \text{KF} + \frac{1}{2}\text{H}_2\text{O}$ .

$\text{AsF}_5, 2\text{KF} + \text{H}_2\text{O}$ .

$\text{AsF}_5, \text{AsOF}_3, 4\text{KF} + 3\text{H}_2\text{O}$ . (Marignac, A. **145**, 237.)

#### Arsenic fluoride ammonia, $2\text{AsF}_3, 5\text{NH}_3$ .

Easily decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. **110**, 1258.)

#### Arsenic pentafluoride nitrosyl fluoride, $\text{AsF}_5, \text{NOF}$ .

Decomp. by  $\text{H}_2\text{O}$ , fuming  $\text{HCl}$ ,  $\text{NaOH} + \text{Aq}$ , dry ether and dry alcohol with evolution of  $\text{NO}$ . Sol. in conc.  $\text{HNO}_3$ , hot conc.  $\text{H}_2\text{SO}_4$ , boiling  $\text{NOCl}$  and  $\text{AsF}_3$ . Insol. in  $\text{CCl}_4$  and  $\text{CS}_2$ . (Ruff, Z. anorg. 1908, **58**, 327.)

#### Arsenic trifluoride sulphur tetrachloride, $2\text{AsF}_3, \text{SCl}_4$ .

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$  and  $\text{NaOH}$ . Decomp. by thionyl chloride,  $\text{CCl}_4$ ,  $\text{CS}_2$ , abs. alcohol and ether. Decomp. by ligroin, benzene and toluene. (Ruff, B. 1904, **37**, 4520.)

#### Arsenic hydride, $\text{AsH}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$  and alkali hydrates +  $\text{Aq}$ , with subsequent decomposition.  $\text{H}_2\text{O}$  absorbs  $\frac{1}{4}$  vol.  $\text{AsH}_3$ . Decomp. by conc. acids. Absorbed rapidly by oil of turpentine, slightly by fixed oils, and not at all by alcohol, ether, or  $\text{KOH} + \text{Aq}$ . (Gmelin.)

Insol. in  $\text{KOH} + \text{Alcohol}$ . (Meissner.)

Not more sol. in alkaline solutions than in pure  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{AsH}_3$  Solid. Insol. in  $\text{H}_2\text{O}$ , alcohol, ether, and  $\text{CS}_2$ . (Wiederhold, Pogg. **118**, 615.)

Insol. in  $\text{H}_2\text{O}$ ; sol. in methylene iodide, xylene, or in conc.  $\text{KOH} + \text{Aq}$ . (Retgers, Z. anorg. **4**, 403.)

#### Arsenic hydride boron bromide, $\text{AsH}_3, \text{BBr}_3$ .

Easily decomp. Decomp. by  $\text{H}_2\text{O}$ . Appreciably sol. in  $\text{AsH}_3$  or  $\text{BBr}_3$ . Insol. in  $\text{CS}_2$ . (Stock, B. 1901, **34**, 949.)

#### Arsenic diiodide, $\text{As}_2\text{I}_4$ .

Decomp. by  $\text{H}_2\text{O}$  or alkalis; easily sol. in alcohol, ether, chloroform, or carbon disulphide. (Bamberger and Phillip, B. **14**, 2643.)

Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , or by cold fuming  $\text{HNO}_3$ . The latter oxidizes on warming. Decomp. by pyridine. Sol. in boiling acetic anhydride. (Hewitt and Winmill, Chem. Soc. 1907, **91**, 962.)

#### Arsenic triiodide, $\text{AsI}_3$ .

Sol. in 3.32 pts. boiling  $\text{H}_2\text{O}$ , and solution if boiled down deposits pure  $\text{AsI}_3$ , but if left to cool slowly, deposits crystals of  $\text{As}_2\text{O}_3$  and  $\text{AsOI}$ .

Sl. sol. in  $\text{HCl} + \text{Aq}$ .

Sol. in  $\text{POCl}_3$ ,  $\text{PCl}_5$  and  $\text{PBr}_5$ . (Walden, Z. anorg. 1900, **25**, 212.)

Sol. in  $\text{PCl}_5$ . (Beckmann, Z. anorg. 1906, 51. 110.)

Sol. in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$ , and  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 216.)

Sol. in  $\text{SnCl}_4$ . (Walden, l.c.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{AsCl}_3$ . (Walden, Z. anorg. 1900, 25. 214.)

Sol. in alcohol without decomp.

Sol. in ether, benzene, chloroform, and  $\text{CS}_2$ .

100 pts. methylene iodide dissolve 17.4 pts.  $\text{AsI}_3$  at  $12^\circ$ . (Retgers, Z. anorg. 3. 343.)

#### Arsenic pentaiodide, $\text{AsI}_5$ .

More or less sol. in  $\text{H}_2\text{O}$ , alcohol,  $\text{CHCl}_3$ , ether and  $\text{CS}_2$ . (Sloan, C. N. 1882, 46. 194.)

#### Arsenic caesium iodide, $2\text{AsI}_3$ , $3\text{CsI}$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{HI} + \text{Aq}$ . (Wheeler, Z. anorg. 4. 451.)

#### Arsenic rubidium iodide, $2\text{AsI}_3$ , $3\text{RbI}$ .

As the corresponding Cs comp.

#### Arsenic sulphur iodide.

See Arsenic sulphoiodide.

#### Arsenic triiodide ammonia, $2\text{AsI}_3$ , $9\text{NH}_3$ .

Insol. in benzene. (Bamberger and Phillip, B. 14. 2643.)

$\text{AsI}_3$ ,  $4\text{NH}_3$ . (Besson, C. R. 110. 1258.)

#### Arsenic nitride, $\text{As}_2\text{N}_3$ .

Easily decomp. into As and N. (Hugot, C. R. 1904, 139. 56.)

Decomp. by heat. (Franz Fischer, B. 1910, 43. 1471.)

#### Arsenic suboxide, $\text{As}_2\text{O}$ (?).

Insol. in  $\text{H}_2\text{O}$ ; decomp. by dil. acids or  $\text{NH}_4\text{OH} + \text{Aq}$ .

Does not exist. (Geuther, A. 240. 208.)

#### Arsenic trioxide, $\text{As}_2\text{O}_3$ .

"White arsenic" exists in two modifications:  $\alpha\text{As}_2\text{O}_3$ ,—crystalline, octahedral, opaque, porcelainous, etc.;  $\beta\text{As}_2\text{O}_3$ ,—amorphous, vitreous, "arsenic glass."

The data concerning the solubility of  $\text{As}_2\text{O}_3$  are very contradictory, the reasons being that (1) the solubility of the two modifications is different; (2) that the length of time necessary to effect solution differs in the two modifications; and (3) that there is a tendency of the amorphous  $\text{As}_2\text{O}_3$  to go over into the crystalline state during the process of solution.  $\alpha\text{As}_2\text{O}_3$  is also not easily moistened, especially when in a pulverulent condition, which is not the case with the  $\beta$  modification. (Winkler, J. pr. (2) 31. 247.)

The older data are very unreliable, but possess a certain historical interest.

1 pt.  $\text{As}_2\text{O}_3$  is sol. in 10.55 pts. (Wenzel); 11.34 pts. (Fischer); 11.86 pts. in  $\frac{1}{2}$  hour (Klaproth); 12.2 pts. (Bucholz); 15.0 pts. (Brandt; Bergman); 16.0 pts. (Vogel); 24 pts. (Lametherie); 40 pts. (Pörner); 64 pts.

(Baumé); 80 pts. (Navier); 200 pts. (Aschof and Nasse, 1812); 640 pts. (Hagen, 1798) boiling  $\text{H}_2\text{O}$ .

1 pt.  $\text{As}_2\text{O}_3$  is sol. in 7.72 pts.  $\text{H}_2\text{O}$  if  $\alpha$ , or 9.33 pts. if  $\beta$  (Guibort); in 24 pts.  $\text{H}_2\text{O}$  if  $\alpha$ , or 21 pts. if  $\beta$  (Taylor).

Sol. in 53.3 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abt.)

Sol. in 30 pts.  $\text{H}_2\text{O}$ . (Nussebrook.)

After the solution in  $\text{H}_2\text{O}$  at  $100^\circ$  has been left standing at ordinary temperatures—

1 pt.  $\text{As}_2\text{O}_3$  remains dissolved in 16 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 20 pts.  $\text{H}_2\text{O}$  at  $7^\circ$  (Bucholz); in 33 pts.  $\text{H}_2\text{O}$  at  $7^\circ$  (Klaproth); in 38.45 pts.  $\text{H}_2\text{O}$  after 3 days, 55 pts.  $\text{H}_2\text{O}$  after 8 days, 64.50 pts.  $\text{H}_2\text{O}$  after 2.3 weeks at  $10^\circ$  (Fischer); in 33.52 pts. if  $\alpha\text{As}_2\text{O}_3$  was used, 56.06 pts. if  $\beta\text{As}_2\text{O}_3$  was used (Guibort); in 38 pts. if  $\alpha\text{As}_2\text{O}_3$  after 6 months, 53.71 pts. if  $\beta\text{As}_2\text{O}_3$  after 48 hours (Taylor).

When an excess of pulverized  $\text{As}_2\text{O}_3$  is left to digest for several days with cold  $\text{H}_2\text{O}$ —

1 pt. dissolves in 50 pts. (Bucholz); in 66 pts. (Fischer); in 80 pts. at  $15^\circ$  (Bergman); in 80 pts. if  $\alpha$ , and 103 pts. if  $\beta$  (Guibort); 96 pts. at  $10^\circ$  (Spelman); 96 pts. at  $35.5^\circ$  (Hahnemann); 320 pts. (Hözel) at  $20^\circ$  (Aschof and Nasse, 1812.)

$\text{H}_2\text{O}$  at  $15.6^\circ$  or below dissolves less than  $\frac{1}{4}\%$   $\text{As}_2\text{O}_3$ . (Dalton.)

To dissolve 1 pt.  $\text{As}_2\text{O}_3$  in 12 pts.  $\text{H}_2\text{O}$ , it is necessary to boil an excess of  $\text{As}_2\text{O}_3$  with  $\text{H}_2\text{O}$ ; if 1 pt.  $\text{As}_2\text{O}_3$  is boiled with 12 pts.  $\text{H}_2\text{O}$ , considerable remains undissolved; and even with 1 pt.  $\text{As}_2\text{O}_3$  to 50–60 pts.  $\text{H}_2\text{O}$  long continued boiling is necessary to effect solution. If a clear solution saturated by long boiling with an excess of  $\text{As}_2\text{O}_3$  is poured off and evaporated continuously to  $\frac{1}{2}$  its original bulk, no  $\text{As}_2\text{O}_3$  separates out, and the solution contains 1 pt.  $\text{As}_2\text{O}_3$  to 6 pts.  $\text{H}_2\text{O}$ . (Fischer.)

100 pts. aqueous solution of  $\beta\text{As}_2\text{O}_3$  sat. at  $15^\circ$  contain 0.96 pt.  $\text{As}_2\text{O}_3$ , and 9.68 pts. when sat. at  $100^\circ$ . (Guibort.)

If 1 pt. pulverized  $\text{As}_2\text{O}_3$  be digested 10 days at  $10$ – $25^\circ$  in 5–10 pts.  $\text{H}_2\text{O}$ , the solution contains 1 pt.  $\text{As}_2\text{O}_3$  to 50 pts.  $\text{H}_2\text{O}$ . A solution of same strength is obtained in 25 days by digesting 1 pt.  $\text{As}_2\text{O}_3$  in 40 pts.  $\text{H}_2\text{O}$ . If 1 pt.  $\text{As}_2\text{O}_3$  be immersed in 80 pts.  $\text{H}_2\text{O}$ , the resulting solution contains 1 pt.  $\text{As}_2\text{O}_3$  to 90 pts.  $\text{H}_2\text{O}$ ; if in 160 pts.  $\text{H}_2\text{O}$ , 1 pt.  $\text{As}_2\text{O}_3$  to 180 pts.  $\text{H}_2\text{O}$ ; if in 240 pts.  $\text{H}_2\text{O}$ , 1 pt.  $\text{As}_2\text{O}_3$  to 280 pts.  $\text{H}_2\text{O}$ ; if in 1000 pts.  $\text{H}_2\text{O}$ , 1 pt.  $\text{As}_2\text{O}_3$  to 1200 pts.  $\text{H}_2\text{O}$ ; and even when 1 pt.  $\text{As}_2\text{O}_3$  is digested at ordinary temperatures for several days with 16,000–100,000 pts.  $\text{H}_2\text{O}$ , a portion remains undissolved. Pulverized  $\alpha\text{As}_2\text{O}_3$  was set aside with  $\text{H}_2\text{O}$  in closed bottles for 18 years; when 1 pt.  $\text{As}_2\text{O}_3$  was present in 1000 pts.  $\text{H}_2\text{O}$ , a perfect solution was obtained; when 1 pt.  $\text{As}_2\text{O}_3$  in 100 pts.  $\text{H}_2\text{O}$ , 0.017%  $\text{As}_2\text{O}_3$  was undissolved; when 1 pt.  $\text{As}_2\text{O}_3$  in 35 pts.  $\text{H}_2\text{O}$ , 0.35%  $\text{As}_2\text{O}_3$  was undissolved, so that the solution contained 1 pt.  $\text{As}_2\text{O}_3$  to 54 pts.  $\text{H}_2\text{O}$ . (Gmelin.)

Porcellaneous modification ( $\alpha\text{As}_2\text{O}_3$ ) is much more sol. in  $\text{H}_2\text{O}$  than the vitreous ( $\beta\text{As}_2\text{O}_3$ ). 100 pts.  $\text{H}_2\text{O}$  at ordinary temperature dissolve 0.96 pt.  $\beta\text{As}_2\text{O}_3$  and 1.25 pts.  $\alpha\text{As}_2\text{O}_3$ ; 100 pts. boiling  $\text{H}_2\text{O}$  dissolve 9.68 pts.  $\beta\text{As}_2\text{O}_3$  and 11.47 pts.  $\alpha\text{As}_2\text{O}_3$ ; and when the temperature of this solution has fallen to  $15^\circ$ , the solution from  $\beta\text{As}_2\text{O}_3$  retains 1.78 pts., and that from  $\alpha\text{As}_2\text{O}_3$  retains 2.9 pts. (Berzelius [citing Guibort].)

$\beta\text{As}_2\text{O}_3$  dissolves more quickly and abundantly than  $\alpha\text{As}_2\text{O}_3$ . The same amount  $\text{H}_2\text{O}$  which will take up 36–38 pts.  $\beta\text{As}_2\text{O}_3$  at  $12$ – $13^\circ$  will dissolve only 12–14 pts.  $\alpha\text{As}_2\text{O}_3$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 4 pts.  $\beta\text{As}_2\text{O}_3$  and 1.2–1.3 pts.  $\alpha\text{As}_2\text{O}_3$ . By long boiling with  $\text{H}_2\text{O}$ ,  $\alpha\text{As}_2\text{O}_3$  is converted into  $\beta\text{As}_2\text{O}_3$ , and thus acquires the solubility of the latter, so that 100 pts. boiling  $\text{H}_2\text{O}$  can take up 11 pts.  $\text{As}_2\text{O}_3$ . But at low temperature  $\beta\text{As}_2\text{O}_3$  is converted into  $\alpha\text{As}_2\text{O}_3$  when in contact with  $\text{H}_2\text{O}$ , so that the solution becomes weaker after a while, and retains only the proportion of  $\text{As}_2\text{O}_3$  corresponding to the solubility of  $\alpha\text{As}_2\text{O}_3$ . Communion, which hastens the rate of solubility of  $\alpha\text{As}_2\text{O}_3$ , without increasing the amount dissolved, diminishes the solubility of  $\beta\text{As}_2\text{O}_3$ , as this is converted into  $\alpha\text{As}_2\text{O}_3$ .



by the friction or contact with  $\text{H}_2\text{O}$ .  $\text{As}_2\text{O}_3$ , which has been rendered opaque by  $\text{NH}_4\text{OH}$ , and that which has been crystallized from an aqueous solution, are equally sol. in  $\text{H}_2\text{O}$ . (Bussy, C. R. 24. 774; A. 64. 286.)

100 pts.  $\text{H}_2\text{O}$  dissolve 1.707 pts.  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{2}$  years; 100 pts. boiling  $\text{H}_2\text{O}$  dissolve 11.46 pts.  $\beta\text{As}_2\text{O}_3$  in 3 hours, and 11.86 pts. in 12 hours; 10.14 pts.  $\alpha\text{As}_2\text{O}_3$  in 3 hours, and 10.18 pts. in 12 hours. (Rose, Ann. Phys. (1) 36. 494.)

A cold sat. solution which stood over excess of  $\text{As}_2\text{O}_3$  for 10 months at  $10-20^\circ$  contains 1.2%  $\text{As}_2\text{O}_3$ ; hot sat. solution a few days after saturation contains 2.25-2.50%  $\text{As}_2\text{O}_3$ . If trace of  $\text{HCl}$  is present, the solution contains 3.8%  $\text{As}_2\text{O}_3$ . Hot sat. solution of porcelain mod. of  $\text{As}_2\text{O}_3$  contains 4 days after saturation 2.4%  $\text{As}_2\text{O}_3$  at  $24^\circ$ ; after 82 days at  $14^\circ$ , 1.5%; after 4 months at  $12^\circ$ , 1.3%  $\text{As}_2\text{O}_3$ . (Bacalogo, J. pr. 83. 111.)

According to later experiments, 1 pt.  $\alpha\text{As}_2\text{O}_3$  dissolves in 355 pts.  $\text{H}_2\text{O}$  in 1 day at  $15^\circ$ , while 1 pt.  $\beta\text{As}_2\text{O}_3$  dissolves in 108 pts.  $\text{H}_2\text{O}$  under the same conditions. 1 pt.  $\alpha\text{As}_2\text{O}_3$  dissolves in 46 pts.  $\text{H}_2\text{O}$ , if solution is prepared at  $100^\circ$ , and allowed to stand 24 hours at  $15^\circ$ , while 1 pt.  $\beta\text{As}_2\text{O}_3$  dissolves in 30 pts.  $\text{H}_2\text{O}$  under the same conditions. (Büchner, N. Rep. Pharm. 22. 265.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\alpha\text{As}_2\text{O}_3$  and  $\beta\text{As}_2\text{O}_3$  at ordinary temperature:

Time	$\alpha\text{As}_2\text{O}_3$	$\beta\text{As}_2\text{O}_3$
1 hour	0.023	1.589
3 hours	0.088	2.356
6 hours	0.353	3.666
12 hours	0.364	3.361
24 hours	0.956	3.306
2 days	1.627	2.629
4 days	1.814	2.429
1 week	1.673	1.763
3 weeks	1.776	1.713
$2\frac{1}{4}$ years	1.712	1.707

In the solution of  $\beta\text{As}_2\text{O}_3$ , octahedral crystals were deposited on the sides of the vessel after 12 hours, which continued to increase. There was no such deposit in the case of  $\alpha\text{As}_2\text{O}_3$ .

From the maxima in the above table, 100 pts.  $\text{H}_2\text{O}$  can dissolve 3.7 pts.  $\beta\text{As}_2\text{O}_3$  and 1.7 pts.  $\alpha\text{As}_2\text{O}_3$  at ordinary temperature.

100 pts. boiling  $\text{H}_2\text{O}$  dissolve 11.46 pts.  $\beta\text{As}_2\text{O}_3$  and 10.140 pts.  $\alpha\text{As}_2\text{O}_3$  in 3 hours; 11.86 pts.  $\beta\text{As}_2\text{O}_3$  and 10.176 pts.  $\alpha\text{As}_2\text{O}_3$  in 12 hours. (Cl. Winkler, J. pr. (2) 31. 247.)

100 pts.  $\text{H}_2\text{O}$  dissolve 1.75 pts. of a third modification (hexagonal crystalline) at ordinary temperature, and 2.75 pts. at  $100^\circ$ . (Claudet, Chem. Soc. (2) 6. 179.)

$\beta\text{As}_2\text{O}_3$  dissolves more rapidly in  $\text{HCl} + \text{Aq}$  than  $\alpha\text{As}_2\text{O}_3$ . (Schultz-Sellac, B. 4. 109.)

While 100 ccm.  $\text{H}_2\text{O}$  dissolve 0.8507 g.  $\beta\text{As}_2\text{O}_3$  at  $18.5^\circ$ , 100 ccm.  $\text{H}_2\text{O}$  containing 1.3195 g.  $\text{HCl}$  dissolve 1.1513 g.  $\beta\text{As}_2\text{O}_3$ ; containing 6.09 g.  $\text{HCl}$ , 1.2724 g.  $\beta\text{As}_2\text{O}_3$ . (Chodounsky, Listy Chemické, 13. 114.)

100 ccm.  $\text{H}_2\text{O}$  dissolve 1.495 g.  $\text{As}_2\text{O}_3$  at  $15^\circ$ . (Wood, Chem. Soc. 1908, 93. 412.)

Solubility of crystalline  $\text{As}_2\text{O}_3$  in  $\text{H}_2\text{O}$ .

1 l. of the sat. solution contains at:

$2^\circ$   $15^\circ$   $25^\circ$   $39.8^\circ$  bpt.  
12.006 16.566 20.384 29.302 60+g.  $\text{As}_2\text{O}_3$   
(Bruner, Z. anorg. 1903, 37. 456.)

Much more easily sol. in many acids than in  $\text{H}_2\text{O}$ . Easily sol. in fuming  $\text{H}_2\text{SO}_4$ . (Schultz-Sellac.)

100 pts. dilute  $\text{H}_2\text{SO}_4 + \text{Aq}$  of various strengths dissolve at  $t^\circ$ .

$t^\circ$	Pts. $\beta\text{As}_2\text{O}_3$	$t^\circ$	Pts. $\beta\text{As}_2\text{O}_3$	Ratio of amts. dissolved at $80^\circ : 18.5^\circ$
$80^\circ$	1.0195	$18.5^\circ$	0.5422	1.88 : 1
..	1.3664	....	0.7203	1.89 : 1
..	1.1933	....	0.6522	1.84 : 1

(Chodounsky, l.c.)

Decomp. by  $\text{HNO}_3$  or aqua regia into  $\text{As}_2\text{O}_5$ . Sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Bergman.)

More sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$ , and still less in  $\text{HCl}, \text{H}_2\text{SO}_4 + \text{Aq}$ . Solubility in  $\text{HCl} + \text{Aq}$ .

Conc. of $\text{HCl} + \text{Aq}$	Grams of $\text{As}_2\text{O}_3$ per 100 cc. of solution
0.46N	1.52
0.98N	1.41
2.03N	1.17
3.13N	1.11
3.81N	1.13
5.32N	2.20
6.50N	5.11
7.85N	12.28
9.17N	18.16

As the concentration of the acid increases, the solubility of the oxide decreases, a minimum being reached when the concentration of the solvent is about 3.2N. Beyond this point, an increase in the concentration of the solvent leads to a corresponding increase in the solubility. (Wood, Chem. Soc. 1908, 93. 413.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Easily sol. in cold  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . (Bergman.)

When pulverized, it dissolves in hot  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ , but separates out on cooling.

Easily sol. in hot benzoic acid +  $\text{Aq}$ .

Sol. in tartaric acid +  $\text{Aq}$ .

Easily sol. in alkali hydrates, or carbonates +  $\text{Aq}$ .

Easily sol. in  $\text{NH}_4$  arsenite + Aq. at  $70-80^\circ$ , crystallizing out on cooling. (Berzelius.)

Sol. in hot  $\text{K}_2\text{C}_2\text{O}_4$  + Aq.

Sol. in  $\text{AsCl}_3$ . (Penney and Wallace.)

More sol. in  $\text{Na}_2\text{B}_2\text{O}_7$  + Aq. than in  $\text{H}_2\text{O}$ .

Very al. sol. in absolute alcohol. (Vogel.)

Sol. in 80 pts. highly rectified spirit. (Wensel.)

When 1 pt. powdered  $\text{As}_2\text{O}_3$  is digested 30 days in 10-40 pts. alcohol, a solution is formed containing 1 pt.  $\text{As}_2\text{O}_3$  to 80 pts. alcohol; when 1 pt.  $\text{As}_2\text{O}_3$  is digested with 60-160 pts. alcohol, a solution is formed containing 1 pt.  $\text{As}_2\text{O}_3$  to 124-140 pts. alcohol. (Fischer.)

Sol. in 70-80 pts. alcohol. (Thompson.)

Alcohol dissolves 0.446 pt.  $\beta\text{As}_2\text{O}_3$ . (Rose, A. Phys. (1) 52. 455.)

100 pts. alcohol dissolve pts.  $\text{As}_2\text{O}_3$ :

Vol. % of alcohol	$\alpha\text{As}_2\text{O}_3$ at $15^\circ$	$\alpha\text{As}_2\text{O}_3$ at b.-pt. of alcohol	$\beta\text{As}_2\text{O}_3$ at $15^\circ$
56	1.680	4.895	0.504
79	1.430	4.551	0.540
84	.....	.....	0.565
86	0.715	3.197	.....
88	.....	.....	0.717
100	0.025	3.402	1.060

(Girardin, J. Pharm. (3) 46. 269.)

100 pts. absolute alcohol dissolve 0.446 pt.  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{4}$  years. (Winkler, J. pr. (2) 31. 347.)

Nearly insol. in ether.

100 pts. ether dissolve 0.454 pt.  $\beta\text{As}_2\text{O}_3$ . (Winkler.)

Ether extracts 1 mg.  $\text{As}_2\text{O}_3$  from sat.  $\text{As}_2\text{O}_3$  + Aq. for every 15 cc. ether used; less is extracted when the solution is acidified with  $\text{HCl}$ , and almost none if acidified with  $\text{H}_2\text{SO}_4$  or  $\text{H}_2\text{C}_4\text{O}_4$ . (Selmi, B. 13. 206.)

$\alpha\text{As}_2\text{O}_3$  is sol. in 50 pts. boiling nitrobenzol.  $\beta\text{As}_2\text{O}_3$  is insol. in boiling nitrobenzol. (Auerbach, Z. anorg. 1903, 37. 353.)

$\beta\text{As}_2\text{O}_3$  dissolves in oil of turpentine, but  $\alpha\text{As}_2\text{O}_3$  is insol. therein.  $\alpha\text{As}_2\text{O}_3$  is very al. sol. in benzene or petroleum ether, but more sol. in methyl alcohol, ethyl alcohol, ether, or chloroform. (Selmi.)

100 pts.  $\text{CS}_2$  dissolve 0.001 pt.  $\beta\text{As}_2\text{O}_3$  in  $2\frac{1}{4}$  years. (Winkler.)

Sl. sol. in the fatty oils.

1000 pts. castor-oil dissolve 1.33 pts.  $\text{As}_2\text{O}_3$  at ordinary temperature, and 9 pts. at boiling temperature. 1000 pts. other oils dissolve 0.6-0.8 pt.  $\text{As}_2\text{O}_3$  in the cold, and about 1.7 pts. on boiling. (Berzelius.)

Insol. in chinoline or aniline. (Hoffmann, A. ch. (3) 9. 143, 169.)

Moderately sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329); (Eidmann, C. C. 1899, II. 1014.)

Sol. in amyl alcohol and is divided between it and  $\text{H}_2\text{O}$  in the constant ratio of 1 : 5.47 at  $25^\circ$ . (Auerbach, Z. anorg. 1903, 37. 376.)

Min. *Arsenolite*.

**Arsenic trioxide pentoxide**,  $3\text{As}_2\text{O}_3$ ,  $2\text{As}_2\text{O}_5$  +  $3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Joly, C. R. 100. 1221.)

$2\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Joly.)

$\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . (Joly.)

**Arsenic tetroxide**,  $\text{As}_2\text{O}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$  from which it is partially pptd. by alcohol. More easily sol. in alkali carbonates or  $\text{HCl}$  + Aq. Most easily sol. in  $\text{NaOH}$  or  $\text{KOH}$  + Aq. (Herbst, Dissert. 1894.)

**Arsenic pentoxide**,  $\text{As}_2\text{O}_5$ .

Deliquescent in moist air; slowly sol. in  $\text{H}_2\text{O}$ , forming  $\text{H}_3\text{AsO}_4$ , which see. Easily sol. in alcohol; much more sol. in alcohol than  $\text{As}_2\text{O}_3$ . Very sl. sol. in the fatty oils, 100 pts. of oil dissolving 0.2 pt.  $\text{As}_2\text{O}_5$  in the cold, and 1 pt. with partial decomp. on boiling. (Berzelius.)

1000 pts. boiling poppy-oil dissolve 27 pts.  $\text{As}_2\text{O}_5$ ; 1000 pts. boiling castor-oil dissolve 34 pts.  $\text{As}_2\text{O}_5$ . (Heimpel and Grundner.)

+  $4\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_3\text{AsO}_4$ in 100 pts. solution	$t^\circ$	Pts. $\text{H}_3\text{AsO}_4$ in 100 pts. solution
-55°	69.9	-5°	80.0
-50	70.9	0	81.0
-45	71.9	+5	82.1
-40	72.9	10	83.3
-35	73.9	15	84.7
-30	74.9	20	86.3
-25	75.9	25	88.0
-20	76.9	30	90.1
-15	77.9	35	92.8
-10	78.9	..	....

(Menzies and Potter, J. Am. Chem. Soc. 1912, 34. 1464.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_3\text{AsO}_4$ in 100 pts. of solution
+10°	88.4
20	89.1
30	89.8
40	90.5
50	91.2
60	91.9
70	92.6
80	93.2
90	93.8
100	94.4
110	95.0
120	95.6
130	96.2
140	96.8

(Menzies and Potter, J. Am. Chem. Soc. 1912, 34. 1464.)

$\text{As}_2\text{O}_3 + 4\text{H}_2\text{O}$  and  $3\text{As}_2\text{O}_3 + 5\text{H}_2\text{O}$  are the only hydrates that can be isolated. (Menzies and Potter.)

See also Arsenic Acid.

**Arsenic trioxide, with alkali haloid.**

See Arsenite, alkali haloid.

**Arsenic sulphur trioxide,  $\text{As}_2\text{O}_3, \text{SO}_3$ .**

Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Adie, Chem. Soc. 55. 157.)

$\text{As}_2\text{O}_3, 2\text{SO}_3$ . As above. (Adie.)

$\text{As}_2\text{O}_3, 3\text{SO}_3$ . (Weber, B. 19. 3186.)

$\text{As}_2\text{O}_3, 4\text{SO}_3$ . As above. (Adie.)

$\text{As}_2\text{O}_3, 6\text{SO}_3$ . (Weber.)

$\text{As}_2\text{O}_3, 8\text{SO}_3$ . As above. (Adie.)

**Arsenic oxychloride, etc.**

See Arsenyl chloride, etc.

**Arsenic phosphide,  $\text{AsP}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Not attacked by cold  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ , and only sl. sol. therein on warming. Easily decomp. by  $\text{HNO}_3$ ,  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{BaO}_2\text{H}_2 + \text{Aq}$ . Insol. in alcohol, ether, chloroform; sl. sol. in  $\text{CS}_2$ .

$\text{P}_2\text{As}_2\text{O}_3$ . Product of action of  $\text{H}_2\text{O}$  on above compound, which it resembles. (Janowsky, B. 6. 216.)

**Arsenic monoselenide,  $\text{As}_2\text{Se}$ .**

Insol. in most organic and inorganic solutions. Sol. very slowly in conc.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . Sol. in boiling alkali hydroxides +  $\text{Aq}$ . (Szarvasy, B. 1897, 30. 1245.)

**Arsenic triselenide,  $\text{As}_2\text{S}_3$ .**

Partially sol. in  $\text{KOH} + \text{Aq}$  if boiled with it for a long time. (Uelsmann, A. 116. 123.)

**Arsenic pentaselenide,  $\text{As}_2\text{Se}_5$ .**

Insol. in most solvents, as conc.  $\text{HCl}$ . Sol. in alkali hydrates and sulphydrates +  $\text{Aq}$ . (Szarvasy, B. 1895, 28. 2655-2656.)

Insol. in  $\text{H}_2\text{O}$ , in dil. acids and in conc.  $\text{HCl}$ . Sl. sol. in warm  $\text{HNO}_3 + \text{Aq}$ . Oxidized by cold fuming  $\text{HNO}_3$ . Sol. in alkalis and in hot alkali carbonates +  $\text{Aq}$ . Insol. in alcohol, ether,  $\text{CS}_2$ , etc. (Clever, Z. anorg. 1895, 10. 129.)

**Arsenic selenosulphide.**

See Arsenic sulphoselenide.

**Arsenic sulphide,  $\text{As}_2\text{S}_3$ .**

Ppt. Insol. in  $\text{NH}_4\text{OH}$  or in colorless  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sol. in yellow  $\text{NH}_4\text{SH} + \text{Aq}$ . (Scott, Chem. Soc. 1900, 77. 652.)

**Arsenic disulphide,  $\text{As}_2\text{S}_2$ .**

Min. *Realgar*. Difficultly sol. in alkali sulphides +  $\text{Aq}$ . Partly dissolved by  $\text{KOH} + \text{Aq}$  with decomposition. Sol. at  $150^\circ$  in a sealed tube in  $\text{NaHCO}_3 + \text{Aq}$ , and crystallizes out on cooling. (Senarmont, A. ch. (3) 32. 158.)

**Arsenic trisulphide,  $\text{As}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$  when prepared in the dry way, but when prepared moist is very liable to go into the colloidal modification mentioned below. Insol. in  $\text{H}_2\text{O}$  containing  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{C}_2\text{O}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ ,  $\text{CO}_2$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KNO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{MgSO}_4$ . (Bontigny.)

Insol. in  $\text{H}_2\text{O}$ . Traces are dissolved by  $\text{H}_2\text{S} + \text{Aq}$ . Sl. decomp. by boiling with  $\text{H}_2\text{O}$ , or long contact with cold  $\text{H}_2\text{O}$ . (Fresenius.)

1 l.  $\text{H}_2\text{O}$  dissolves  $2.1 \times 10^{-4}$  mols. pptd.  $\text{As}_2\text{S}_3$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Insol. in dil. acids. Insol. in cold, and scarcely attacked by hot conc.  $\text{HCl} + \text{Aq}$ .

Easily decomp. by  $\text{HNO}_3$  or aqua regia.

Easily sol. in cold  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , also in alkali carbonates, or sulphates +  $\text{Aq}$ .

Sol. in hot  $\text{KHSO}_4 + \text{Aq}$ .

Sol. in citric acid, and alkali citrates +  $\text{Aq}$ . (Spiller.)

Slowly sol. in cold 2%  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$ . Easily sol. on heating. (Materne, C. C. 1906, II. 557.)

Insol. in  $\text{CS}_2$ .

Min. *Orpiment*.

$\text{As}_2\text{S}_3$  may also be obtained in a colloidal form, sol. in  $\text{H}_2\text{O}$ . Sat. solution contains 34.46%  $\text{As}_2\text{S}_3$ ; it is decomp. by standing, but may be boiled without undergoing decomposition; most acids and many salts ppt.  $\text{As}_2\text{S}_3$ . (Schulze, J. pr. (2) 25. 431.)

The following solutions cause pptn. of  $\text{As}_2\text{S}_3$  in a solution of the colloidal modification, when added in the given state of dilution:—

$\text{HCl} + \text{Aq}$	1 : 555
$\text{HNO}_3 + \text{Aq}$	1 : 276
$\text{H}_2\text{SO}_4 + \text{Aq}$	1 : 255
$\text{H}_2\text{SO}_3 + \text{Aq}$	1 : 138
$\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$	1 : 65
$\text{H}_3\text{PO}_4 + \text{Aq}$	1 : 26
$\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$	1 : 0.18
$\text{K}_2\text{SO}_4 + \text{Aq}$	1 : 76
$\text{Na}_2\text{SO}_4 + \text{Aq}$	1 : 129
$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$	1 : 188
$\text{CaSO}_4 + \text{Aq}$	1 : 2780
$\text{MgSO}_4 + \text{Aq}$	1 : 2630
$\text{ZnSO}_4 + \text{Aq}$	1 : 3330
$\text{MnSO}_4 + \text{Aq}$	1 : 2860
$\text{NiSO}_4 + \text{Aq}$	1 : 3440
$\text{FeSO}_4 + \text{Aq}$	1 : 2380
$\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$	1 : 52600
$\text{Ti}_2\text{SO}_4 + \text{Aq}$	1 : 799
$\text{Cl}_2 + \text{Aq}$	1 : 137
$\text{KBr} + \text{Aq}$	1 : 103
$\text{KI} + \text{Aq}$	1 : 55
$\text{LiI} + \text{Aq}$	1 : 127
$\text{NaCl} + \text{Aq}$	1 : 212
$\text{NH}_4\text{Cl} + \text{Aq}$	1 : 207
$\text{BaCl}_2 + \text{Aq}$	1 : 2860
$\text{CaCl}_2 + \text{Aq}$	1 : 4370
$\text{MgCl}_2 + \text{Aq}$	1 : 10000

FeCl <sub>3</sub> +Aq . . . . .	1 : 50000
AlCl <sub>3</sub> +Aq . . . . .	1 : 83000
CrCl <sub>3</sub> +Aq . . . . .	1 : 20000
KNO <sub>3</sub> +Aq . . . . .	1 : 84
NaNO <sub>3</sub> +Aq . . . . .	1 : 117
NH <sub>4</sub> NO <sub>3</sub> +Aq . . . . .	1 : 138
Ba(NO <sub>3</sub> ) <sub>2</sub> +Aq . . . . .	1 : 2080
KClO <sub>3</sub> +Aq . . . . .	1 : 88
CaH <sub>2</sub> (CO <sub>3</sub> ) <sub>2</sub> +Aq . . . . .	1 : 3120
K <sub>2</sub> C <sub>2</sub> H <sub>2</sub> O <sub>4</sub> +Aq . . . . .	1 : 85
K <sub>2</sub> C <sub>2</sub> O <sub>4</sub> +Aq . . . . .	1 : 81
NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> +Aq . . . . .	1 : 78
Urea+Aq . . . . .	1 : 25
(NH <sub>4</sub> ) <sub>2</sub> Fe(SO <sub>4</sub> ) <sub>2</sub> +Aq . . . . .	1 : 1160
K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq . . . . .	1 : 50000
K <sub>2</sub> Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq . . . . .	1 : 55500
K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +Aq . . . . .	1 : 25000
K <sub>2</sub> Fe(CN) <sub>6</sub> +Aq . . . . .	1 : 67
K <sub>2</sub> Fe(CN) <sub>5</sub> +Aq . . . . .	1 : 81

Cold conc. solutions of boric, arsenious, tartaric, benzoic, and salicylic acids, also cane sugar, or chloral hydrate cause no pptn. Absolute alcohol and glycerine may also be mixed with the solutions without causing pptn. (Schulze, J. pr. (2) 25. 442.)

+H<sub>2</sub>O; decomp. completely into As<sub>2</sub>S<sub>3</sub> under a pressure of 6000 to 7000 atmos. (Spring, Z. anorg. 1895, 10. 186.)

#### Arsenic pentasulphide, As<sub>2</sub>S<sub>5</sub>.

Insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH, KOH, NaOH+Aq. and solutions of alkali sulphides and carbonates. Sol. in BaO<sub>2</sub>H<sub>2</sub> and CaO<sub>2</sub>H<sub>2</sub>+Aq.

Sol. in citric acid, and alkali citrates+Aq. (Spiller.)

Alcohol dissolves out S on boiling. (Berzelius.)

Sol. in alkali arsenates+Aq. (Nilson, J. pr. (2) 14. 155.)

+H<sub>2</sub>O. (Nilson, l.c.)

#### Arsenic trisulphide, with M<sub>2</sub>S.

See Sulpharsenites, M.

#### Arsenic pentasulphide, with M<sub>2</sub>S.

See Sulpharsenates, M.

#### Arsenic sulphobromide, As<sub>2</sub>S<sub>2</sub>Br<sub>2</sub>=AsSBr+SBBr<sub>2</sub>.

Decomp. by H<sub>2</sub>O. (Hannay, Chem. Soc. 33. 284.)

#### Arsenic sulphochloride, As<sub>2</sub>S<sub>2</sub>Cl<sub>2</sub>.

Slowly decomp. by boiling H<sub>2</sub>O. Sol. in hot AsCl<sub>3</sub> without decomp. (Ouvrard, C. R. 116. 1516.)

As<sub>2</sub>S<sub>2</sub>Cl<sub>2</sub>. Decomp. by H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH, and alkali carbonates+Aq. (Ouvrard.)

As<sub>2</sub>S<sub>2</sub>Cl<sub>2</sub>. Slowly decomp. by boiling H<sub>2</sub>O. Sol. in alkali carbonates and in NH<sub>4</sub>OH+Aq. (Ouvrard, C. R. 1893, 116. 1517.)

#### Arsenic sulphioiodide, AsSI.

Insol. in alcohol, chloroform or carbon disulphide. (Schneider, J. pr. (2) 23. 486.)

Formula is probably As<sub>2</sub>S<sub>3</sub>, AsI<sub>3</sub>.

Slowly attacked by HCl+Aq; somewhat more easily by HNO<sub>3</sub>+Aq. Easily sol. in KOH, or NH<sub>4</sub>OH+Aq. (Schneider, J. pr. (2) 34. 505.)

2AsI<sub>3</sub>, SI<sub>4</sub>. Decomp. on air. (Schneider, J. pr. (2) 36. 509.)

As<sub>2</sub>SI<sub>2</sub>. Less sol. in CS<sub>2</sub> than AsI<sub>3</sub>. (Ouvrard, C. R. 117. 107.)

As<sub>2</sub>SI<sub>4</sub>. (Ouvrard.)

See also Arsenyl sulphioiodide.

#### Arsenic sulphoselenide, As<sub>2</sub>SeS<sub>2</sub>.

Easily sol. in cold NH<sub>4</sub>SH+Aq. Nearly completely sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. (v. Gerichten, B. 7. 29.)

As<sub>2</sub>SSe<sub>2</sub>. More difficultly sol. than the preceding comp. in NH<sub>4</sub>SH+Aq. (v. Gerichten.)

As<sub>2</sub>SeS<sub>2</sub>. Sp. gr.=6.402 at ca. 750°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides+Aq. (Szarvasy, B. 1895, 28. 2661.)

As<sub>2</sub>Se<sub>2</sub>S<sub>2</sub>. Sp. gr.=11.35 at 550-600°.

Insol. in most solvents. Easily sol. in alkali hydroxides and sulphides+Aq. (Szarvasy, B. 1895, 28. 2659.)

#### Arsenic telluride, As<sub>2</sub>Te<sub>2</sub>.

Sol. in HNO<sub>3</sub> and HNO<sub>3</sub>+HCl+Aq. (Oppenheim, J. pr. 71. 266.)

As<sub>2</sub>Te<sub>2</sub>. As above. (Oppenheim.)

#### Arsenic acid, anhydrous, As<sub>2</sub>O<sub>3</sub>.

See Arsenic pentoxide.

#### Metaarsenic acid, HAsO<sub>3</sub>.

Slowly sol. in cold, quite easily sol. in hot H<sub>2</sub>O, with considerable evolution of heat, and conversion into H<sub>2</sub>AsO<sub>4</sub>. (Kopp, A. ch. (3) 48. 196.)

#### Orthoarsenic acid, H<sub>2</sub>AsO<sub>4</sub>.

Sol. in H<sub>2</sub>O, with absorption of heat.

1 pt. As<sub>2</sub>O<sub>3</sub> dissolves in 0.405 pt. H<sub>2</sub>O at 12.5°, or 100 pts. H<sub>2</sub>O dissolve 244.81 pts. As<sub>2</sub>O<sub>3</sub> at 12.5°. (Vogel.)

Sol. in 0.5 pt. H<sub>2</sub>O. (Thénard.)

Sol. in 6 pts. cold H<sub>2</sub>O, and more quickly in 2 pts. hot H<sub>2</sub>O. (Buchholz.)

100 pts. H<sub>2</sub>O at 15.56° dissolve 150 pts. As<sub>2</sub>O<sub>3</sub>. (Ure's Dict.)

H<sub>2</sub>AsO<sub>4</sub>+Aq sat. at 15° contains 15% As<sub>2</sub>O<sub>3</sub>.

Sp. gr. of H<sub>2</sub>AsO<sub>4</sub>+Aq at 15°: a=sp. gr. if % is As<sub>2</sub>O<sub>3</sub>; b=sp. gr. if % is H<sub>2</sub>AsO<sub>4</sub>.

%	a	b	%	a	b
5	1.042	1.0337	45	1.540	1.3973
10	1.085	1.0690	50	1.635	1.4617
15	1.134	1.1061	55	1.742	1.5320
20	1.187	1.1457	60	.....	1.6086
25	1.245	1.1882	65	.....	1.6919
30	1.306	1.2342	70	.....	1.7827
35	1.378	1.2840	75	.....	.....
40	1.453	1.3382	..	.....	.....

(Schiff, A. 113. 183, calculated by Gerlach, Z. anal. 27. 303.)

Sp. gr. of  $\text{H}_2\text{AsO}_4 + \text{Aq}$  at  $15^\circ$ :  $a$  = sp. gr. if % is  $\text{As}_2\text{O}_3$ ;  $b$  = sp. gr. if % is  $\text{H}_2\text{AsO}_4$ .

%	a	b	%	a	b
1	1.008	1.006	47	1.564	1.412
2	1.016	1.013	48	1.582	1.425
3	1.023	1.019	49	1.601	1.437
4	1.031	1.026	50	1.620	1.450
5	1.039	1.032	51	1.642	1.464
6	1.048	1.039	52	1.663	1.478
7	1.057	1.046	53	1.685	1.491
8	1.065	1.052	54	1.708	1.505
9	1.074	1.059	55	1.728	1.519
10	1.083	1.066	56	1.752	1.534
11	1.092	1.073	57	1.777	1.549
12	1.102	1.081	58	1.801	1.564
13	1.111	1.088	59	1.825	1.579
14	1.121	1.096	60	1.850	1.594
15	1.130	1.103	61	1.880	1.610
16	1.140	1.111	62	1.910	1.626
17	1.150	1.119	63	1.940	1.643
18	1.160	1.126	64	1.970	1.659
19	1.170	1.134	65	2.000	1.675
20	1.180	1.142	66	2.030	1.693
21	1.191	1.150	67	2.060	1.712
22	1.203	1.158	68	2.090	1.730
23	1.214	1.167	69	2.120	1.749
24	1.226	1.175	70	2.150	1.767
25	1.237	1.183	71	.....	1.788
26	1.249	1.192	72	.....	1.809
27	1.261	1.201	73	.....	1.830
28	1.274	1.210	74	.....	1.851
29	1.286	1.219	75	.....	1.872
30	1.298	1.228	76	.....	1.897
31	1.312	1.238	77	.....	1.921
32	1.325	1.248	78	.....	1.946
33	1.339	1.257	79	.....	1.970
34	1.352	1.267	80	.....	1.995
35	1.366	1.277	81	.....	2.020
36	1.381	1.288	82	.....	2.045
37	1.396	1.299	83	.....	2.070
38	1.411	1.309	84	.....	2.095
39	1.426	1.320	85	.....	2.120
40	1.441	1.331	86	.....	2.149
41	1.458	1.342	87	.....	2.178
42	1.475	1.353	88	.....	2.207
43	1.492	1.366	89	.....	2.236
44	1.509	1.376	90	.....	2.265
45	1.526	1.387	91	.....	2.295
46	1.545	1.400	..	.....	.....

(Kopp, calculated by Gerlach, Z. anal. 27. 316.)

See also Arsenic pentoxide.

### Pyroarsenic acid, $\text{H}_4\text{As}_2\text{O}_7$ .

Very deliquescent; easily sol. in  $\text{H}_2\text{O}$  with evolution of much heat, and conversion into  $\text{H}_2\text{AsO}_4$ .

### Arsenates.

Arsenates of the alkali metals, and acid arsenates of the alkaline-earth metals are sol. in  $\text{H}_2\text{O}$ . Neutral and basic arsenates are easily sol. in mineral acids, including  $\text{H}_2\text{AsO}_4$ ;

less sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . The neutral alkaline-earth arsenates are less sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , but more sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  (Field). The alkali arsenates are sol. in hot glycerine. (Lefèvre, C. R. 106. 1058.)

### Aluminum arsenate, $\text{Al}_2(\text{AsO}_4)_3$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Coloriano, C. R. 103. 273.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

$2\text{Al}_2\text{O}_3, 3\text{As}_2\text{O}_5$ . Nearly unattacked by boiling  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Lefèvre, A. ch. (6) 27. 5.)

### Aluminum potassium arsenate, $2\text{Al}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{As}_2\text{O}_5$ .

(Lefèvre.)

### Aluminum sodium arsenate, $2\text{Al}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$ .

(Lefèvre.)

### Ammonium arsenate, $(\text{NH}_4)_3\text{AsO}_4 + 3\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_2\text{HASO}_4$ . (Mitscherlich.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

### Ammonium hydrogen arsenate, $(\text{NH}_4)_2\text{HASO}_4$ .

Effloresces, giving off  $\text{NH}_3$ ; more sol. in  $\text{H}_2\text{O}$  than  $(\text{NH}_4)_3\text{AsO}_4$ . (Salkowsky, J. pr. 104. 129.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

### Ammonium dihydrogen arsenate, $\text{NH}_4\text{H}_2\text{AsO}_4$ .

Not efflorescent. Very sol. in  $\text{H}_2\text{O}$ .

### Ammonium barium arsenate, $\text{NH}_4\text{BaAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. by 10 days' contact in 1391 pts.  $\text{H}_2\text{O}$ ; in 18,832 pts. of a mixture of 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  and 3 pts.  $\text{H}_2\text{O}$ ; in 227 pts. of a solution of 1 pt.  $\text{NH}_4\text{Cl}$  in 10 pts.  $\text{H}_2\text{O}$ ; and in 2169 pts. of a solution of 1 pt.  $\text{NH}_4\text{Cl}$  in 10 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  and 60 pts.  $\text{H}_2\text{O}$ . (Lefèvre, A. ch. 1892, (6) 27. 13.)

$(\text{NH}_4)_2\text{BaH}_2(\text{AsO}_4)_2$ . Efflorescent. Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Bau- mann, Arch. Pharm. 36. 36.)

### Ammonium calcium arsenate, $\text{NH}_4\text{CaAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

1000 pts. pure  $\text{H}_2\text{O}$  dissolve 0.20 pt. this salt; 1000 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (containing 50 pts.  $\text{NH}_4\text{Cl}$ ) dissolve 4.15 pts. this salt; 900 pts.  $\text{H}_2\text{O} + 100$  pts.  $\text{NH}_4\text{OH}$  (sp. gr. = 0.880) dissolve 0.01 pt. this salt. (Field, Chem. Soc. 11. 6.)

Soluble by 10 days' contact in 2167 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; in 381 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1:7); in

43478 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 : 3); in 10570 pts.  $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH} + \text{Aq}$  (1 : 10 : 60). (Lefèvre, A. ch. 1892, (6) 27. 13.)

+  $6\text{H}_2\text{O}$ . Sol. in hot, very sl. sol. in cold  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Wach, Schw. J. 12. 285.)

+  $7\text{H}_2\text{O}$ . (Bloxam, C. N. 54. 163.)

$(\text{NH}_4)_2\text{CaH}_2(\text{AsO}_4)_2$ . Efflorescent. Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Bauermann, Arch. Pharm. 36. 36.)

$(\text{NH}_4)_2\text{Ca}_2\text{H}_2(\text{AsO}_4)_3 + 3\text{H}_2\text{O}$ .

$(\text{NH}_4)_2\text{Ca}_2\text{H}_2(\text{AsO}_4)_3 + 3\text{H}_2\text{O}$ . (Bloxam, C. N. 54. 163.)

**Ammonium glucinum arsenate**,  $\text{NH}_4\text{GlAsO}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ .

More stable than the corresponding potassium salt. (Bleyer, Z. anorg. 1912, 75. 291.)

**Ammonium iron (ferric) dihydrogen arsenate**,  $\text{NH}_4\text{H}_2\text{AsO}_4 \cdot \text{FeAsO}_4$ .

Hydrolyzed by  $\text{H}_2\text{O}$ .

Sol. in cold conc.  $\text{HCl}$ , hot  $\text{HNO}_3$ , hot dil.  $\text{H}_2\text{SO}_4$ , and in hot arsenic acid +  $\text{Aq}$  containing 75% arsenic pentoxide.

Sol. in hot conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . Completely hydrolyzed by caustic alkalis.

Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$  and in 50% acetic acid. (Curtman, J. Am. Chem. Soc. 1910, 32. 628.)

**Ammonium magnesium arsenate**,  $\text{NH}_4\text{MgAsO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in acids.

Anhydrous salt is sol. in 2784 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; in 15,904 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 : 3) (0.96 sp. gr.); in 1386 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 70); in 886.7 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 7); in 3014 pts.  $\text{NH}_4\text{Cl}$  (1 pt.) +  $\text{NH}_4\text{OH}$  (0.96 sp. gr.) (10 pts.) +  $\text{Aq}$  (60 pts.); in 32,827 pts. magnesia mixture. (Fresenius, Z. anal. 3. 206.)

Anhydrous salt is sol. in 4389 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (1 : 50); in 2561.5 pts.  $\text{KCl} + \text{Aq}$  (1 : 165); in 1422 pts. ammoniacal solution of 3.5 g. tartaric acid in 250 cc.  $\text{H}_2\text{O}$ ; in 933.5 pts. ammoniacal solution of 2.5 g. citric acid in 250 cc.  $\text{H}_2\text{O}$ . (Puller, Z. anal. 10. 62.)

+  $\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 2656 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; in 15,038 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 : 3) (0.96 sp. gr.); in 844 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 7); in 1315 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 70); in 2871 pts.  $\text{NH}_4\text{Cl}$  (1 pt.) +  $\text{NH}_4\text{OH}$  (0.96 sp. gr.) (10 pts.) +  $\text{Aq}$  (60 pts.). (Fresenius.)

1000 pts. pure  $\text{H}_2\text{O}$  dissolve 0.14 pt. salt; 1000 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (containing 100 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 7); in 1315 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1 : 70); in 2871 pts.  $\text{NH}_4\text{Cl}$  (1 pt.) +  $\text{NH}_4\text{OH}$  (0.96 sp. gr.) (10 pts.) +  $\text{Aq}$  (60 pts.). (Fresenius.)

0.07 pt. salt. (Field, Chem. Soc. 11. 6.)

+  $6\text{H}_2\text{O}$ . Sl. efflorescent. Sl. sol. in  $\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Solubility of  $\text{NH}_4\text{MgAsO}_4 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  and  $\text{NH}_4$  salts +  $\text{Aq}$ .  
Grams salt dissolved in 100 g. solvent.

$t^\circ$	$\text{H}_2\text{O}$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	$\text{NH}_4\text{OH} + \text{Aq}$ 1 pt. $\text{NH}_4\text{OH} + \text{Aq}$ (0.96) + 4 pts. $\text{H}_2\text{O}$	4% $\text{NH}_4\text{OH} + \text{Aq} + 5\%$ $\text{NH}_4\text{Cl} + \text{Aq}$	4% $\text{NH}_4\text{OH} + \text{Aq} + 10\%$ $\text{NH}_4\text{Cl} + \text{Aq}$
0°	0.03388	0.09216	0.08397	0.00874	.....	.....
20	0.02066	0.11358	0.12284	0.00958	0.01331	0.03165
30	.....	0.11758	0.11264	.....	.....	.....
40	0.02746	0.13936	0.19016	0.01173	.....	.....
50	0.02261	0.18945	0.18889	0.01005	.....	.....
60	0.03103	0.21115	0.21952	0.00902	0.04691	0.05353
70	0.01564	0.18880	0.22092	0.00949	.....	.....
80	0.02364	0.18945	0.23144	0.00912	.....	.....

(Wenger, Dissert. 1911.)

**Ammonium manganous arsenate**,  $\text{NH}_4\text{MnAsO}_4 + 6\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ ; easily sol. in dil. acids; insol. in alcohol. (Otto, J. pr. 2. 414.)

**Ammonium sodium arsenate**,  $\text{NH}_4\text{NaHASO}_4 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Uelsmann, Zeit. f. ges. Nat. 23. 347.)

**Ammonium sodium hydrogen arsenate**,  $(\text{NH}_4)_2\text{Na}_2\text{H}_2(\text{AsO}_4)_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Filhol and Senderens, C. R. 94. 649.)

**Ammonium strontium arsenate**,  $\text{NH}_4\text{SrAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. by 10 days' contact in 3229 pts.  $\text{H}_2\text{O}$ , in 11,586 pts. dil.  $\text{NH}_4\text{OH} + \text{Aq}$ , in 199 pts.

of a mixture of 1 pt.  $\text{NH}_4\text{Cl}$  in 7 pts.  $\text{H}_2\text{O}$ , and in 1519 pts. of a solution of 1 pt.  $\text{NH}_4\text{Cl}$  in 10 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  and 60 pts.  $\text{H}_2\text{O}$ . (Lefèvre, A. ch. 1892, (6) 27. 13.)

**Ammonium uranyl arsenate**,  $\text{NH}_4(\text{UO}_2)_2\text{AsO}_4 + x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , and saline solutions as  $\text{NH}_4\text{Cl} + \text{Aq}$ ; sol. in mineral acids. (Puller, Z. anal. 10. 72.)

**Ammonium vanadium arsenate**,  $\text{NH}_4(\text{VO}_2)_2\text{AsO}_4$ , and  $(\text{NH}_4)_2\text{HASO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4$ .

See Arseniovanadate, ammonium.

**Ammonium arsenate tellurate.**

See Arseniotellurate, ammonium.

**Antimony arsenate (?)**

Insol. in  $H_2O$ ; insol. in acids after ignition, but when fresh is sol. in conc. boiling  $HCl$  +  $Aq$ , and sl. sol. in  $HNO_3$  +  $Aq$ . (Dumas.)

**Barium arsenate,  $Ba_3(AsO_4)_2$ .**

1000 pts. pure  $H_2O$  dissolve 0.55 pt.  $Ba_3(AsO_4)_2$ ; 1000 pts.  $NH_4Cl$  +  $Aq$  (containing 50 pts.  $NH_4Cl$ ) dissolve 1.95 pts.  $Ba_3(AsO_4)_2$ ; 900 pts.  $H_2O$  + 100 pts.  $NH_4OH$  +  $Aq$  (sp. gr. = 0.88) dissolve 0.03 pt.  $Ba_3(AsO_4)_2$ . (Field, Chem. Soc. 11. 6.)

Sol. in cold  $HNO_3$ , and  $HCl$  +  $Aq$  (Berzelius);  $H_2C_4H_4O_6$ , and  $HC_2H_3O_2$  +  $Aq$ . (Anthon.)

Solubility in  $H_2O$  is not increased by presence of  $NH_4$ ,  $Na$ , or  $K$  salts. (Laugier.)

Not pptd. in presence of  $Na$  citrate. (Spiller.)

+  $1\frac{1}{2}H_2O$ . (Salkowsky, J. pr. 104. 129.)

**Barium hydrogen arsenate,  $BaHAsO_4 + 1\frac{1}{2}H_2O$ .**

Very sl. sol. in  $H_2O$ , but decomp. thereby into  $Ba_3(AsO_4)_2$  and  $BaH_4(AsO_4)_2$ . (Berzelius.)

Sl. sol. in cold acids.

+  $H_2O$ . Sl. sol. in either  $BaCl_2$  +  $Aq$  or  $Na_2HAsO_4$  +  $Aq$ . (Maumené, J. B. 1864. 237.)

**Barium tetrahydrogen arsenate,  $BaH_4(AsO_4)_2 + 2H_2O$ .**

Easily sol. in  $H_2O$ . (Setterberg, Berz. J. B. 26. 206.)

Difficultly sol. in little, but decomp. by much  $H_2O$ . Easily sol. in  $HCl$  +  $Aq$ , less easily in  $HC_2H_3O_2$  +  $Aq$  (Hörmann, Dissert, 1879.)

**Barium arsenate, acid,  $BaO, 2As_2O_3 + 4H_2O$ .**

Very sl. sol. in  $H_2O$ . (Mitscherlich.)

**Barium pyroarsenate,  $Ba_2As_2O_7$ .**

Insol. in  $H_2O$ , but decomp. thereby into  $BaHAsO_4 + H_2O$ . (Lefèvre, C. R. 108. 1058.)

**Barium potassium arsenate,  $BaKAsO_4$ .**

Sl. decomp. by cold  $H_2O$ ; rapidly sol. in dil. acids. (Lefèvre, A. ch. (6) 27. 1.)

**Barium sodium arsenate,  $BaNaAsO_4 + 9H_2O$ .**

(Joly, C. R. 1887, 104. 1702.)

**Barium arsenate chloride,  $3Ba_3(AsO_4)_2, BaCl_2$ .**

Insol. in  $H_2O$ ; sol. in dil.  $HNO_3$  +  $Aq$ . (Lechartier, C. R. 66. 172.)

**Bismuth arsenate, basic,  $BiAsO_4, 3Bi_2O_3$ .**

Insol. in  $H_2O$ . Sol. in mineral acids. (Cavazzi, Gazz. ch. it. 14. 289.)

$5Bi_2O_3, 2As_2O_3 + 8H_2O$ . Min. *Rhagile*.

Easily sol. in  $HCl$  +  $Aq$ ; sl. sol. in  $HNO_3$  +  $Aq$ .

**Bismuth arsenate,  $BiAsO_4 + \frac{1}{2}H_2O$ .**

Insol. in  $H_2O$ . Insol. in  $HNO_3$  +  $Aq$  in presence of  $H_2AsO_4$ , or alkali arsenates +  $Aq$ ; sol. in  $HCl$  +  $Aq$ . (Salkowsky, J. pr. 104. 129.)

Not wholly insol. in  $HNO_3$  +  $Aq$ . (Schneider, J. pr. (2) 20. 418.)

Very sol. in  $H_2AsO_4$  +  $Aq$ . (Dumas.)

Insol. in  $Bi(NO_3)_3$  +  $Aq$ . (Dumas.)

Sol. in  $Bi(NO_3)_3$  +  $Aq$ . (Salkowsky.)

Insol. in conc.  $Bi(NO_3)_3$  +  $Aq$  containing a small quantity of  $HNO_3$ . (Schneider.)

**Bismuth copper arsenate,  $Bi_2Cu_{10}As_{10}H_{44}O_{76} = Bi_2O_3, 20CuO, 5As_2O_3 + 22H_2O$ .**

Min. *Mizite*. Decomp. by dil.  $HNO_3$  +  $Aq$  into insol.  $BiAsO_4$ , and  $Cu_3(AsO_4)_2$ , which goes into solution. (Dana.)

**Bismuth uranyl arsenate,  $Bi_2(AsO_4)_3, 8Bi_2O_3H_2, (UO_2)_2(AsO_4)_2$ .**

Min. *Walpurgite*.

**Cadmium arsenate,  $Cd_2(AsO_4)_2$ .**

Ppt. (Salkowsky, J. pr. 104. 129.)

$2CdO, As_2O_3$ . (Lefèvre, C. R. 110. 405.)

$5CdO, 2As_2O_3 + 5H_2O$ . Ppt. (Salkowsky.)

**Cadmium pyroarsenate,  $Cd_2As_2O_7$ .**

(de Schulten.)

**Cadmium hydrogen arsenate,  $CdHAsO_4 + H_2O$ .**

Decomp. by  $H_2O$ . (Demel, B. 12. 1279.)

$CdH_4(AsO_4)_2 + 2H_2O$ . Decomp. by excess of  $H_2O$ . (de Schulten, Bull. Soc. (3) 1. 473.)

**Cadmium potassium arsenate,  $2CdO, K_2O, As_2O_3$ .**

(Lefèvre, C. R. 110. 405.)

**Cadmium sodium arsenate,  $CdO, 2Na_2O, As_2O_3$ .**

Slowly sol. in dil. acids. (Lefèvre, C. R. 110. 405.)

$2CdO, 4Na_2O, 3As_2O_3$ . (Lefèvre.)

**Cadmium arsenate bromide,  $3Cd_2(AsO_4)_2, CdBr_2$ .**

Sol. in very dil.  $HNO_3$  +  $Aq$ . (de Schulten, Bull. Soc. (3) 1. 472.)

**Cadmium arsenate chloride,  $3Cd_2(AsO_4)_2, CdCl_2$ .**

Sol. in very dil.  $HNO_3$  +  $Aq$ . (de Schulten.)

**Cæsium arsenate,  $Cs_2O, 2As_2O_3 + 5H_2O$ .**

Ppt. (Ephraim, Z. anorg. 1910, 66. 246.)

**Calcium arsenate,  $Ca_3(AsO_4)_2 + 3H_2O$ .**

Ppt. Insol. in  $H_2O$ ; sol. in  $H_2AsO_4$  +  $Aq$ . (Kotschoubey, J. pr. 49. 182.)

**Calcium pyroarsenate,  $Ca_2As_2O_7$ .**

Slowly decomp. by cold  $H_2O$  into  $CaHAsO_4 + 1\frac{1}{2}H_2O$ . (Lefèvre.)

**Calcium hydrogen arsenate**,  $\text{CaHAsO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Debray, A. ch. (3) 61. 419.)  
+  $\text{H}_2\text{O}$ . Min. *Haidingerite*. Easily sol. in acids.

+  $2\frac{1}{2}\text{H}_2\text{O}$ . Min. *Pharmacolite*. Easily sol. in acids.

+  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{AsO}_4 + \text{Aq}$ ; also in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Pfaff.)

**Calcium tetrahydrogen arsenate**,  
 $\text{CaH}_4(\text{AsO}_4)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Graham.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by much hot  $\text{H}_2\text{O}$  into  $\text{H}_2\text{AsO}_4$  and  $\text{Ca}_3(\text{AsO}_4)_2$ . (Hörmann, Dissert. 1879.)

**Calcium iron (ferric) arsenate**,  $6\text{CaO}$ ,  $4\text{Fe}_2\text{O}_3$ ,  
 $5\text{As}_2\text{O}_5 + 15\text{H}_2\text{O}$  (?).

Min. *Arseniosiderite*. Sol. in acids.

**Calcium magnesium arsenate**,  $\text{Ca}_3\text{H}_2(\text{AsO}_4)_4$ ,  
 $\text{Mg}_2\text{H}_2(\text{AsO}_4)_4 + 10\text{H}_2\text{O}$ .

Min. *Picropharmacolite*. Easily sol. in acids.

$\text{Ca}_2(\text{AsO}_4)_2$ ,  $\text{Mg}_2(\text{AsO}_4)_2$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Kühn.)

Min. *Berzelite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

$\text{Ca}_2\text{Mg}_2\text{H}_{14}(\text{AsO}_4)_{14} + 49\text{H}_2\text{O}$ . Min. *Wapplerite*.

**Calcium potassium arsenate**,  $\text{CaKAsO}_4$ .

(Lefèvre, A. ch. (6) 27. 5.)

**Calcium sodium arsenate**,  $\text{CaNaAsO}_4$ .

(Lefèvre, A. ch. (6) 27. 1.)

$4\text{CaO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . Not attacked by boiling  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Lefèvre.)

**Calcium uranyl arsenate**,  $\text{Ca}(\text{UO}_2)_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$ .

Min. *Uranospinite*.

**Calcium vanadium arsenate**,  $\text{CaHAsO}_4$ ,  
 $2(\text{VO})_2\text{H}_2\text{AsO}_4 + 8\text{H}_2\text{O}$ .

See *Arseniovanadate*, calcium.

**Calcium arsenate chloride**,  $\text{Ca}_3(\text{AsO}_4)_2$ ,  $\text{CaCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Lechartier, C. R. 65. 172.)

$3\text{Ca}_3(\text{AsO}_4)_2$ ,  $\text{CaCl}_2$ . As above. (Lechartier.)

**Cerous arsenate**,  $\text{CeHAsO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in arsenic acid +  $\text{Aq}$ . (Berzelius.)

**Ceric hydrogen arsenate**,  $\text{Ce}(\text{HAsO}_4)_2 + 6\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Barbieri, B. 1910, 43. 2216.)

**Ceric dihydrogen arsenate**,  $\text{Ce}(\text{H}_2\text{AsO}_4)_4 + 4\text{H}_2\text{O}$ .

Sol. in conc.  $\text{HNO}_3$ . (Barbieri l. c.)

**Chromic arsenate**,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{As}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$  and conc. boiling acids. (Lefèvre, A. ch. (6) 27. 5.)

**Chromic potassium arsenate**,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  
 $3\text{As}_2\text{O}_5$ .

(Lefèvre.)

**Chromic sodium arsenate**,  $2\text{Cr}_2\text{O}_3$ ,  $3\text{Na}_2\text{O}$ ,  
 $3\text{As}_2\text{O}_5$ .

(Lefèvre.)

**Cobaltous arsenate, basic**,  $4\text{CoO}$ ,  $\text{As}_2\text{O}_5$ .

Easily sol. in acids. (Gentile, J. B. 1851. 359.)

$\text{Co}(\text{CoOH})\text{AsO}_4$ . Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Coloriano.)

**Cobaltous arsenate**,  $\text{Co}_3(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$ .

Ppt. Insol. even in boiling  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in  $\text{H}_2\text{AsO}_4 + \text{Aq}$  (Proust); sol. in dil.  $\text{FeSO}_4 + \text{Aq}$ . (Karsten, Pogg. 60. 266.)

Min. *Cobalt bloom*, *Erythrite*. Easily sol. in acids.

$5\text{CoO}$ ,  $2\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Coloriano, C. R. 103. 273.)

$2\text{CoO}$ ,  $\text{As}_2\text{O}_5$ . Sl. attacked by boiling  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Lefèvre.)

**Cobaltous hydrogen arsenate**,  $\text{CoH}_2(\text{AsO}_4)_2$ .

Sol. in  $\text{H}_2\text{O}$ .

**Cobaltous potassium arsenate**,  $\text{CoKAsO}_4$ .

(Lefèvre.)

**Cobaltous sodium arsenate**,  $\text{CoNaAsO}_4$ .

(Lefèvre.)

$4\text{CoO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . (Lefèvre.)

**Cobaltous vanadium arsenate**,

$\text{Co}(\text{VO})_2\text{H}_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$ .

See *Arseniovanadate*, cobaltous.

**Cobaltous arsenate ammonia**,  $\text{Co}_3(\text{AsO}_4)_2$ ,  
 $\text{NH}_3 + 7\text{H}_2\text{O}$ .

(Ducru, A. ch. 1901, (7) 22. 185.)

$\text{Co}_3(\text{AsO}_4)_2$ ,  $2\text{NH}_3 + 6\text{H}_2\text{O}$ . (Ducru, l. c.)

$\text{Co}_3(\text{AsO}_4)_2$ ,  $3\text{NH}_3 + 5\text{H}_2\text{O}$ . (Ducru, l. c.)

**Cuprous arsenate**,  $2\text{Cu}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ .

(Hampe, Dissert. 1874.)

$4\text{Cu}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ . (Hampe, l. c.)

**Cuprous pyroarsenate**,  $\text{Cu}_4\text{As}_2\text{O}_7$ .

Ppt. Sol. in  $\text{NH}_4\text{OH}$  or  $\text{KOH} + \text{Aq}$ . (Reichard, B. 1898, 31. 2166.)

**Cupric arsenate, basic**,  $8\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 12\text{H}_2\text{O}$ .

Min. *Chalcophyllite*. Easily sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ .

$6\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Min. *Aphanesite*, *Clioclaseite*. Sol. in acids and ammonia.

$5\text{CuO}$ ,  $\text{As}_2\text{O}_5 + 2\text{H}_2\text{O}$ . Min. *Erinite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .



+5H<sub>2</sub>O. Min. *Cornwallite*. Sol. in acids, and NH<sub>4</sub>OH + Aq.  
 +9H<sub>2</sub>O. Min. *Tirolite*.  
 4CuO, As<sub>2</sub>O<sub>5</sub> + H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Debray, A. ch. (3) 61. 423.)  
 Min. *Olivenite*. Sol. in acids, and NH<sub>4</sub>OH + Aq; decomp. by hot KOH + Aq.  
 +7H<sub>2</sub>O. Min. *Euchroite*. Sol. in HNO<sub>3</sub> + Aq.  
 +4½H<sub>2</sub>O. (Hirsch, C. C. 1891, I. 15.)

#### Cupric arsenate, Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>.

Insol. in H<sub>2</sub>O. Easily sol. in HCl + Aq; sl. sol. in other acids; sol. in NH<sub>4</sub>OH + Aq. (Coloriano, C. R. 103. 273.)  
 Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)  
 Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)  
 +4H<sub>2</sub>O. Decomp. by hot H<sub>2</sub>O. (Debray.)  
 +5H<sub>2</sub>O. Min. *Trichalcite*. Easily sol. in cold HCl + Aq.

#### Cupric arsenate, acid, 5CuO, 2As<sub>2</sub>O<sub>5</sub>.

Sol. in H<sub>2</sub>SO<sub>4</sub> + Aq. (Vogel.)  
 +3H<sub>2</sub>O. (Salkowsky.)  
 +8, 9½, and 12½H<sub>2</sub>O. (Hirsch.)  
 CuHAsO<sub>4</sub> + H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Coloriano.)  
 +1½H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Debray, A. ch. (3) 61. 419.)  
 8CuO, 3As<sub>2</sub>O<sub>5</sub> + 12H<sub>2</sub>O. (Hirsch.)

#### Cupric lead arsenate, 3CuO, PbO, As<sub>2</sub>O<sub>5</sub> + 2H<sub>2</sub>O.

Min. *Bayldonite*. Nearly insol. in HNO<sub>3</sub> + Aq.

#### Cupric potassium arsenate, CuKAsO<sub>4</sub>.

Slowly sol. in NH<sub>4</sub>OH + Aq; easily sol. in acids. (Lefèvre, A. ch. (6) 27. 5.)  
 8CuO, K<sub>2</sub>O, As<sub>2</sub>O<sub>5</sub>. Easily sol. in dil. acids. (Lefèvre.)

#### Cupric sodium arsenate, CuNaAsO<sub>4</sub>.

(Lefèvre.)  
 3CuO, Na<sub>2</sub>O, 2As<sub>2</sub>O<sub>5</sub>. Very sol. in dil. acids. (Lefèvre.)  
 2Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, NaH<sub>2</sub>AsO<sub>4</sub> + 5H<sub>2</sub>O. Ppt. (Hirsch, C. C. 1891, I. 15.)  
 6Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 2NaH<sub>2</sub>AsO<sub>4</sub>, Na<sub>2</sub>HAsO<sub>4</sub> + 13½H<sub>2</sub>O, or 16H<sub>2</sub>O. Ppt. (Hirsch.)  
 3Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, Na<sub>2</sub>HAsO<sub>4</sub> + 9½H<sub>2</sub>O. Ppt. (Hirsch.)  
 4Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, Na<sub>2</sub>HAsO<sub>4</sub> + 11H<sub>2</sub>O. Ppt. (Hirsch.)

#### Cupric uranyl arsenate, Cu(UO<sub>2</sub>)<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub> + 8H<sub>2</sub>O.

(Werther, A. 68. 312.)  
 Min. *Zeunerite*.

#### Cupric vanadium arsenate,

Cu(VO<sub>2</sub>)<sub>2</sub>H<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub> + 3H<sub>2</sub>O.

See Arseniovanadate, cupric.

#### Cupric arsenate ammonia, Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub> + 4H<sub>2</sub>O.

Insol. in cold or hot H<sub>2</sub>O. (Damour, J. p. 37. 485.)

2CuO, As<sub>2</sub>O<sub>5</sub>, 4NH<sub>3</sub> + 3H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Schiff, A. 123. 42.)

#### Cupric arsenate calcium carbonate, 5CuO, As<sub>2</sub>O<sub>5</sub>, CaCO<sub>3</sub> + 4H<sub>2</sub>O, or 9H<sub>2</sub>O.

Min. *Tyrolite*. Easily sol. in acids, and NH<sub>4</sub>OH + Aq.

#### Cupric arsenate sodium chloride, 2Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, NaCl + 7½H<sub>2</sub>O.

Decomp. by hot H<sub>2</sub>O. (Hirsch, Dissert. 1891.)

3Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 2NaCl + 13½H<sub>2</sub>O.

+17½H<sub>2</sub>O. (Hirsch, l.c.)

5Cu<sub>3</sub>(AsO<sub>4</sub>)<sub>2</sub>, 3NaCl + 23H<sub>2</sub>O. (Hirsch.)

#### Didymium arsenate, Di<sub>2</sub>H<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>.

Ppt. Insol. in H<sub>2</sub>O; sl. sol. in weak acids. (Marignac, A. ch. (3) 33. 164.)

5Di<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, As<sub>2</sub>O<sub>5</sub> + 3H<sub>2</sub>O. Ppt.

#### Glucinum arsenate, Gl<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>.

Insol. in H<sub>2</sub>O; sol. in H<sub>2</sub>AsO<sub>4</sub> + Aq. (Berzelius.)

#### Glucinum hydrogen arsenate, GlHAsO<sub>4</sub>.

Obtained in impure state by heating As<sub>2</sub>O<sub>5</sub> with Gl(OH)<sub>3</sub> in a sealed tube at 220°. (Bleyer, Z. anorg. 1912, 75. 287.)

#### Glucinum tetrahydrogen arsenate, GlH<sub>4</sub>(AsO<sub>4</sub>)<sub>2</sub>.

Very hygroscopic. (Bleyer, Z. anorg. 1912, 75. 287.)

#### Glucinum potassium arsenate, KGlAsO<sub>4</sub>, ½GlO + 5H<sub>2</sub>O.

Unstable. Amorphous. Easily hydrolyzed, giving more basic salts. (Bleyer, Z. anorg. 1912, 75. 289.)

#### Glucinum sodium arsenate, NaGlAsO<sub>4</sub>, ½GlO + 6H<sub>2</sub>O.

Unstable. Easily hydrolyzed. (Bleyer, Z. anorg. 1912, 75. 290.)

#### Iron (ferrous) arsenate, Fe<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub> + 6H<sub>2</sub>O (?).

Ppt. Sl. sol. in NH<sub>4</sub>OH + Aq. Insol. in (NH<sub>4</sub>)<sub>2</sub>AsO<sub>4</sub> + Aq or other NH<sub>4</sub> salts + Aq. (Wittstein.)

+8H<sub>2</sub>O. Min. *Symplectite*. Sol. in HCl + Aq.

#### Iron (ferric) arsenate, basic, 16Fe<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>5</sub> + 24H<sub>2</sub>O.

Insol. in NH<sub>4</sub>OH + Aq. (Berzelius.)  
 2Fe<sub>2</sub>O<sub>3</sub>, As<sub>2</sub>O<sub>5</sub> + 12H<sub>2</sub>O. Insol. in NH<sub>4</sub>OH + Aq.

3Fe<sub>2</sub>O<sub>3</sub>, 2As<sub>2</sub>O<sub>5</sub>.

3Fe<sub>2</sub>(AsO<sub>4</sub>)<sub>2</sub>, Fe<sub>2</sub>O<sub>4</sub>H<sub>6</sub> + 12H<sub>2</sub>O. Min. *Pharmacosiderite*. Easily sol. in acids; decomp. by KOH + Aq.

**Iron (ferric) arsenate,  $\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_5$ .**

Ppt. Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ .  
Sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$ . (Metzke, Z. anorg. 1898, 19. 473.)

+  $4\text{H}_2\text{O}$ . Min. *Scorodite*. Easily sol. in  $\text{HCl}$  + Aq; insol. in  $\text{HNO}_3$  + Aq.

+  $8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . When freshly pptd., sol. in  $\text{NH}_4\text{OH}$  + Aq. Sol. in  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq. Insol. in  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4$  salts + Aq. (Wittstein.)

Sol. in warm  $\text{H}_2\text{SO}_4$  + Aq or  $(\text{NH}_4)_2\text{SO}_4$  + Aq. (Berthier, A. ch. (3) 7. 79.)

**Iron (ferric) arsenate, acid,  $\text{Fe}_2\text{O}_3, 3\text{As}_2\text{O}_5$ , +  $16.7\text{H}_2\text{O}$ .**

Ppt.; al. sol. in acids with a yellow color, and in  $\text{NH}_4\text{OH}$  + Aq with a red color. (Metzke, Z. anorg. 1898, 19. 476.)

$2\text{Fe}_2\text{O}_3, 3\text{As}_2\text{O}_5 + 12\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq.

Sol. in mineral acids.

Sol. only in conc.  $\text{H}_2\text{AsO}_4$  + Aq.

Sol. in  $(\text{NH}_4)_2\text{AsO}_4$ , and other  $\text{NH}_4$  salts + Aq. (Wittstein.)

Sol. in  $\text{NH}_4\text{OH}$  + Aq.

+  $22\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Sl. sol. in acids with a yellow color, and in  $\text{NH}_4\text{OH}$  + Aq with a red color. (Metzke, Z. anorg. 1898, 19. 475.)

**Iron (ferroferrous) arsenate,  $6\text{FeO}, 3\text{Fe}_2\text{O}_3, 4\text{As}_2\text{O}_5 + 32\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  + Aq. Decomp. by  $\text{KOH}$  + Aq. (Wittstein, J. B. 1866. 243.)

**Iron (ferric) lead arsenate,  $5\text{Fe}_2(\text{AsO}_4)_3, \text{Pb}_3(\text{AsO}_4)_2$ .**

Min. *Carmin Spar. Carminite*. Sol. in acids;  $\text{KOH}$  + Aq dissolves out  $\text{As}_2\text{O}_5$ . (Sandberger.)

**Iron (ferric) potassium arsenate,  $2\text{Fe}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{As}_2\text{O}_5$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Lefèvre.)

$\text{Fe}_2\text{C}_3, \text{K}_2\text{O}, 2\text{As}_2\text{O}_5$ . (Lefèvre.)

**Iron (ferric) sodium arsenate,  $\text{Fe}_2\text{O}_3, \text{Na}_2\text{O}, 2\text{As}_2\text{O}_5$ .**

(Lefèvre.)

$2\text{Fe}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$ . (Lefèvre.)

**Lanthanum arsenate,  $\text{La}_2\text{H}_2(\text{AsO}_4)_3$ .**

(Frerichs and Smith.)

Doubtful. (Cleve, B. 11. 910.)

**Lead arsenate, basic,  $15\text{PbO}, 2\text{As}_2\text{O}_5$  (?).**

Ppt. (Strömholm, Z. anorg. 1904, 38. 446.)

**Lead arsenate,  $\text{Pb}_3(\text{AsO}_4)_2$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq. (Wittstein.)

Sol. in 2703.5 pts.  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq containing 38.94%  $\text{HC}_2\text{H}_3\text{O}_2$ . (Bertrand, Monit. Scient. (3) 10. 477.)

Sol. in sat.  $\text{NaCl}$  + Aq. (Becquerel, C. R. 20. 1523.)

Not pptd. in presence of  $\text{Na citrate}$ . (Spiller.)

**Lead pyroarsenate,  $\text{Pb}_2\text{As}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. Sol. in  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq. (Rose.)

Decomp. by cold  $\text{H}_2\text{O}$ . (Lefèvre.)

+  $\text{H}_2\text{O} = \text{PbHAsO}_4$ . Ppt. (Salkowsky, J. pr. 104. 109.)

**Lead potassium arsenate,  $\text{PbKAsO}_4$ .**

(Lefèvre, A. ch. (6) 27. 5.)

**Lead sodium arsenate,  $\text{PbNaAsO}_4$ .**

(Lefèvre.)

$4\text{PbO}, 2\text{Na}_2\text{O}, 3\text{As}_2\text{O}_5$ . Superficially decomp. by cold  $\text{H}_2\text{O}$ . (Lefèvre.)

**Lead arsenate chloride,  $3\text{Pb}_3(\text{AsO}_4)_2, \text{PbCl}_2$ .**

Sol. in dil.  $\text{HNO}_3$  + Aq. (Lechartier.)

Min. *Mimetite*. Sol. in  $\text{HNO}_3$ , and  $\text{KOH}$  + Aq.

**Lithium arsenate,  $\text{Li}_3\text{AsO}_4$ .**

Ppt. Sol. in dil. acids and in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. (de Schulten, Bull. Soc. (3) 1. 479.)

$\text{LiH}_2\text{AsO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{H}_2\text{AsO}_4$  and  $\text{Li}_2\text{AsO}_4$ . (Rammelsberg, Pogg. 128. 311.)

**Magnesium arsenate,  $\text{Mg}_3(\text{AsO}_4)_2$ .**

Ppt.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $7\text{H}_2\text{O}$ , +  $8\text{H}_2\text{O}$ , +  $10\text{H}_2\text{O}$ , and +  $22\text{H}_2\text{O}$ . (Grühl, Dissert. 1897.)

+  $8\text{H}_2\text{O}$ . Min. *Hörnæsile*. Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids.

**Magnesium hydrogen arsenate,  $\text{MgHAsO}_4$ .**

+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (de Schulten, C. R. 100. 263.)

+  $5\text{H}_2\text{O}$ . (Schiefer.)

+  $6\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . 1000 pts. boiling  $\text{H}_2\text{O}$  dissolve 1.5 pts. (Thompson.)

Sol. in  $\text{HNO}_3$  + Aq before ignition, but insol. in acids after ignition. (Graham, A. 29. 29.)

+  $7\text{H}_2\text{O}$ . Min. *Roesslerite*. Sol. in  $\text{HCl}$  + Aq.

**Magnesium tetrahydrogen arsenate,  $\text{MgH}_4(\text{AsO}_4)_2$ .**

Very deliquescent; sol. in  $\text{H}_2\text{O}$ . (Schiefer.)

**Magnesium potassium arsenate,  $\text{MgKAsO}_4$ .**

Insol. in, but decomp. by cold  $\text{H}_2\text{O}$ . (Rose.)

Easily sol. in dil. acids. (Lefèvre.)

+  $7\text{H}_2\text{O}$ . (Kinkelin, Dissert. 1893.)

$4\text{MgO}, 2\text{K}_2\text{O}, 3\text{As}_2\text{O}_5$ . Not attacked by boiling  $\text{H}_2\text{O}$ ; slowly sol. in dil. acids. (Lefèvre.)

**Magnesium potassium hydrogen arsenate,  $\text{KMgH}(\text{AsO}_4)_2 + x\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Kinkelin, Dissert. 1893.)

$\text{Mg}_3\text{KH}_2(\text{AsO}_4)_3 + 5\text{H}_2\text{O}$ . (Chevron and Droxhe, J. B. 1888, 523.)

**Magnesium potassium sodium arsenate**,  $\text{Mg}_2\text{KNa}(\text{AsO}_4)_2 + 10\text{H}_2\text{O}$ .  
(Kinkelin, Dissert. 1883.)

**Magnesium sodium arsenate**,  $\text{MgNaAsO}_4$ .  
Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in dil. acids. (Lefèvre.)  
 $4\text{MgO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . (Lefèvre.)

**Magnesium vanadium arsenate**,  
 $\text{MgH}_2(\text{VO}_3)_2(\text{AsO}_4)_2 + 9\text{H}_2\text{O}$  and  
 $\text{MgHAsO}_4$ ,  $2(\text{VO}_3)_2\text{H}_2\text{AsO}_4 + 9\text{H}_2\text{O}$ .  
See Arseniovanadate, magnesium.

**Magnesium arsenate chloride**,  $\text{Mg}_2(\text{AsO}_4)_2$ ,  $\text{MgCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Lechartier, C. R. 65. 172.)

**Magnesium arsenate fluoride**,  $\text{Mg}_2(\text{AsO}_4)_2$ ,  $\text{MgF}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Lechartier.)

**Manganous arsenate, basic**,  $6\text{MnO}$ ,  $\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$  (?).

Min. *Chondroarsenite*. Easily and completely sol. in dil.  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ .

**Manganous arsenate**,  $\text{Mn}_2(\text{AsO}_4)_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in acids. (Coloriano, C. R. 103. 273.)

$5\text{MnO}$ ,  $2\text{As}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Coloriano.)

$2\text{MnO}$ ,  $\text{As}_2\text{O}_5$ . Sl. decomp. by cold  $\text{H}_2\text{O}$ , but rapidly on heating. (Lefèvre.)

$\text{MnHAsO}_4 + \text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$  into  $5\text{MnO}$ ,  $2\text{As}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{AsO}_4 + \text{Aq}$ .

**Manganous tetrahydrogen arsenate**,  
 $\text{MnH}_4(\text{AsO}_4)_2$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Schiefer.)

**Manganous potassium arsenate**,  $\text{MnKAsO}_4$ .  
(Lefèvre, A. ch. (6) 27. 5.)

**Manganous sodium arsenate**,  $\text{MnNaAsO}_4$ .

Very sol. in dil. acids. (Lefèvre.)  
 $2\text{MnO}$ ,  $4\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . Not attacked by boiling  $\text{H}_2\text{O}$ ; very sol. in dil. acids. (Lefèvre.)

**Manganous arsenate chloride**,  $\text{Mn}_2(\text{AsO}_4)_2$ ,  $\text{MnCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Lechartier, A. 58. 259.)

**Manganic arsenate**,  $\text{Mn}_2(\text{AsO}_4)_2 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids.

**Mercurous arsenate**,  $(\text{Hg}_2)_3(\text{AsO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Coloriano, C. R. 103. 273.) Ppt. (Haack, C. C. 1890, II. 736.)

$\text{Hg}_2(\text{AsO}_4)_2$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or alcohol. Decomp. by cold  $\text{HCl} + \text{Aq}$ . Sl. sol. in cold  $\text{HNO}_3 + \text{Aq}$ , from which it is precipitated by  $\text{NH}_4\text{OH}$  as  $\text{Hg}_2\text{HASO}_4$ . (Simon, Pogg. 41. 424.)

**Mercurous hydrogen arsenate**,  $\text{Hg}_2\text{HASO}_4$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by cold  $\text{HCl} + \text{Aq}$ ; sol. in cold  $\text{HNO}_3 + \text{Aq}$  without decomp; very sl. sol. without decomp. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Simon, Pogg. 41. 424.)

**Mercuric arsenate**,  $\text{Hg}_2(\text{AsO}_4)_2$ .

Ppt. Sol. in  $\text{H}_2\text{AsO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . (Bergman.) Very sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{H}_2\text{AsO}_4 + \text{Aq}$ . (Haack, C. C. 1890, II. 736.)

**Mercurous silver arsenate**,  $\text{Hg}_2\text{AgAsO}_4$ .

Sol. in hot conc.  $\text{HNO}_3$ . (Jacobsen, Bull. Soc. 1909, (4) 5. 948.)

**Mercurous arsenate nitrate**,  $\text{Hg}_2\text{AsO}_4$ ,  $\text{HgNO}_3 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Simon, Pogg. 41. 424.)

$3\text{Hg}_2\text{AsO}_4$ ,  $2\text{HgNO}_3$ ,  $2\text{Hg}_2\text{O}$ . Ppt. (Haack.)

**Molybdenum arsenate**.

Ppt.

**Nickel arsenate, basic**,  $5\text{NiO}$ ,  $\text{As}_2\text{O}_5$ .

Min. — (Bergemann.)

$\text{Ni}(\text{NiOH})\text{AsO}_4$ . Difficultly attacked by acids or alkalis. (Coloriano, Bull. Soc. (2) 45. 241.)

$5\text{NiO}$ ,  $2\text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ . As above.

**Nickel arsenate**,  $\text{Ni}_2(\text{AsO}_4)_2$ .

Min. — (Bergemann.)

$+x\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{AsO}_4$ , and conc. mineral acids. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

$+2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Coloriano, Bull. Soc. 45. 241.)

$+8\text{H}_2\text{O}$ . Min. *Nickel-bloom*, *Annabergite*. Easily sol. in acids.

$\text{NiHAsO}_4 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Difficultly attacked by acids. (Coloriano, C. R. 103. 274.)

**Nickel potassium arsenate**,  $12\text{NiO}$ ,  $3\text{K}_2\text{O}$ ,  $5\text{As}_2\text{O}_5$ .

(Lefèvre.)

$2\text{NiO}$ ,  $\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ . Rapidly sol. in dil. acids. (Lefèvre.)

**Nickel sodium arsenate**,  $\text{NiNaAsO}_4$ .

Very slowly sol. in dil. acids. (Lefèvre.)

$4\text{NiO}$ ,  $2\text{Na}_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ . (Lefèvre.)

**Nickel arsenate ammonia**,

$\text{Ni}_2(\text{AsO}_4)_2 \cdot \text{NH}_3 + 7\text{H}_2\text{O}$ .

$\text{Ni}_2(\text{AsO}_4)_2 \cdot 2\text{NH}_3 + 6\text{H}_2\text{O}$ .

$\text{Ni}_2(\text{AsO}_4)_2 \cdot 3\text{NH}_3 + 5\text{H}_2\text{O}$ . (Ducru, C. R. 1900, 131. 703.)

**Palladium arsenate (?)**.

Ppt.

**Platinum arsenate (?)**.

Ppt. Sol. in  $\text{HNO}_3 + \text{Aq.}$

**Potassium arsenate,  $\text{K}_2\text{AsO}_4$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Graham, Pogg. 32. 47.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Potassium hydrogen arsenate,  $\text{K}_2\text{HAsO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Potassium dihydrogen arsenate,  $\text{KH}_2\text{AsO}_4$ .**

Sol. in 5.3 pts.  $\text{H}_2\text{O}$  at  $6^\circ$ , forming a solution of sp. gr. 1.1134. Much more sol. in hot  $\text{H}_2\text{O}$ . Insol. in alcohol.

Sol. in 26.666 pts. boiling conc. alcohol. (Wenzel.)

**Potassium sodium hydrogen arsenate,  $\text{KNaHAsO}_4 + 16\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{Na}_2\text{H}_4(\text{AsO}_4)_4 + 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , and not easily decomp. thereby into its constituents. (Filhol and Senderens, C. R. 95. 343.)

**Potassium strontium arsenate,  $\text{KSrAsO}_4$ .**

(Lefèvre, C. R. 108. 1058.)

**Potassium vanadium arsenate,  $\text{K}(\text{VO}_2)_2\text{AsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ .**

See Arseniovanadate, potassium.

**Potassium zinc arsenate,  $\text{KZnAsO}_4$ .**

(Lefèvre.)

**Potassium arsenate sulphate.**

See Arseniosulphate, potassium.

**Rhodium arsenate (?)**.

Ppt.

**Rubidium metaarsenate,  $\text{RbAsO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Bouchonnet, C. R. 1907, 144. 642.)

**Rubidium arsenate,  $\text{Rb}_3\text{AsO}_4 + 2\text{H}_2\text{O}$ .**

Very hygroscopic; sol. in  $\text{H}_2\text{O}$  to give an alkaline solution. Absorbs  $\text{CO}_2$  from the air. (Bouchonnet, l.c.)

**Rubidium pyroarsenate,  $\text{Rb}_4\text{As}_2\text{O}_7$ .**

(Bouchonnet, l.c.)

**Rubidium hydrogen arsenate,  $\text{Rb}_2\text{HAsO}_4 + \text{H}_2\text{O}$ .**

Absorbs  $\text{CO}_2$  from the air. Very hygroscopic; sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Bouchonnet, l.c.)

**Rubidium dihydrogen arsenate,  $\text{RbH}_2\text{AsO}_4$ .**

Not hygroscopic. Very sol. in  $\text{H}_2\text{O}$ ; aq. solution is acid to litmus. (Bouchonnet, l.c.)

**Silver arsenate,  $\text{Ag}_3\text{AsO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids; easily sol. in  $\text{H}_3\text{AsO}_4 + \text{Aq.}$  (Joly, C. R. 103. 1071.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0085 g.  $\text{Ag}_3\text{AsO}_4$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, 67. 108.)

Much less sol. in  $\text{H}_2\text{AsO}_4$  than  $\text{Ag}_3\text{PO}_4$ . (Graham.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Scheele.)

Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  Insol. in  $\text{NH}_4$  sulphate, nitrate, or succinate +  $\text{Aq.}$  (Wittstein.)

Very sl. sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  more easily in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Graham.)

Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  but not so easily as  $\text{Ag}_3\text{PO}_4$ .

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

**Silver hydrogen arsenate,  $\text{Ag}_3\text{HAsO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ , with formation of  $\text{Ag}_3\text{AsO}_4$ . (Setterberg, Berz. J. B. 26. 208.)

$\text{AgH}_2\text{AsO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (Joly, C. R. 103. 1071.)

$\text{Ag}_2\text{O}, 2\text{As}_2\text{O}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Rather sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  Very easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Hurtzig and Geuther, A. 111. 168.)

**Silver arsenate ammonia,  $\text{Ag}_3\text{AsO}_4, 4\text{NH}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Widmann, Bull. Soc. (2) 20. 64.)

**Silver arsenate sulphate,  $3\text{Ag}_2\text{O}, \text{As}_2\text{O}_3, \text{SO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ , with separation of  $\text{Ag}_3\text{AsO}_4$ ; decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Setterberg, Berz. J. B. 26. 209.)

**Sodium arsenate,  $\text{Na}_2\text{AsO}_4 + 12\text{H}_2\text{O}$ .**

Permanent in dry air. Sol. in 3.57 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ . (Graham.) 100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 28 pts.  $\text{Na}_2\text{AsO}_4 + 12\text{H}_2\text{O}$ . (Berzelius.) Sol. in 3.75 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ ; or 100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  dissolve 26.7 pts.; or sat.  $\text{Na}_2\text{AsO}_4 + \text{Aq}$  at  $17^\circ$  contains 21.1%  $\text{Na}_2\text{AsO}_4 + 12\text{H}_2\text{O}$  or 10.4%  $\text{Na}_2\text{AsO}_4$ , and has sp. gr. 1.1186. (Schiff, A. 113. 350.)

Melts in crystal  $\text{H}_2\text{O}$  at  $85.5^\circ$ .

Sp. gr. of  $\text{Na}_2\text{AsO}_4 + \text{Aq}$  at  $17^\circ$ .

% = %  $\text{Na}_2\text{AsO}_4 + 12\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0053	9	1.0490	17	1.0945
2	1.0107	10	1.0547	18	1.1003
3	1.0161	11	1.0603	19	1.1061
4	1.0215	12	1.0659	20	1.1121
5	1.0270	13	1.0716	21	1.1179
6	1.0325	14	1.0773	22	1.1238
7	1.0380	15	1.0830	..	.....
8	1.0435	16	1.0887	..	.....

(Schiff, calculated by Gerlach, Z. anal. 8. 286.)

"Arsenate of soda" dissolves in 60 pts. boiling alcohol. (Wenzel.)

+  $4\frac{1}{2}\text{H}_2\text{O}$ . (Hall, Chem. Soc. 51. 93.)

+  $10\text{H}_2\text{O}$ . Efflorescent. (Hall.)

**Sodium hydrogen arsenate,  $\text{Na}_2\text{HASO}_4 + 7\text{H}_2\text{O}$ .**

Not efflorescent. (Schiff.)

Solubility in  $\text{Pb}(\text{NO}_3)_2 + \text{Aq.}$  A table is given which records the g. of  $\text{As}_2\text{O}_3$  in 100 cc. of the filtrate. (Curry, J. Am. Chem. Soc. 1915, **37**, 1685.)

+  $7\frac{1}{2}\text{H}_2\text{O}$ . (Lescocoeur, C. R. **104**, 1171.)

+  $12\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ ; sol. in 1.79 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ ; or 100 pts.  $\text{H}_2\text{O}$  at  $14^\circ$  dissolve 56 pts.  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$ . Sat.  $\text{Na}_2\text{HASO}_4 + \text{Aq}$  contains 35.9%  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$ , or 16.5%  $\text{Na}_2\text{HASO}_4$ , and has sp. gr. = 1.1722. (Schiff, A. **113**, 350.)

100 pts.  $\text{H}_2\text{O}$  at  $7.2^\circ$  dissolve 22.268 pts. (Thompson.)

100 pts.  $\text{H}_2\text{O}$  dissolve 17.2 pts.  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$  at  $0^\circ$ , and 140.7 pts. at  $30^\circ$ . (Tilden, Chem. Soc. **45**, 409.)

Melts in crystal  $\text{H}_2\text{O}$  at  $28^\circ$ . (Tilden.)

Sp. gr. of  $\text{Na}_2\text{HASO}_4 + \text{Aq}$  at  $14^\circ$ .  
% = %  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0042	15	1.0665	29	1.1358
2	1.0084	16	1.0712	30	1.1410
3	1.0126	17	1.0759	31	1.1463
4	1.0168	18	1.0807	32	1.1516
5	1.0212	19	1.0855	33	1.1569
6	1.0256	20	1.0904	34	1.1623
7	1.0300	21	1.0953	35	1.1677
8	1.0344	22	1.1003	36	1.1731
9	1.0389	23	1.1052	37	1.1786
10	1.0434	24	1.1103	38	1.1841
11	1.0479	25	1.1153	39	1.1896
12	1.0525	26	1.1204	40	1.1952
13	1.0571	27	1.1255	..	.....
14	1.0618	28	1.1306	..	.....

(Schiff, calculated by Gerlach, Z. anal. **8**, 280.)

Insol. in alcohol.

+  $13\frac{1}{2}\text{H}_2\text{O}$ . (Setterberg.)

**Sodium dihydrogen arsenate,  $\text{NaH}_2\text{AsO}_4 + \text{H}_2\text{O}$ .**

More sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{AsO}_4$  or  $\text{Na}_2\text{HASO}_4$ . (Schiff.)

+  $2\text{H}_2\text{O}$ . Efflorescent. (Joly and Duffet, C. R. **102**, 1391.)

**Sodium trihydrogen diarsenate,  $\text{Na}_2\text{H}_3(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Filhol and Senderens, C. R. **95**, 343.)

**Sodium strontium arsenate,  $\text{NaSrAsO}_4$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ . (Lefèvre.)

+  $9\text{H}_2\text{O}$ . Scarcely sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. **104**, 905.)

+  $18\text{H}_2\text{O}$ . (Joly.)

**Sodium uranyl arsenate,  $\text{Na}(\text{UO}_2)\text{AsO}_4$ .**

Ppt. (Werther, A. **68**, 312.)

**Sodium zinc arsenate,  $\text{NaZnAsO}_4$ .**

Slowly sol. in dil. acids. (Lefèvre.)

$\text{Na}_2\text{ZnAs}_2\text{O}_7$ . As above. (Lefèvre.)

**Sodium arsenate fluoride,  $\text{Na}_3\text{AsO}_4, \text{NaF} + 12\text{H}_2\text{O}$ .**

Sol. in 9.5 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ , and 2 pts. at  $75^\circ$ . (Briegleb, A. **97**, 95.)

**Sodium arsenate stannate,  $6\text{Na}_2\text{O}, 2\text{As}_2\text{O}_5, \text{SnO}_2 + 50\text{H}_2\text{O}$ .**

More difficultly sol. than sodium stannate. (Haefely, Phil. Mag. (4) **10**, 290.)

$5\text{Na}_2\text{AsO}_4, \text{Na}_2\text{SnO}_3 + 60\text{H}_2\text{O}$ . (Prandtl, B. **1907**, **40**, 2133.)

**Sodium arsenate sulphate,  $\text{Na}_4\text{As}_2\text{O}_{10}, 2\text{Na}_2\text{SO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Mitscherlich.)

$\text{Na}_4\text{As}_2\text{O}_7, \text{Na}_2\text{SO}_4$ . (Setterberg.)

**Sodium arsenate tungstate,  $\text{Na}_4\text{As}_2\text{O}_7, \text{Na}_2\text{W}_2\text{O}_{10} + 20\text{H}_2\text{O}$ .**

See Arseniotungstate, sodium.

**Strontium arsenate,  $\text{Sr}_3(\text{AsO}_4)_2$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Lefèvre, A. ch. (6) **27**, 5.)

**Strontium pyroarsenate,  $\text{Sr}_2\text{As}_2\text{O}_7$ .**

Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{SrHASO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . (Lefèvre.)

**Strontium hydrogen arsenate,  $\text{SrHASO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .**

Insol. in cold, but decomp. by hot  $\text{H}_2\text{O}$  into a basic, and a sol. acid salt. 100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 0.284 pt. (Thompson, **1831**.)

Sol. in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2$ , and very easily in  $\text{HCl} + \text{Aq.}$  (Kotschoubey, J. pr. **49**, 182.)

Sol. in  $\text{HNO}_3 + \text{Aq.}$

$\text{SrH}_4(\text{AsO}_4)_2 + 2\text{H}_2\text{O}$ . Partly sol. in  $\text{H}_2\text{O}$ . (Hörmann, Dissert. **1879**.)

**Strontium vanadium arsenate,  $\text{SrHASO}_4, 2(\text{VO}_2)\text{H}_2\text{AsO}_4 + 7\frac{1}{2}\text{H}_2\text{O}$ .**

See Arseniovanadate, strontium.

**Strontium arsenate chloride,  $3\text{Sr}_3(\text{AsO}_4)_2, \text{SrCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Lechartier, C. R. **65**, 172.)

**Thalious arsenate,  $\text{Tl}_3\text{AsO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) **5**, 5.)

**Thalious hydrogen arsenate,  $\text{Tl}_2\text{HASO}_4$ .**

Very easily sol. in  $\text{H}_2\text{O}$ . (Willm.)

**Thalious dihydrogen arsenate,  $\text{TlH}_2\text{AsO}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Willm.)

**Thallic arsenate,  $\text{TlAsO}_4 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq.}$ ; decomp. by  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq.}$  (Willm.)

**Thorium hydrogen arsenate**,  $\text{Th}(\text{HASO}_4)_2 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{AsO}_4 + \text{Aq.}$  (Berzelius.)  
Ppt.; insol. in  $\text{H}_2\text{O}$ . (Barbieri, C. A. 1911. 3385.)

$\text{Th}(\text{H}_2\text{AsO}_4)_4 + 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Barbieri, l. c.)

**Tin (stannous) arsenate**,  $\text{SnHASO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Lensen, A. 114. 113.)

**Tin (stannic) arsenate**,  $2\text{SnO}_2, \text{As}_2\text{O}_3$ .

Ppt. Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{HNO}_3 + \text{Aq.}$  (Haefely, Phil. Mag. (4) 10. 290.)

$\text{Sn}_2(\text{AsO}_4)_4 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{HCl} + \text{Aq.}$  and in aqua regia; insol. in  $\text{HNO}_3 + \text{Aq.}$  or  $\text{H}_2\text{SO}_4$ . (Williams, Proc. Soc. Manchester, 15. 67.)

*Colloidal.* Very slowly sol. in  $\text{H}_2\text{O}$ , from which it is pptd. by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$ ; also by  $\text{BaCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{FeCl}_3 + \text{Aq.}$  and by  $\text{AgNO}_3$ , or  $\text{KI} + \text{Aq.}$  Not pptd. by alcohol,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{HgCl}_2$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  The pptd. jelly is readily sol. in conc. acids, and  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq.}$  (Williams, l. c.)

**Tin (stannous) arsenate chloride**,  $\text{Sn}_2(\text{AsO}_4)_2, \text{SnCl}_2 + 2\text{H}_2\text{O}$ .

Decomp. on air. (Lensen, A. 114. 113.)

**Titanium arsenate (?)**.

Insol. in  $\text{H}_2\text{O}$ . Sol. in titanic acid, arsenic acid, or  $\text{HCl} + \text{Aq.}$  Sol. in Ti salts +  $\text{Aq.}$  (Rose.)

**Titanyl arsenate**,  $5\text{TiO}_2, 2\text{As}_2\text{O}_3$ .

Sol. in acids without decomp. Scarcely attacked by  $\text{KOH}$  or by  $\text{NH}_4\text{OH} + \text{Aq.}$  (Reichard, B. 1894, 27. 1026.)

**Uranous arsenate**,  $\text{U}_2(\text{AsO}_4)_3$ .

Ppt.

**Uranous hydrogen arsenate**,  $\text{UH}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$ .

Ppt. Sol. in  $\text{HCl} + \text{Aq.}$

**Uranyl arsenate**,  $(\text{UO}_2)_2\text{HASO}_4 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , and saline solutions, as  $\text{NH}_4\text{Cl} + \text{Aq.}$ ; sol. in the mineral acids; sol. in  $\text{K}_2\text{CO}_3 + \text{Aq.}$  (Werther, A. 68. 313.)

$(\text{UO}_2)_2\text{H}_4(\text{AsO}_4)_3 + 3\text{H}_2\text{O}$ . (Werther.)

$(\text{UO}_2)_2\text{As}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids.

$(\text{UO}_2)_3(\text{AsO}_4)_2 + 12\text{H}_2\text{O}$ .

Min. *Troegeite*.

**Vanadium dihydrogen arsenate**,  $(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Friedheim, B. 23. 2600.)

See *Arseniovandic acid*.

**Vanadium zinc arsenate**,  $(\text{VO}_2)_2\text{ZnH}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$ , and  $2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 6\frac{1}{2}\text{H}_2\text{O}$ .

See *Arseniovandate*, zinc.

**Vanadyl arsenate**,  $(\text{VO})_2\text{HASO}_4 + \text{H}_2\text{O}$ .

Very slowly sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol; easily sol. in  $\text{HCl} + \text{Aq.}$  (Berzelius.)

Composition given by Friedheim (B. 23. 2600).

**Yttrium arsenate**,  $\text{YtHASO}_4$ .

Ppt. Insol. in acetic, easily sol. in mineral acids.

**Zinc arsenate, basic**,  $4\text{ZnO}, \text{As}_2\text{O}_3 + \text{H}_2\text{O}$ .

(Friedel, J. B. 1866. 949.)

Min. *Adamite*. Easily sol. in dil.  $\text{HCl} + \text{Aq.}$  and is attacked by  $\text{HC}_2\text{H}_3\text{O}_2$ .

**Zinc arsenate**,  $\text{Zn}_3(\text{AsO}_4)_2$ .

(deSchulten, Bull. Soc. (3) 2. 300.)

$+ 3\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{HNO}_3$ , and  $\text{H}_2\text{AsO}_4 + \text{Aq.}$  (Köttig, J. pr. 48. 182.)

$+ 8\text{H}_2\text{O}$ .

Min. *Köttigite*.

**Zinc arsenate, acid**,  $\text{Zn}_2\text{H}_2(\text{AsO}_4)_4$ .

Easily sol. in cold  $\text{HCl} + \text{Aq.}$ , less easily in cold  $\text{HNO}_3$ . Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq.}$  (Gorguel, Dissert, 1894.)

$+ 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{AsO}_4$ , or  $\text{HNO}_3 + \text{Aq.}$  (Mitscherlich.)

$+ 5\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Demel, B. 12. 1279.) Could not be obtained, (Coloriano, Bull. Soc. (2) 45. 709.)

$2\text{ZnO}, \text{As}_2\text{O}_3$ . Very slowly decomp. by cold, rapidly by boiling  $\text{H}_2\text{O}$ . (Lefèvre.)

$\text{ZnHASO}_4 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Debray, Bull. Soc. (2) 2. 14.)

Decomp. by hot  $\text{H}_2\text{O}$  into  $4\text{ZnO}, \text{As}_2\text{O}_3 + \text{H}_2\text{O}$ . (Coloriano, C. R. 103. 273.)

$\text{Zn}(\text{ZnOH})_2\text{As}_2\text{O}_7 + 7\text{H}_2\text{O}$  (Gorgeul.)

**Zinc arsenate ammonia**,  $\text{Zn}_3(\text{AsO}_4)_2, 2\text{NH}_3 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids,  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq.}$  (Bette, A. 15. 141.)

**Zirconium arsenate**,  $2\text{ZrO}_2, \text{As}_2\text{O}_3 + \frac{1}{2}\text{H}_2\text{O} = (\text{ZrO})\text{HASO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq.}$  (Paykull, B. 6. 1467.)

**Perarsenic acid**.

See *Perarsenic acid*.

**Arsenicotungstic Acid**.

**Ammonium vanadium arsenicotungstate**.

See *Arsenicovanadicotungstate*, ammonium.

**Arsenicovanadicotungstic acid**.

**Ammonium arsenicovanadicotungstate**,

$16(\text{NH}_4)_2\text{O}, 5\text{As}_2\text{O}_3, 15\text{V}_2\text{O}_5, 26\text{WO}_3 + 101\text{H}_2\text{O}$ .

Sl. sol. in cold, readily sol. in hot  $\text{H}_2\text{O}$ . (Rogers, J. Am. Chem. Soc. 1903, 25. 308.)

**Arsenimide**,  $\text{As}_2(\text{NH})_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Hugot, C. R. 1904, 139. 56.)

**Arsenioarsenic acid**,  $3\text{As}_2\text{O}_3$ ,  $2\text{As}_2\text{O}_5$  +  $3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Joly, C. R. 100. 1221.)

$3\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Joly.)

$\text{As}_2\text{O}_3$ ,  $\text{As}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Joly.)

See also Arsenic trioxide pentoxide.

**Arseniochromic acid.**

**Ammonium arseniochromate**,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $4\text{CrO}_3$  +  $\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 280.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $8\text{CrO}_3$ . Decomp. by recryst. from  $\text{H}_2\text{O}$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 281.)

**Potassium arseniochromate**,  $2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $4\text{CrO}_3$ .

Decomp. by recryst. from  $\text{H}_2\text{O}$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 275.)

$2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $4\text{CrO}_3$  +  $\text{H}_2\text{O}$ . Decomp. by recryst. from  $\text{H}_2\text{O}$ . (Friedheim and Mozkin, l. c.)

**Arseniomolybdic acid**,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $10\text{H}_2\text{O}$ .

By recryst. from  $\text{H}_2\text{O}$  the comp. with  $18\text{H}_2\text{O}$  is formed. (Pufahl, Dissert. 1888.)

+  $16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Debray.)

+  $18\text{H}_2\text{O}$ . Completely sol. in  $\text{H}_2\text{O}$ . Sp. gr. of sat. solution at  $18.8^\circ$  is 2.21. Easily sol. in abs. alcohol. Insol. in  $\text{CS}_2$ , liq. hydrocarbons and  $\text{CHCl}_3$ . (Pufahl, l. c.)

$\text{As}_2\text{O}_5$ ,  $7\text{MoO}_3$  +  $14\text{H}_2\text{O}$ . (Seyberth, B. 7. 391.)

$\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $28\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Sp. gr. of sat. solution at  $18.3^\circ$  = 2.45 and 1 cc. contains 2.16 g. acid. Easily sol. in absolute alcohol; insol. in  $\text{CS}_2$ , liquid hydrocarbons and  $\text{CHCl}_3$ . (Pufahl, l. c.)

Sol. in ether with subsequent separation into two layers. See Phosphotungstic acid. (Drechsel, B. 20. 1452.)

+  $38\text{H}_2\text{O}$ . Efflorescent. When recryst. comp. with  $28\text{H}_2\text{O}$  is formed. (Pufahl, l. c.)

$\text{As}_2\text{O}_5$ ,  $20\text{MoO}_3$  +  $27\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3$  + Aq. (Debray, C. R. 78. 1408.)

**Ammonium arseniomolybdate**,  $(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $3\text{H}_2\text{O}$ .

(Friedheim, Z. anorg. 1894, 6. 28.)

+  $4\text{H}_2\text{O}$ . (Friedheim, l. c.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $2\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. in acids. (Debray.)

+  $4\text{H}_2\text{O}$ . Sl. sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . (Pufahl, l. c.)

$2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Cannot be recryst. therefrom. (Pufahl.)

+  $12\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 1894, 6. 31.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $4\text{H}_2\text{O}$ . (Friedheim, l. c.)

+  $8\text{H}_2\text{O}$ . (Friedheim, l. c.)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $7\text{MoO}_3$ ,  $\text{As}_2\text{O}_5$  +  $4\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Seyberth, B. 7. 391.)

Not obtained. (Pufahl.)

$7(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $14\text{MoO}_3$  +  $28\text{H}_2\text{O}$ .

(Friedheim, l. c.)

$5(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{MoO}_3$  +  $5\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 1894, 6. 31.)

$5(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $16\text{MoO}_3$  +  $9\text{H}_2\text{O}$ . Nearly insol. in cold, sol. in boiling  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH}$  + Aq. (Gibbs, Am. Ch. J. 3. 402.)

+  $12\text{H}_2\text{O}$ . (Pufahl, l. c.)

$2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $17\text{H}_2\text{O}$ . (Pufahl, l. c.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $14\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Kehrmann, Z. anorg. 1894, 7. 421.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $20\text{MoO}_3$ . Easily sol. in  $\text{H}_2\text{O}$ . (Debray, C. R. 78. 1408.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $24\text{MoO}_3$  +  $12\text{H}_2\text{O}$ . Decomposed by  $\text{H}_2\text{O}$ , especially when boiling.

Easily sol. in  $\text{NH}_4\text{OH}$  + Aq, less easily sol. in warm  $\text{H}_2\text{SO}_4$  and boiling  $\text{H}_2\text{AsO}_4$  + Aq. Sl. sol. in molybdic acid + Aq,  $\text{HNO}_3$ , and conc.  $\text{NH}_4\text{NO}_3$  + Aq. (Pufahl, l. c.)

**Barium arseniomolybdate**,  $\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $10\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Partially decomp. by boiling. (Pufahl, l. c.)

$3\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Pufahl, l. c.)

$3\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $7\text{MoO}_3$ . Ppt. (Seyberth.)

$3\text{BaO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Pufahl, l. c.)

**Cadmium arseniomolybdate**,  $\text{CdO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $11\text{H}_2\text{O}$ .

(Pufahl.)

$3\text{CdO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $33\text{H}_2\text{O}$ . (Pufahl.)

**Cæsium arseniomolybdate**,  $\text{Cs}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Pufahl, l. c.)

$4\text{Cs}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $26\text{MoO}_3$  +  $15\text{H}_2\text{O}$ . Ppt. (Ephraim, Z. anorg. 1910, 66. 246.)

**Calcium arseniomolybdate**,  $\text{CaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $10\text{H}_2\text{O}$ .

Rather difficultly sol. in cold  $\text{H}_2\text{O}$ . (Pufahl, l. c.)

$3\text{CaO}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$ . As Ba salt. (Pufahl, l. c.)

$3\text{CaO}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $32\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $18^\circ$  has sp. gr. = 2.163. (Pufahl, l. c.)

**Cobalt arseniomolybdate**,  $\text{CoO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $11\text{H}_2\text{O}$ .

(Pufahl.)

$3\text{CoO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $33\text{H}_2\text{O}$ . (Pufahl.)

**Cupric arseniomolybdate**,  $\text{CuO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$  +  $15\text{H}_2\text{O}$ . (Pufahl.)

$3\text{CuO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $18\text{MoO}_3$  +  $34\text{H}_2\text{O}$ . (Pufahl.)

**Lithium arseniomolybdate**,  $\text{Li}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 14\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{Li}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$ . Solution sat. at  $15^\circ$  has sp. gr. of 2.481. (Pufahl, l.c.)

**Magnesium arseniomolybdate**,  $\text{MgO}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{MgO}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 36\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

**Manganese arseniomolybdate**,  $\text{MnO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$ .

(Pufahl.)

$3\text{MnO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 33\text{H}_2\text{O}$ . (Pufahl.)

**Nickel arseniomolybdate**,  $\text{NiO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$ .

(Pufahl.)

$3\text{NiO}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$ . (Pufahl.)

**Potassium arseniomolybdate**,  $\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 2. 314.)

$\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{O}$  without decomp. (Friedheim, Z. anorg. 1892, 2. 330.)

$\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 25\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ . Decomp. on dilution. (Pufahl, l.c.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 26\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $20\text{MoO}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Debray, C. R. 78. 1408.)

$3\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $24\text{MoO}_3 + 12\text{H}_2\text{O}$ . Somewhat sol. in  $\text{H}_2\text{O}$  acidified with  $\text{HNO}_3$ . (Pufahl, l.c.)

**Rubidium arseniomolybdate**,  $3\text{Rb}_2\text{O}$ ,  $3\text{As}_2\text{O}_3$ ,  $5\text{MoO}_3 + 9\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1910, 65. 241.)

$\text{Rb}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$4\text{Rb}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 40\text{H}_2\text{O}$ . Pptd. (Ephraim, Z. anorg. 1910, 65. 241-4.)

**Silver arseniomolybdate**,  $3\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + x\text{H}_2\text{O}$ .

(Pufahl, Leipzig, 1888.)

$6\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 22\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH}$  and in dil.  $\text{HNO}_3$ . (Pufahl, l.c.)

$7\text{Ag}_2\text{O}$ ,  $2\text{As}_2\text{O}_3$ ,  $36\text{MoO}_3 + 30\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  strongly acidified with  $\text{HNO}_3$ . (Pufahl, l.c.)

**Sodium arseniomolybdate**,  $\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $2\text{MoO}_3 + 8\text{H}_2\text{O}$ .

(Friedheim, Z. anorg. 1892, 2. 357.)

$\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $19.8^\circ$  has sp. gr. = 1.678. (Friedheim, l.c.)

$3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O} + 12\text{H}_2\text{O}$ , and  $+13\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$3\text{Na}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 24\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

$+30\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

**Strontium arseniomolybdate**,  $\text{SrO}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 10\text{H}_2\text{O}$ .

As Ba salt. (Pufahl, l.c.)

$3\text{SrO}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3$ . As Ba salt. (Pufahl, l.c.)

$3\text{SrO}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 32\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Pufahl, l.c.)

**Thallium arseniomolybdate**,  $6\text{Tl}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + x\text{H}_2\text{O}$ .

Ppt. (Pufahl.)

$3\text{Tl}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 3\text{H}_2\text{O}$ . Ppt. (Pufahl.)

**Zinc arseniomolybdate**,  $\text{ZnO}$ ,  $2\text{H}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $6\text{MoO}_3 + 11\text{H}_2\text{O}$ .

(Pufahl.)

$3\text{ZnO}$ ,  $\text{As}_2\text{O}_3$ ,  $18\text{MoO}_3 + 37\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Pufahl.)

### Arseniophosphovanadicotungstic acid.

**Ammonium arseniophosphovanadicotungstate**,  $88(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_3$ ,  $12\text{P}_2\text{O}_5$ ,  $69\text{V}_2\text{O}_5$ ,  $148\text{WO}_3 + 484\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Rogers, J. Am. Chem. Soc. 1903, 25. 313.)

### Arseniophosphovanadico vanadiotungstic acid.

**Ammonium arseniophosphovanadico vanadiotungstate**,  $99(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_3$ ,  $12\text{P}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ ,  $66\text{V}_2\text{O}_5$ ,  $191\text{WO}_3 + 522\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Rogers, J. Am. Chem. Soc. 1903, 25. 314.)

### Arseniophosphovanadiotungstic acid.

**Ammonium arseniophosphovanadiotungstate**,  $82(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_3$ ,  $12\text{P}_2\text{O}_5$ ,  $52\text{V}_2\text{O}_5$ ,  $201\text{WO}_3 + 567\text{H}_2\text{O}$ .

Very sol. in warm  $\text{H}_2\text{O}$ . Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, 25. 312.)

### Arseniosulphuric acid.

**Ammonium arseniosulphate**,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$ .

Can be recryst. from  $\text{H}_2\text{O}$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 290.)

**Potassium arseniosulphate**,  $2\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$ .

(Friedheim and Mozkin, Z. anorg. 1894, 6. 289.)

$5\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $8\text{SO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Mozkin, Z. anorg. 1894, 6. 291.)



**Sodium arseniosulphate**,  $2\text{Na}_2\text{O}, \text{As}_2\text{O}_3, 2\text{SO}_3 + 3\text{H}_2\text{O}$ .  
(Friedheim and Moskin, Z. anorg. 1894, 6. 290.)

### Arseniotelluric acid.

**Ammonium arseniotellurate**,  $2(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, \text{TeO}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 28. 65.)

$4(\text{NH}_4)_2\text{O}, 3\text{As}_2\text{O}_3, 2\text{TeO}_3 + 11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Weinland.)

**Sodium arseniotellurate**,  $2\text{Na}_2\text{O}, \text{As}_2\text{O}_3, 2\text{TeO}_3 + 9\text{H}_2\text{O}$ .

Ppt. (Weinland, l.c.)

**Arseniotungstic acid**,  $3\text{H}_2\text{O}, \text{As}_2\text{O}_3, 16\text{WO}_3 + 32\text{H}_2\text{O} = \text{H}_2\text{AsW}_3\text{O}_{23} + 16\text{H}_2\text{O}$  ( $\alpha$ -anhydroarsenioluteotungstic acid).

Sol. in  $\text{H}_2\text{O}$ . (Kehrmann, A. 245. 45.)  
 $3\text{H}_2\text{O}, \text{As}_2\text{O}_3, 19\text{WO}_3$  (?). Sp. gr. of sat. solution in  $\text{H}_2\text{O}$  is 3.279. (Fremery, B. 17. 296.)

Is a mixture containing principally  $\text{H}_2\text{AsW}_3\text{O}_{23} + 16\text{H}_2\text{O}$ . (Kehrmann.)  
 $\text{As}_2\text{O}_3, 18\text{WO}_3 + x\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1899, 22. 292.)

### Aluminum ammonium arseniotungstate.

See **Aluminicoarseniotungstate**, ammonium.

**Ammonium arseniotungstate**,  $4(\text{NH}_4)_2\text{O}, 2\text{H}_2\text{O}, \text{As}_2\text{O}_3, 6\text{WO}_3 + 3\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ ; easily sol. in boiling  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 135.)

$7(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, 14\text{WO}_3 + 17\text{H}_2\text{O}$ . Very al. sol. even in boiling  $\text{H}_2\text{O}$ . (Fremery, l.c.)

$3(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, 16\text{WO}_3 + 16\text{H}_2\text{O} = (\text{NH}_4)_3\text{AsW}_3\text{O}_{23} + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$5(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, 17\text{WO}_3 + 8\text{H}_2\text{O}$ . Can be recryst. from  $\text{H}_2\text{O}$  without decomp. Decomp. by long boiling with  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1899, 22. 294.)

$3(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, 18\text{WO}_3 + 14$ , or  $18\text{H}_2\text{O}$ . Very sol. in cold  $\text{H}_2\text{O}$ . Can be recryst. from  $\text{H}_2\text{O}$ . (Kehrmann, l.c.)

$3(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, 21\text{WO}_3 + x\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Easily decomp. on recryst. (Kehrmann, l.c.)

$3(\text{NH}_4)_2\text{O}, \text{As}_2\text{O}_3, 24\text{WO}_3 + 12\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than corresponding phosphotungstate. (Kehrmann, l.c.)

**Barium arseniotungstate**,  $2\text{BaO}, \text{As}_2\text{O}_3, 16\text{WO}_3 + x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 262.)  
 $7\text{BaO}, \text{As}_2\text{O}_3, 22\text{WO}_3 + 54\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Can be recryst. therefrom. (Kehrmann, l.c.)

**Potassium arseniotungstate**,  $3\text{K}_2\text{O}, 3\text{H}_2\text{O}, \text{As}_2\text{O}_3, 6\text{WO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Readily sol. in alkali hydroxides + Aq. (Gibbs.)

$3\text{K}_2\text{O}, \text{As}_2\text{O}_3, 16\text{WO}_3 + 16\text{H}_2\text{O} = \text{K}_3\text{AsW}_3\text{O}_{23} + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$5\text{K}_2\text{O}, \text{As}_2\text{O}_3, 17\text{WO}_3 + 22\text{H}_2\text{O}$ . Scarcely sol. in cold  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1899, 22. 295.)

$3\text{K}_2\text{O}, \text{As}_2\text{O}_3, 18\text{WO}_3 + 14\text{H}_2\text{O}$ . Efflorescent. (Kehrmann, l.c.)

$3\text{K}_2\text{O}, \text{As}_2\text{O}_3, 19\text{WO}_3 + 16\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ . (Fremery.)

### Silver arseniotungstate, $\text{Ag}_3\text{AsW}_3\text{O}_{23}$ .

Insol. in  $\text{H}_2\text{O}$  (Kehrmann, A. 245. 55); perhaps identical with—

$6\text{Ag}_2\text{O}, \text{As}_2\text{O}_3, 16\text{WO}_3 + 11\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Sodium arseniotungstate**,  $3\text{Na}_2\text{O}, \text{As}_2\text{O}_3, 3\text{WO}_3 + 20\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Lefort, C. R. 92. 1461.)

### Arsenious acid, $\text{HASO}_2$ .

Solubility of  $\text{HASO}_2$  in amyl alcohol + Aq. at  $25^\circ$ .

$a_w$  = mol. of  $\text{HASO}_2$  in 1 l. of  $\text{H}_2\text{O}$ .

$a_a$  = mol. of  $\text{HASO}_2$  in 1 l. of amyl alcohol.

$h$  = partition coefficient.

$a_w$	$a_a$	$h$
0.0449	0.0082	5.48
0.0446	0.0083	5.38
0.0887	0.0164	5.41
0.0892	0.0161	5.53
0.1800	0.0324	5.55

(Auerbach, Z. anorg. 1903, 37. 356.)

Solubility of  $\text{HASO}_2$  in sat.  $\text{H}_3\text{BO}_3 + \text{Aq}$  and amyl alcohol.

$\delta_w$  = mol. of  $\text{HASO}_2$  in 1 l. of  $\text{H}_2\text{O}$ .

$\delta_a$  = mol. of  $\text{HASO}_2$  in 1 l. of amyl alcohol.

$h$  = partition coefficient.

$\delta_w$	$\delta_a$	$h$
0.0859	0.0161	5.33
0.1720	0.0321	5.35

(Auerbach, l.c.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

See **Arsenic trioxide**.

### Arsenites.

All arsenites, except those of the alkali metals, are partially or wholly insol. in  $\text{H}_2\text{O}$ , but easily sol. in acids; several are sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$ .

All basic arsenites are sol. in acids except those that give an insol. salt with the bases. Many are sol. in excess of  $\text{As}_2\text{O}_3 + \text{Aq}$ .

**Aluminum arsenite,  $Al_2O_3, As_2O_3$ .**

Sl. sol. in boiling  $H_2O$ . Easily sol. in  $NaOH + Aq$  and in acids. (Reichard, B. 1894, 27. 1029.)

**Aluminum arsenite iodide,  $AlI_3, 6As_2O_3 + 16H_2O$ .**

(Grühl, Dissert. 1897.)

**Ammonium arsenite,  $NH_4AsO_3$ .**

Very sol. in  $H_2O$ . (Luynes, J. pr. 72. 180.)  
Insol. in acetone. (Eidmann, C. C. 1899, II. 1014); (Naumann, B. 1904, 37. 4328.)  
 $(NH_4)_2AsO_3$  (?). Sol. in  $H_2O$ . (Stavenhagen, J. pr. 1895, (2) 51. 11.)

$(NH_4)_4As_2O_5$ . Very sol. in  $H_2O$ . Insol. in alcohol or ether. (Stein, A. 74. 218.)

Could not be obtained. (Stavenhagen.)

**Ammonium arsenite bromide,  $2As_2O_3, NH_4Br$ .**

Sl. sol. in  $H_2O$ . (Rüdorff, B. 19. 2679.)

**Ammonium arsenite chloride,  $As_2O_3, NH_4Cl$ .**

Sl. sol. in  $H_2O$ . Sol. in warm dil.  $NH_4OH + Aq$ . (Rüdorff.)

**Ammonium arsenite iodide,  $2As_2O_3, NH_4I$ .**

Sl. sol. in boiling  $H_2O$ . Sol. in warm dil.  $NH_4OH + Aq$ . (Rüdorff.)

**Antimony arsenite (?).**

Ppt. Sol. in a small amount  $H_2O$ , but insol. in a large quantity. (Berzelius.)

Completely sol. in  $KOH + Aq$ . (Reynolds.)

**Barium arsenite,  $Ba(AsO_3)_2$ .**

Easily sol. in  $H_2O$  when recently pptd., but insol. after being dried. Pptd. from aqueous solution by boiling. (Filhol, A. 68. 308.)

Only al. sol. in  $H_2O$ . (Stavenhagen, J. pr. 1895, (2) 51. 18.)

$Ba_2(AsO_3)_3$ . Sl. sol. in cold  $H_2O$ ; sol. in hot  $H_2O$  and dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 17.)

$BaH_4(AsO_3)_3$ . Ppt. (Bloxam, Chem. Soc. 15. 281.)

+  $34H_2O$ . Moderately sol. in cold, more easily sol. in hot  $H_2O$ . Insol. in alcohol. (Perper, Dissert. 1894.)

$Ba_2As_2O_5 + 2H_2O$ . Easily sol. in  $H_2O$ . (Stavenhagen, J. pr. 1895, (2) 51. 18.)

+  $4H_2O$ . Sl. sol. in  $H_2O$ ; also somewhat sol. in alcohol. (Stein, A. 74. 218.)

Sl. sol. in  $H_2AsO_4 + Aq$  and  $BaO, H_2 + Aq$ . (Dumas.)

Sol. in  $NH_4Cl + Aq$ . (Wackenroder, A. 41. 316.)

Not pptd. from solutions containing Na citrate. (Spiller.)

$BaAs_2O_7$ . Sol. in  $H_2O$ . Less sol. in alcohol. (Reichard, B. 1894, 27. 1033.)

**Bismuth arsenite,  $BiAsO_3 + 5H_2O$  (?).**

Easily sol. in  $HNO_3 + Aq$ . (Schneider, J. p. (2) 20. 419.)

Sl. sol. in  $H_2O$ . (Stavenhagen, J. pr. 1895, (2) 51. 35.)

**Cadmium arsenite,  $Cd_2(AsO_3)_2$ .**

Sl. sol. in  $H_2O$ ; easily sol. in  $NH_4OH + Aq$  and dil. acids. (Stavenhagen, l.c.)

$Cd_3As_2O_5$ . Ppt. (Reichard, B. 1898, 31. 2168.)

Sol. in acids without decomp.; insol. in alkalis. (Reichard, B. 1894, 27. 1033.)

$5CdO, As_2O_3 + 12H_2O$ . Not attacked by  $KOH, Ba(OH)_2$  or alkali carbonates +  $Aq$ . Insol. in  $KCN + Aq$ . (Reichard, Ch. Z. 1902, 26. 1145.)

**Cæsium arsenite bromide,  $As_2O_3, CsBr$ .**

Sol. in  $H_2O$ . (Wheeler, Z. anorg. 4. 451.)

**Cæsium arsenite chloride,  $As_2O_3, CsCl$ .**

As above.

**Cæsium arsenite iodide,  $As_2O_3, CsI$ .**

As above.

**Calcium arsenite,  $Ca(AsO_3)_2$ .**

Somewhat sol. in  $H_2O$ ; sol. in  $Ca(OH)_2 + Aq$  or  $As_2O_3 + Aq$ . (Simon, Pogg. 47. 417.)

$Ca_2(AsO_3)_3$ . Ppt. (Kühn, J. B. 1852. 379.)  
Only sl. sol.  $H_2O$ ; readily sol. in dil. acids. (Stavenhagen, l.c.)

Sol. in  $H_2O$ , insol. in alcohol. (Reichard, B. 1894, 27. 1036.)

$3CaO, 2As_2O_3 + 3H_2O$ . Sl. sol. in  $H_2O$ ; easily sol. in  $NH_4Cl + Aq$ ; sol. in  $As_2O_3 + Aq$ . (Stein.)

$CaH_4(AsO_3)_3 + xH_2O$ . Moderately sol. in  $H_2O$ . Insol. in abs. alcohol. (Perper, Dissert. 1894.)

$Ca_2As_2O_5$ . Sl. sol. in  $H_2O$ ; 1 pt. in 3000-4000 pts.  $H_2O$ . Alkali chlorides increase solubility slightly. (Stavenhagen, l.c.)

Sl. sol. in  $H_2O$ ; insol. in  $H_2O$  containing  $CaO, H_2$ . (Berzelius.)

Not pptd. in presence of 4000-5000 pts.  $H_2O$ . (Harting, Lassaing.)

Not pptd. from solutions containing  $NH_4$  salts; and when pptd. is sol. in  $(NH_4)_2SO_4, NH_4NO_3, NH_4C_2H_3O_2$ , and  $NH_4Cl + Aq$ . (Giesecke and Schweigger.)

Sol. in  $NH_4AsO_4 + Aq$ . (Schweigger.)

Sol. in  $CaCl_2 + Aq$ . (Ordway.)

Easily sol. in dil. acids. Not pptd. from solutions containing sodium citrate. (Spiller.)

**Calcium arsenite iodide,  $CaI_2, 3As_2O_3 + 12H_2O$ .**

Sl. sol. in  $H_2O$ . Decomp. on heating. (Grühl, Dissert. 1897.)

**Chromic arsenite,  $CrAsO_3$ .**

Sol. in  $H_2O$ , but slowly decomp. by boiling. (Neville, C. N. 34. 220.)

Sol. in  $HCl$ ; repptd. by  $NH_4OH + Aq$ ; sol. in  $KOH + Aq$ . (Reichard, B. 1894, 27. 1028.)

**Cobaltous arsenite basic,  $7CoO, As_2O_3$ .**

Very sol. in dil., difficultly sol. in conc.  $H_2SO_4$ . Sol. in conc.  $NaOH$  and in conc.  $NH_4OH + Aq$ . (Reichard, Z. anal. 1903, 42. 10.)

**Cobaltous arsenite,  $3\text{CoO}, \text{As}_2\text{O}_3$ .**

Sol.  $\text{KOH} + \text{Aq}$  with decomp. (Identical with salt of Girard). (Reichard, B. 1894, 27. 1031.)

+  $4\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Stavenhagen, J. pr. 1895, (2) 51. 39.)

$3\text{CoO}, 2\text{As}_2\text{O}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . (Girard, C. R. 1852, 34. 918.)

$\text{Co}_2\text{H}_3(\text{AsO}_3)_4$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Proust.)

Only sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when formed in a solution containing an excess of those reagents. (Reynoso, C. R. 31. 68.)

$\text{Co}_2\text{As}_2\text{O}_5$ . Ppt. (Reichard, B. 1898, 31. 2165.)

Sol. in  $\text{HNO}_3$  and  $\text{HCl} + \text{Aq}$ . (Proust.)

**Cupric arsenite,  $\text{Cu}(\text{AsO}_3)_2$ .**

(Avery, J. Am. Chem. Soc. 1906, 28. 1161.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, l.c.)

+  $2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Stavenhagen, l.c.)

$3\text{CuO}, \text{As}_2\text{O}_3$ . Ppt. (Stavenhagen, l.c.)

$2\text{CuO}, \text{As}_2\text{O}_3$ . (Scheele's green.) Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and in most acids. Formula is  $\text{Cu}_3(\text{AsO}_3)_2 + 2\text{H}_2\text{O}$ . (Sharples, C. N. 35. 89.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. Sol. in  $\text{KOH} + \text{Aq}$  with decomp. (Reichard, B. 1894, 27. 1026.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

$5\text{CuO}, \text{As}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , sol. in acids,  $\text{NH}_4\text{OH} + \text{Aq}$  and conc.  $\text{MOH} + \text{Aq}$ . (Reichard, Ch. Z. 1902, 26. 1142.)

$x\text{CuO}, y\text{As}_2\text{O}_3$ . Min. *Trippkäte*. Easily sol. in  $\text{HNO}_3$  and in  $\text{HCl} + \text{Aq}$ .

**Didymium arsenite,  $\text{Di}_2\text{H}_2(\text{AsO}_3)_2$ .**

Ppt. (Frerichs and Smith, A. 191. 355.)

Does not exist. (Cleve, B. 11. 910.)

**Glucinum arsenite iodide,  $\text{GlH}_2, 3\text{As}_2\text{O}_3 + 8\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Grühl, Dissert. 1897.)

**Gold (aurous) arsenite,  $3\text{Au}_2\text{O}, \text{As}_2\text{O}_3$ .**

Decomp. by light. (Reichard, B. 1894, 27. 1027.)

**Gold (auric) arsenite,  $\text{AuAsO}_3 + \text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 28.)

**Iron (ferrous) arsenite,  $\text{FeO}, \text{As}_2\text{O}_3$ .**

Decomp. in the air when moist; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd. (Reichard, B. 1894, 27. 1029-30.)

$\text{Fe}_2\text{As}_2\text{O}_5$ . Ppt. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{NH}_3$  arsenite, or other  $\text{NH}_4$  salts +  $\text{Aq}$ . (Wittstein.)

**Iron (ferric) arsenite, basic,  $4\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_3 + 5\text{H}_2\text{O}$ .**

Ppt.  $\text{H}_2\text{O}$  extracts  $\text{As}_2\text{O}_3$ . Sol. in conc. acids with separation of  $\text{As}_2\text{O}_3$ . Acetic acid is without action. (Bunsen and Berthold, 1834.)

Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

**Iron (ferric) arsenite,  $\text{Fe}_2\text{O}_3, \text{As}_2\text{O}_3$ .**

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  when freshly pptd. (Reichard, B. 1894, 27. 1030.)

$\text{Fe}_2\text{As}_2\text{O}_5$ . Ppt. (Reichard, B. 1898, 31. 2170.)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{NaOH}$ , and  $\text{KOH} + \text{Aq}$ . "Ferric arsenite" is sl. sol. in  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$ . (Kynaston, Dingt. 235. 326.)

**Lanthanum arsenite,  $\text{La}_2\text{H}_2(\text{AsO}_3)_2$ .**

Ppt. (Frerichs and Smith, A. 191. 355.)

Does not exist. (Cleve, B. 11. 910.)

**Lead arsenite,  $\text{Pb}(\text{AsO}_3)_2 + x\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{KOH}$ , but sol. in  $\text{NaOH} + \text{Aq}$ . (Berzelius.)

$\text{Pb}_2\text{As}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ ,  $\text{NH}_3$  arsenite, or other  $\text{NH}_4$  salts +  $\text{Aq}$ . (Wittstein.)

$\text{Pb}_3(\text{AsO}_3)_2$ . Scarcely sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HNO}_3$ , or  $\text{HCl}, \text{H}_2\text{O}_2 + \text{Aq}$ . Boiling  $\text{H}_2\text{O}$  dissolves some  $\text{As}_2\text{O}_3$ . Not completely insol. in  $\text{KOH} + \text{Aq}$ . (Streng, A. 129. 238.)

Sol. in acetic acid; insol. in  $\text{H}_2\text{O}$  in the presence of ammonium salts; sol. in  $\text{NaOH} + \text{Aq}$ ; sl. sol. in  $\text{KOH} + \text{Aq}$ . (Reichard, B. 1894, 27. 1024.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 33.)

**Lead arsenite chloride,  $\text{Pb}_2\text{As}_2\text{O}_5, 2\text{PbCl}_2$ .**

Min. *Ekdemite*. Easily sol. in  $\text{HNO}_3 + \text{Aq}$ , and warm  $\text{HCl} + \text{Aq}$ .

**Magnesium arsenite,  $\text{Mg}_2(\text{AsO}_3)_2$ .**

Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but sol. in a large excess of  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

Very sol. in boiling  $\text{H}_2\text{O}$  and in dil. acids. Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Reichard, B. 1894, 27. 1032.)

Very sol. in  $\text{H}_2\text{O}$  and dil. acids. (Stavenhagen, l.c.)

$\text{Mg}_2\text{As}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Hydroscopic. Very sol. in  $\text{H}_2\text{O}$  and acids. (Stavenhagen, l.c.)

$3\text{MgO}, 2\text{As}_2\text{O}_3 + 3\text{H}_2\text{O} + 15\text{H}_2\text{O}$ , and +  $18\text{H}_2\text{O}$ . (Perper, Dissert. 1894.)

**Magnesium arsenite iodide,  $\text{MgI}_2, 3\text{As}_2\text{O}_3 + 12\text{H}_2\text{O}$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . (Grühl, Dissert. 1897.)

**Manganous arsenite,  $\text{Mn}_2(\text{AsO}_3)_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol; easily oxidized by moist air. (Stavenhagen, l.c.)

$3\text{MnO}, 2\text{As}_2\text{O}_3$ . (Reichard, B. 1894, 27. 1032.)

**Mn<sub>3</sub>H<sub>2</sub>As<sub>2</sub>O<sub>10</sub> + 4H<sub>2</sub>O.** Sl. sol. in H<sub>2</sub>O. Very sol. in acids and alkali. (Stavenhagen, l.c.)

**Mn<sub>3</sub>As<sub>2</sub>O<sub>8</sub>.** Ppt. (Reichard, B. 1898, 31. 2165.)

**Mercurous arsenite, Hg<sub>2</sub>O, As<sub>2</sub>O<sub>3</sub>.**

Decomp. by light. Decomp. by H<sub>2</sub>O. (Reichard, B. 1894, 27. 1022.)

**Hg<sub>2</sub>AsO<sub>3</sub>.** Only sl. sol. in H<sub>2</sub>O; sol. in dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 24.)

Gradually and completely decomposed by H<sub>2</sub>O. (Reichard, Ch. Z. 1902, 26. 1143.)

**Mercuric arsenite, Hg<sub>2</sub>(AsO<sub>3</sub>)<sub>2</sub>.**

Sl. sol. in H<sub>2</sub>O. (Stavenhagen, l.c.)

Decomp. more easily by H<sub>2</sub>O than is the mercurous comp. (Reichard, Ch. Z. 1902, 26. 1143.)

**2HgO, As<sub>2</sub>O<sub>3</sub>.** Not decomp. by boiling with H<sub>2</sub>O. Undecomp. by boiling acids. Decomp. by KOH + Aq, K<sub>2</sub>CO<sub>3</sub> + Aq and NH<sub>4</sub>OH + Aq. (Reichard, B. 1894, 27. 1021.)

**Hg<sub>2</sub>As<sub>2</sub>O<sub>8</sub>.** Ppt. Decomp. by boiling H<sub>2</sub>O. Very sl. sol. in H<sub>2</sub>SO<sub>4</sub> + HCl. (Reichard, B. 1898, 31. 2170.)

**Nickel arsenite, Ni<sub>2</sub>(AsO<sub>3</sub>)<sub>2</sub>.**

Insol. in H<sub>2</sub>O; easily sol. in NH<sub>4</sub>OH + Aq (Proust.)

Ppt. (Reichard, B. 1898, 31. 2165.)

**3NiO, 2As<sub>2</sub>O<sub>3</sub>.** Sol. in NH<sub>4</sub>OH + Aq (identical with salt of Girard). (Reichard, B. 1894, 27. 1031.)

**+ 4H<sub>2</sub>O.** Insol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH + Aq. (Proust.)

Sol. in KOH + Aq. (Girard, C. R. 34. 918.)

**2NiO, As<sub>2</sub>O<sub>3</sub>.** Insol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH + Aq; sol. in KOH + Aq. (Reynoso, C. R. 31. 68.)

**Platinum arsenite, Pt<sub>2</sub>(AsO<sub>3</sub>)<sub>4</sub>.**

Sol. in H<sub>2</sub>O and alcohol; very unstable. (Stavenhagen, l.c.)

**Potassium arsenite, KAsO<sub>3</sub>.**

Sol. in H<sub>2</sub>O; sl. sol. in alcohol. (Pasteur, A. 68. 309.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Does not exist. (Stavenhagen, l.c.)

**K<sub>2</sub>AsO<sub>3</sub>.** Very sol. in H<sub>2</sub>O; sol. in alcohol. (Stavenhagen, l.c.)

**K<sub>4</sub>As<sub>2</sub>O<sub>7</sub> + 6H<sub>2</sub>O.** Very sol. in H<sub>2</sub>O; sol. in alcohol. (Stavenhagen, l.c.)

**K<sub>2</sub>As<sub>2</sub>O<sub>7</sub> + 2H<sub>2</sub>O.** Sol. in H<sub>2</sub>O; sl. sol. in alcohol. (Pasteur, A. 68. 309.)

**Potassium arsenite bromide, 4As<sub>2</sub>O<sub>3</sub>, 2KBr.**

More sol. in H<sub>2</sub>O than iodide. (Schiff and Sestini, A. 228. 72.)

**2As<sub>2</sub>O<sub>3</sub>, KBr.** (Rüdorff, B. 19. 2675.)

**Potassium arsenite chloride, 2As<sub>2</sub>O<sub>3</sub>, KCl.**

Much more quickly sol. in hot H<sub>2</sub>O than bromide or iodide. (Rüdorff, B. 19. 2675.)

**As<sub>2</sub>O<sub>3</sub>, KCl.** Decomp. by H<sub>2</sub>O.

**Potassium arsenite iodide, 3As<sub>2</sub>O<sub>3</sub>, 2KI + H<sub>2</sub>O.**

Sl. sol. in cold H<sub>2</sub>O; sol. in 20 pts. boiling, and 40 pts. cold H<sub>2</sub>O. (Emmet, Sill. Am. J. (2) 18. 583.)

**6KAsO<sub>3</sub>, 2KI + 3H<sub>2</sub>O.** Sol. in H<sub>2</sub>O and alcohol. Decomp. by acids. (Harms.)

**2KH(AsO<sub>3</sub>)<sub>2</sub>, As<sub>2</sub>O<sub>3</sub>, 2KI.** Sl. sol. in H<sub>2</sub>O. (Harms, A. 91. 371.)

**2As<sub>2</sub>O<sub>3</sub>, KI.** Very difficultly sol. even in boiling H<sub>2</sub>O. Very easily sol. in KOH + Aq, but much less so in K<sub>2</sub>CO<sub>3</sub> + Aq. (Rüdorff, B. 19. 2670.)

Sol. in 40 pts. cold, 20 pts. hot H<sub>2</sub>O; sol. in alkalies. (Schiff and Sestini, A. 228. 72.)

**Potassium arsenite sulphate, K<sub>2</sub>AsO<sub>3</sub>, 10K<sub>2</sub>SO<sub>4</sub>.**

(Stavenhagen, Zeit. angew. ch. 1894, 8. 166.)

**Rubidium arsenite, RbAsO<sub>3</sub>.**

Sol. in H<sub>2</sub>O; aq. solution is alkaline to litmus. Insol. in alcohol. (Bouchonnet, C. R. 1907, 144. 641.)

**Rubidium arsenite bromide, As<sub>2</sub>O<sub>3</sub>, RbBr.**

Decomp. by H<sub>2</sub>O. (Wheeler, Z. anorg. 4. 451.)

**Rubidium arsenite chloride, As<sub>2</sub>O<sub>3</sub>, RbCl.**

As above.

**Rubidium arsenite iodide, As<sub>2</sub>O<sub>3</sub>, RbI.**

As above.

**Silver arsenite, Ag<sub>3</sub>AsO<sub>3</sub>.**

Insol. in H<sub>2</sub>O. Not pptd. in presence of 20,000 pts. H<sub>2</sub>O. (Harting.)

**11. H<sub>2</sub>O dissolves 0.0115 g. Ag<sub>3</sub>AsO<sub>3</sub> at 20°.** (Whitby, Z. anorg. 1910, 67. 108.)

Only sl. sol. in H<sub>2</sub>O and in dil. acids; readily sol. in NH<sub>4</sub>OH + Aq and conc. acids. (Stavenhagen, l.c.)

Decomp. by light, by KOH + Aq and by NH<sub>4</sub>OH + Aq. (Reichard, B. 1894, 27. 1022-23.)

Easily sol. in HNO<sub>3</sub> + Aq and other acids. (Marcet.)

More easily sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq than Ag<sub>3</sub>PO<sub>3</sub>; sl. sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Santos, C. N. 38. 94.)

Insol. in KOH + Aq. (Kühn, Arch. Pharm. (2) 69. 267.)

Easily sol. in NH<sub>4</sub>OH + Aq. (Marcet.)

Insol. in NH<sub>4</sub>OH + Aq, but sol. therein in presence of alkali nitrates. (Santos, l.c.)

Incompletely sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, or NH<sub>4</sub>NO<sub>3</sub> + Aq. (Wittstein, Report. 51. 41.)

Decomp. by  $\text{NH}_4\text{Cl} + \text{Aq.}$  Sol. in  $\text{KAsO}_2 + \text{Aq.}$  (Kühn, l.c.)

Not pptd. in solutions containing sol. citrates. (Spiller.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sl. sol. in methyl acetate. (Besold, Dissert. 1908.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; (Naumann, B. 1910, 43. 314.)

+  $\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$  and in dil. acids. (Stavenhagen, J. pr. 1895, (2) 51. 29.)

$2\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ . Ppt. (Pasteur, J. Pharm. (3) 13. 395.)

Could not be obtained. (Stavenhagen, l.c.)

$3\text{Ag}_2\text{O}$ ,  $2\text{As}_2\text{O}_3$ . Sol. in cold  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq.}$  (Santos.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and in potassium arsenite +  $\text{Aq.}$  (Girard, C. R. 34. 918.)

Ppt. (Reichard, B. 1898, 31. 2167.)

Could not be obtained. (Stavenhagen, l.c.)

**Silver arsenite ammonia**,  $2\text{Ag}_2\text{O}$ ,  $\text{As}_2\text{O}_3$ ,  $4\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. (Girard.)

### Sodium arsenites.

Correspond to potassium arsenites, but have not been obtained in crystalline form. All are very sol. in  $\text{H}_2\text{O}$ . (Pasteur, A. 68. 308.)

$\text{Na}_2\text{AsO}_3$ . Very sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, l.c.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3602.)

**Sodium arsenite bromide**,  $2\text{As}_2\text{O}_3$ ,  $\text{NaBr}$ .

Decomp. by warm  $\text{H}_2\text{O}$ . (Rüdorff, B. 21. 3052.)

**Sodium arsenite iodide**,  $2\text{As}_2\text{O}_3$ ,  $\text{NaI}$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Rüdorff.)

**Strontium arsenite**,  $\text{Sr}_3(\text{AsO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, l.c.)

Sol. in  $\text{H}_2\text{O}$ , insol. in alcohol (identical with Stein.) (Reichard, B. 1894, 27. 1036.)

$\text{Sr}_2\text{As}_2\text{O}_5 + 2\text{H}_2\text{O}$ . Quite easily sol. in  $\text{H}_2\text{O}$ . (Stein.)

Sl. sol. in  $\text{H}_2\text{C}$ ,  $\text{SrO}$ ,  $\text{H}_2\text{O}_2 + \text{Aq.}$  or  $\text{H}_2\text{AsO}_4 + \text{Aq.}$  (Dumas.)

Very sl. sol. in alcohol. (Stein.)

Easily sol. in  $\text{H}_2\text{O}$  and in acids. (Stavenhagen, J. pr. 1895, (2) 51. 17.)

$\text{Sr}_2\text{As}_2\text{O}_5$ . Moderately sol. in  $\text{H}_2\text{O}$ . (Reichard, B. 1894, 27. 1036.)

**Strontium arsenite iodide**,  $\text{SrI}_2$ ,  $3\text{As}_2\text{O}_3 + 12\text{H}_2\text{O}$ .

As Ba comp. (Grühl, Dissert. 1897.)

**Thallium arsenite**,  $\text{Tl}_3\text{AsO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$  and alcohol; easily sol. in acids, especially in dil.  $\text{H}_2\text{SO}_4$ . (Stavenhagen, l.c.)

**Tin (stannous) arsenite**,  $\text{Sn}_2(\text{AsO}_3)_2$ .

Ppt.; decomp. by acids and alkali. (Reichard, B. 1898, 31. 2169.)

+  $2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids and alkalis. (Stavenhagen, l.c.)

**Tin (stannic) arsenite**,  $\text{Sn}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Stavenhagen, l.c.)

$5\text{SnO}_2$ ,  $2\text{As}_2\text{O}_5$ . Ppt. Sol. in acids without decomp. (Reichard, B. 1894, 27. 1025.)

$\text{Sn}_2\text{As}_2\text{O}_{17}$ . Ppt. (Reichard, B. 1898, 31. 2169.)

**Uranium arsenite**,  $\text{UO}_2$ ,  $\text{As}_2\text{O}_3$ .

Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$ ; only sl. sol.  $\text{KOH} + \text{Aq.}$  Sol. in acids. (Reichard, B. 1894, 27. 1029.)

**Zinc arsenite**,  $\text{ZnO}$ ,  $\text{As}_2\text{O}_3$ .

Ppt. (Avery, J. Am. Chem. Soc. 1906, 28. 1163.)

$3\text{ZnO}$ ,  $\text{As}_2\text{O}_3$ . Sol. in acids without decomp. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Reichard, B. 1894, 27. 1033.)

**Arseniovanadic acid**,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , but solution easily decomposes; crystallizes from  $\text{H}_2\text{O}$  with  $10\text{H}_2\text{O}$ . Composition is vanadium dihydrogen arsenate  $(\text{VO})_2\text{H}_2\text{AsO}_4$ . (Friedheim, B. 23. 2600.)

+ 14, and +  $18\text{H}_2\text{O}$ . (Ditte, C. R. 102. 757.) Could not be obtained. (Friedheim.)

$3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5$ . (Berzelius.) Correct formula is as above. (Friedheim.)

$3\text{H}_2\text{O}$ ,  $7\text{As}_2\text{O}_5$ ,  $6\text{V}_2\text{O}_5$ . (Gibbs, Am. Ch. J. 7. 209.) Could not be obtained. (Friedheim.)

$3\text{H}_2\text{O}$ ,  $5\text{As}_2\text{O}_5$ ,  $8\text{V}_2\text{O}_5 + 24\text{H}_2\text{O}$ . (Gibbs.) Could not be obtained. (Friedheim.)

### Arseniovanadates.

According to Friedheim (Z. anorg. 1892, 2. 319) the arseniovanadates are double arsenates of  $\text{VO}_2$  and  $\text{NH}_4$ .

**Ammonium arseniovanadate**,  $(\text{NH}_4)_2\text{O}$ ,

$\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ .

Efflorescent in dry air; sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Composition is ammonium divanadium arsenate  $= (\text{VO})_2(\text{NH}_4)\text{AsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ . (Friedheim, B. 23. 2600.)

Sl. sol. in cold  $\text{H}_2\text{O}$ . Somewhat more easily sol. in hot  $\text{H}_2\text{O}$  with separation of  $\text{V}_2\text{O}_5$ . (Schmitz-Dumont, Dissert. 1891.)

$2(\text{NH}_4)_2\text{O}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Cannot be crystallized from  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{HAsO}_4 + 2(\text{VO})_2\text{H}_2\text{AsO}_4$ . (Friedheim.)

Decomp. under  $\text{H}_2\text{O}$  to  $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $\text{As}_2\text{O}_5 + 5\text{H}_2\text{O}$ . (Schmitz-Dumont, l.c.)

$5(\text{NH}_4)_2\text{O}$ ,  $4\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1019.) Does not exist. (Friedheim, B. 23. 2605.)

**Calcium arseniovanadate**,  $2\text{CaO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 21\text{H}_2\text{O} = \text{CaHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 8\text{H}_2\text{O}$ .

Can be crystallized in presence of vanadic acid without decomp. (Friedheim.)

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Schmitz-Dumont, l.c.)

**Cobalt arseniovanadate**,  $\text{CoO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 9\text{H}_2\text{O} = \text{Co}(\text{VO}_2)_2\text{H}_2(\text{AsO}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

**Copper arseniovanadate**,  $\text{CuO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 4\text{H}_2\text{O} = \text{Cu}(\text{VO}_2)_2\text{H}_2(\text{AsO}_4)_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

**Magnesium arseniovanadate**,  $\text{MgO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 10\text{H}_2\text{O} = (\text{VO}_2)_2\text{MgH}_2(\text{AsO}_4)_2 + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Moderately sol. in  $\text{H}_2\text{O}$ . Solution decomp. on standing. (Schmitz-Dumont, l.c.)

$2\text{MgO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 23\text{H}_2\text{O} = \text{MgHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Sol. in  $\text{H}_2\text{O}$  but solution decomp. on evaporation. (Schmitz-Dumont, l.c.)

**Potassium arseniovanadate**,  $\text{K}_2\text{O}$ ,  $\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O} = (\text{VO}_2)_2\text{KAsO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Sl. sol. in cold  $\text{H}_2\text{O}$ . Partially decomp. on heating. (Schmitz-Dumont.)

**Strontium arseniovanadate**,  $2\text{SrO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 20\text{H}_2\text{O} = \text{SrHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4 + 7\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

$+21\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Schmitz-Dumont.)

**Zinc arseniovanadate**,  $\text{ZnO}$ ,  $\text{As}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 6\frac{1}{2}\text{H}_2\text{O} = \text{Zn}(\text{VO}_2)_2\text{H}_2(\text{AsO}_4)_2 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

$2\text{ZnO}$ ,  $3\text{As}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ , and  $+18\text{H}_2\text{O} = \text{ZnHAsO}_4 + 2(\text{VO}_2)_2\text{H}_2\text{AsO}_4$ , and  $+6\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

### Arseniovanadicotungstic acid.

**Ammonium arseniovanadicotungstate**,  $17(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $14\frac{1}{2}\text{V}_2\text{O}_5$ ,  $20\text{WO}_3 + 98\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Readily sol. in boiling  $\text{H}_2\text{O}$ . Insol. in alcohol, ether, benzene,  $\text{CS}_2$ ,  $\text{CHCl}_3$ , acetone, nitrobenzene, aniline and acetic anhydride. (Rogers, J. Am. Chem. Soc. 1903, 25. 307.)

### Arseniovanadicovanadic acid.

**Ammonium arseniovanadicovanadate**,  $5(\text{NH}_4)_2\text{O}$ ,  $12\text{As}_2\text{O}_5$ ,  $12\text{VO}_3$ ,  $6\text{V}_2\text{O}_5 + 7\text{H}_2\text{O}$ .

Sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$ , from which crystallizes—

$4(\text{NH}_4)_2\text{O}$ ,  $9\text{As}_2\text{O}_5$ ,  $9\text{VO}_3$ ,  $8\text{V}_2\text{O}_5 + 11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 209.)

### Arseniovanadicovanadidotungstic acid.

**Ammonium arseniovanadicovanadidotungstate**,  $17(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_3$ ,  $32\text{WO}_3 + 73\text{H}_2\text{O}$ .

Sl. sol. in cold, readily sol. in boiling  $\text{H}_2\text{O}$ . (Rogers, J. Am. Chem. Soc. 1903, 25. 310.)

### Arseniovanadidotungstic acid.

**Ammonium arseniovanadidotungstate**,  $18(\text{NH}_4)_2\text{O}$ ,  $2\text{As}_2\text{O}_5$ ,  $13\text{V}_2\text{O}_5$ ,  $39\text{WO}_3 + 88\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in organic solvents. (Rogers, J. Am. Chem. Soc. 1903, 25. 306.)

### Arseniuretted hydrogen, $\text{AsH}_3$ .

See Arsenic hydride.

### Arsenochromic acid.

**Potassium arsenochromate**,  $\text{K}_2\text{Cr}_2\text{As}_2\text{O}_{11} + 12\text{H}_2\text{O}$ .

Sol. in moderately conc. mineral acids. (Tarugi, C. C. 1897, II. 724.)

$\text{K}_2\text{Cr}_2\text{As}_2\text{O}_{11} + 24\text{H}_2\text{O}$ . Ppt. Sol. in dil. warm acids. (Tarugi.)

**Potassium hydrogen arsenochromate**,  $\text{K}_4\text{H}_2\text{Cr}_2\text{As}_2\text{O}_{14}$ .

(Tarugi, C. C. 1897, II. 724.)

### Arsensoarseniotungstic acid.

**Potassium arsenosoarseniotungstate**,  $10\text{K}_2\text{O}$ ,  $4\text{As}_2\text{O}_5$ ,  $\text{As}_2\text{O}_3$ ,  $21\text{WO}_3 + 26\text{H}_2\text{O}$ .

Precipitate. Sol. in a large amount of hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 313.)

### Arsenosomolybdic acid.

**Ammonium arsenosomolybdate**,  $3(\text{NH}_4)_2\text{O}$ ,  $5\text{As}_2\text{O}_5$ ,  $12\text{MoO}_3 + 24\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 313.)

**Ammonium barium arsenosomolybdate**,  $3(\text{NH}_4)_2\text{O}$ ,  $2\text{BaO}$ ,  $5\text{As}_2\text{O}_5$ ,  $10\text{MoO}_3 + 50\text{H}_2\text{O}$ .

Ppt. (Ephraim, Z. anorg. 1910, 66. 57.)

**Ammonium cupric arsenosomolybdate**,  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  $2\text{As}_2\text{O}_5$ ,  $4\text{MoO}_3 + 2\text{H}_2\text{O}$ , and  $2(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  $3\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Ppts. (Ephraim, Z. anorg. 1910, 66. 58.)

**Barium arsenosomolybdate**,  $3\text{BaO}$ ,  $2\text{As}_2\text{O}_5$ ,  $8\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Copper arsenosomolybdate**,  $2\text{CuO}$ ,  $3\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Manganese arsenosomolybdate**,  $2\text{MnO}$ ,  $3\text{As}_2\text{O}_5$ ,  $6\text{MoO}_3 + 6\text{H}_2\text{O}$ , and  $+15\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Potassium arsenosomolybdate**,  $3K_2O, As_2O_3, 5MoO_3 + 3H_2O$ .

Easily sol. in  $H_2O$ . (Ephraim, Z. anorg. 1910, 66. 54.)

$3K_2O, As_2O_3, 8MoO_3 + 18H_2O$ . Easily sol. in  $H_2O$ . (Ephraim.)

**Sodium arsenosomolybdate**,  $Na_2O, As_2O_3, 2MoO_3 + 6H_2O$ .

Easily sol. in  $H_2O$ . (Ephraim, Z. anorg. 1910, 66. 56.)

$2Na_2O, As_2O_3, 4MoO_3 + 13H_2O$ . Ppt. (Ephraim.)

**Zinc arsenosomolybdate**,  $2ZnO, 3As_2O_3, 6MoO_3 + 6H_2O$ .

Sol. in  $H_2O$ . (Gibbs.)

### Arsenosophosphotungstic acid.

**Potassium arsenosophosphotungstate**,  $10K_2O, 14As_2O_3, 3P_2O_5, 32WO_3 + 28H_2O$ .

Moderately sol. in cold, very easily in hot  $H_2O$ . (Gibbs.)

$7K_2O, 2As_2O_3, 4P_2O_5, 60WO_3 + 55H_2O$ . Sol. in hot  $H_2O$  with decomp. (Gibbs.)

**Potassium sodium arsenosophosphotungstate**,  $5K_2O, Na_2O, 2As_2O_3, 2P_2O_5, 12WO_3 + 15H_2O$ .

(Gibbs, Am. Ch. J. 7. 313.)

### Arsenosotungstic acid.

**Ammonium arsenosotungstate**,  $7(NH_4)_2O, 2As_2O_3, 18WO_3 + 18H_2O$ .

Sol. in  $H_2O$ . (Gibbs.)

**Barium arsenosotungstate**,  $4BaO, As_2O_3, 9WO_3 + 21H_2O$ .

Precipitate. Nearly insol. in  $H_2O$ . (Gibbs.)

**Sodium arsenosotungstate**,  $9Na_2O, 8As_2O_3, 16WO_3 + 55H_2O$ .

Very sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 7. 313.)

**Arsenyl bromide**,  $AsOBr$ .

$H_2O$  dissolves out  $As_2O_3$ ; insol. in alcohol. (Sérullas.)

$+H_2O$ . (Wallace, Phil. Mag. (4) 17. 122.)  
 $As_2O_3Br_3 = 2AsBr_3, 3As_2O_3 + 12H_2O$ .

**Arsenyl bromide with MBr.**

See Arsenite bromide, M.

**Arsenyl chloride**,  $AsOCl$ .

Sol. in  $H_2O$  with decomp.

$+H_2O$ . (Wallace, Phil. Mag. (4) 16. 358.)  
 $As_2O_3Cl_3$ . (Wallace.)

**Arsenyl chloride with MCl.**

See Arsenite chloride, M.

**Arsenyl potassium fluoride**,  $AsOF_2, KF + H_2O$ .

(Marignac, A. 145. 237.)

**Arsenyl iodide**,  $As_2I_2O_{11} = 2AsOI, 3As_2O_3 + 12H_2O$ .

Decomp. by  $H_2O$ . (Wallace, Phil. Mag. (4) 17. 122.)

Sl. sol. in cold  $H_2O$ , less sol. in alcohol. (Plisson, J. Pharm. 14. 46.)

**Arsenyl iodide with MI.**

See Arsenite iodide, M.

**Arsenyl sulphoiodide**,  $As_2I_2S_2O_8$ .

Scarcely attacked by cold  $H_2O$ . Boiling  $H_2O$  extracts  $AsI_3$ . Decomp. by hot  $HNO_3$  or  $H_2SO_4$ . Easily sol. in  $KOH$  or  $NH_4OH + Aq$ . (Schneider, J. pr. (2) 36. 513.)

### Arsine.

See Arsenic hydride.

### Atmospheric air.

See Air, atmospheric.

**Auriamine**,  $Au(OH)_2NH_3$ .

(Jacobsen, C. R. 1908, 146. 1214.)

**Diauriamine**,  $Au_2(OH)_4NH_3$ .

(Jacobsen, C. R. 1908, 146. 1214.)

**Sesquiauriamine**,  $NAu_3, NH_3$ .

Decomp. by  $H_2O$  into  $NAu_3$ . (Raschig, A. 235. 341.)

**Auric acid**,  $HAu_2O_4$ .

Sol. in  $HBr$ , or  $HCl + Aq$ . (Krüss, B. 19. 2546.)

**Ammonium aurate.**

See Auroamidoimide.

**Barium aurate**,  $BaAu_2O_4 + 5H_2O$ .

Sl. sol. in  $H_2O$ . (Weigand, Zeit. angew. Ch. 1905, 19. 139.)

$+6H_2O$ . Sl. sol. in  $H_2O$ . Sol. in dil.  $H_2SO_4$  and in dil.  $HNO_3$ . Sol. in  $HCl$ . Decomp. by alcohol. (Meyer, C. R. 1907, 145. 806.)

**Calcium aurate (?)**.

Insol. in  $H_2O$ ; sol. in  $CaCl_2 + Aq$ . (Fremy, A. ch. (3) 31. 485.)

$CaAu_2O_4 + 6H_2O$ . As Ba salt. (Meyer, C. R. 1907, 145. 806.)

**Magnesium aurate (?)**.

Ppt. Insol. in  $H_2O$ ; sol. in  $MgCl_2 + Aq$ . (Pelletier.)

**Potassium aurate**,  $KAuO_2 + 3H_2O$ .

Very sol. in  $H_2O$ , and easily decomp. (Fremy, A. ch. (3) 31. 483.)

Sol. in alcohol; the solution in alcohol does not decomp. below  $50^\circ$ . (Figuier, A. ch. (3) 11. 364.)

**Potassium aurate sulphite**,  $KAuO_2, 2K_2SO_3 + 5H_2O$ .

Sol. in  $H_2O$  with decomp. Nearly insol. in alkaline solutions. (Fremy, A. ch. (3) 31. 485.)

**Sodium aurate,  $\text{Na}_2\text{Au}_2\text{O}_4 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ , dil.  $\text{HNO}_3$ , and  $\text{HCl}$  with decomp. Decomp. by alcohol. (Meyer, C. R. 1907, 145. 806.)

**Strontium aurate,  $\text{SrAu}_2\text{O}_4 + 6\text{H}_2\text{O}$ .**

As Ba salt. (Meyer.)

**Auriimide chloride,  $\text{Au}(\text{NH})\text{Cl}$ .**

(Raschig.)

**Auriimide nitrate,  $\text{Au}_2\text{N}_2\text{H}_2\text{O}$ ,  $2\text{HNO}_3$ , or  $\text{AuN}$ ,  $\text{HNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ , or  $\text{Au}_2\text{O}(\text{NH})_2$ ,  $2\text{HNO}_3$ .**

Not deliquescent. Decomp. by hot  $\text{H}_2\text{O}$  into  $\text{Au}_2\text{O}(\text{NH})_2$ . (Schottländer, J. B. 1884. 453.)

**Auroamidoimide,  $\text{Au}(\text{HN})\text{NH}_2 + 3\text{H}_2\text{O}$ .**

(Fulminating gold.) Insol. in  $\text{H}_2\text{O}$ ; not attacked by dil. acids; sol. in conc. acids, and in moderately dil. acids, when freshly precipitated. Insol. in alkalis or alcohol. Sol. in  $\text{KCN} + \text{Aq}$ .

**Triauroamine,  $\text{Au}_3\text{N} + 5\text{H}_2\text{O}$ .**

Not decomp. by boiling dil. acetic acid,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . (Raschig, A. 1886, 235. 349.)

**Auricyanhydric acid,  $\text{HAu}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.

See also Bromauricyanides.

Chlorauricyanides.

Iodauricyanides.

**Ammonium auricyanide,  $\text{NH}_4\text{Au}(\text{CN})_4$ .**

Easily sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether.

**Cobaltous auricyanide,  $\text{Co}[\text{Au}(\text{CN})_4]_2 + 9\text{H}_2\text{O}$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Lindbom.)

**Potassium auricyanide,  $\text{KAu}(\text{CN})_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Easily sol. in alcohol.

**Silver auricyanide,  $\text{AgAuCN}_4$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Diaurodiamine nitrate.**

See Auriimide nitrate.

**Aurobromhydric acid.**

See Bromauric acid.

**Aurobromic acid.**

See Bromauric acid.

**Aurochlorhydric acid.**

See Chlorauric acid.

**Aurochloric acid.**

See Chlorauric acid.

**Aurocyanhydric acid.****Aurocyanides with MCN.**

See Cyanide, aurous with MCN.

**Azinosulphonic acid.****Ammonium azinosulphonate,  $\text{N}_2\text{SO}_3\text{NH}_4$ .**

(Traube, B. 1914, 47. 944.)

**Barium azinosulphonate,  $(\text{N}_2\text{SO}_3)_2\text{Ba}$ .**

(Traube, B. 1914, 47. 944.)

**Potassium azinosulphonate,  $\text{N}_2\text{SO}_3\text{K}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Can be cryst. from boiling abs. alcohol. (Traube, B. 1914, 47. 943.)

**Sodium azinosulphonate,  $\text{N}_2\text{SO}_3\text{Na}$ .**

(Traube, B. 1914, 47. 944.)

**Azoimide,  $\text{HN}_3$ .**

Miscible with  $\text{H}_2\text{O}$  and alcohol. (Curtius and Radershausen, J. pr. (2) 43. 207.)

Stable in aq. solution; decomp. slowly by dil. boiling  $\text{HCl}$ . (Curtius, J. pr. 1898, (2) 58. 265.)

For salts of  $\text{HN}_3$ , see azoimide of metal under metal.

**Azoimide, hydroxylamine,  $\text{N}_2\text{H}_2\text{NH}_2\text{OH}$ .**

Sol. in  $\text{H}_2\text{O}$ . Gradually volatilizes at ord. temp. (Dennis, J. Am. Chem. Soc. 1907, 29. 22.)

**Azophosphoric acid.**

See Pyrophosphamic acid.

**Deutazophosphoric acid.**

See Pyrophosphodiamic acid.

**Barium, Ba.**

Decomp. by  $\text{H}_2\text{O}$  and abs. alcohol. (Guntz, C. R. 1901, 133. 874.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

**Barium amalgam,  $\text{BaHg}_{11}$ .**

Stable in contact with liquid amalgam up to  $30^\circ$ . Can be cryst. from Hg without decomp. if temp. does not exceed  $30^\circ$ . (Kerp, Z. anorg. 1900, 25. 68.)

$\text{BaHg}_{11}$ . Stable in contact with liquid amalgam from  $30^\circ$ – $100^\circ$ . Can be cryst. from Hg without decomp. at any temp. within these limits. (Kerp.)

**Barium amide,  $\text{Ba}(\text{NH}_2)_2$ .**

B.-pt.  $280^\circ$ . (Mentrel, C. C. 1903, I. 276.)

Decomp. by  $\text{H}_2\text{O}$ . (Guntz and Mentrel, Bull. Soc. 1903, (3) 29. 578.)

**Barium potassium amide.**

See Potassium ammonobarate.

**Barium ammonia,  $\text{Ba}(\text{NH}_3)_4$ .**

Takes fire in the air. Only sl. sol. in liquid  $\text{NH}_3$ . Violently decomp. by  $\text{H}_2\text{O}$ . (Mentrel, C. R. 1902, 135. 740.)



**Barium arsenide,  $Ba_3As_2$ .**

Decomp. by  $H_2O$ . (Lebeau, C. R. 1899, 129. 48.)

**Barium azoimide,  $Ba(N_3)_2$ .**

Very sl. hygroscopic; explosive.

12.5 pts. are sol. in 100 pts.  $H_2O$  at  $0^\circ$

16.2 " " " " 100 "  $H_2O$  "  $10.5^\circ$

16.7 " " " " 100 "  $H_2O$  "  $15^\circ$

17.3 " " " " 100 "  $H_2O$  "  $17^\circ$

0.0172 pts. are sol. in 100 pts. abs. alcohol at  $16^\circ$ .

Insol. in ether. (Curtius, J. pr. 1898, (2) 58. 290.)

See also Barium nitride.

**Barium boride,  $BaB_2$ .**

Sol. in fused oxidizing agents, not decomp. by  $H_2O$ ; insol. in aq. acids; sl. sol. in conc.  $H_2SO_4$ , sol. in dil. and conc.  $HNO_3$ . (Moissan, C. R. 1897, 125, 634.)

**Barium subbromide sodium bromide,  $BaBr$ ,  $NaBr$ .**

Decomp. by  $H_2O$ . (Guntz, C. R. 1903, 136. 750.)

**Barium bromide,  $BaBr_2$ , and  $+2H_2O$ .**

100 pts.  $H_2O$  dissolve—

at  $10^\circ$   $20^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$

98 104 114 123 135 149 pts.  $BaBr_2$ .

Sat.  $BaBr_2 + Aq$  contains at:

$-20^\circ$   $-9^\circ$   $+7^\circ$   $16^\circ$   $19^\circ$   $40^\circ$

45.7 46.5 48.5 48.8 49.3 50.9%  $BaBr_2$

71° 76° 77° 104° 145° 160° 175°

55.1 55.5 55.6 56.6 60.5 59.4 60.3%  $BaBr_2$

(Étard, A. ch. 1894, (7) 2. 540.)

Sp. gr. of  $BaBr_2 + Aq$  at  $19.5^\circ$  containing:

5 10 15 20 25 30%  $BaBr_2$

1.045 1.092 1.114 1.201 1.262 1.329

35 40 45 50 55%  $BaBr_2$ .

1.405 1.485 1.580 1.685 1.800

(Kremers, Pogg. 99. 444, calculated by

Gerlach, Z. anal. 8. 285.)

$BaBr_2 + Aq$  containing 7.74%  $BaBr_2$  has sp. gr.  $20^\circ/20^\circ = 1.0716$ .

$BaBr_2 + Aq$  containing 16.76%  $BaBr_2$  has sp. gr.  $20^\circ/20^\circ = 1.1674$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Sat.  $BaBr_2 + Aq$  boils at  $113^\circ$ . (Kremers, Pogg. 99. 43.)

Solubility in  $BaI_2 + Aq$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains	
	% $BaBr_2$	% $BaI_2$
$-16$	4.7	57.9
$-16$	5.0	59.0
$+60$	5.5	66.0
135	9.3	67.3
135	9.0	67.2
170	11.0	67.4
210	14.9	67.7

(Étard, A. ch. 1894, (7) 3. 287.)

Very sol. in absolute alcohol. (Hünfeld.) 100 pts. absolute methyl alcohol dissolve 50 pts.  $BaBr_2$  at  $22.5^\circ$ .

100 pts. absolute ethyl alcohol dissolve 3 pts.  $BaBr_2$  at  $22.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Sat. solution in 87% alcohol contains 6%  $BaBr_2$ . (Richards, Z. anorg. 3. 455.)

100 pts. absolute methyl alcohol dissolve 45.8 pts.  $BaBr_2 + 2H_2O$  at  $15^\circ$ .

100 pts. 93.5% methyl alcohol dissolve 27.3 pts.  $BaBr_2 + 2H_2O$  at  $15^\circ$ .

100 pts. 50% methyl alcohol dissolve 4 pts.  $BaBr_2 + 2H_2O$  at  $15^\circ$ . (de Bruyn, Z. phys. Ch. 10. 787.)

100 g.  $BaBr_2 + CH_3OH$  contain 0.4 g.  $BaBr_2$  at the critical temp. (Centnerswer, Z. phys. Ch. 1910, 72. 437.)

At  $15^\circ$ , 1 pt. by weight is sol. in:

36 pts. methyl alcohol, sp. gr. 0.709

207 " ethyl " " " 0.8035

652 " propyl " " " 0.8085

(Rohland, Z. anorg. 1897, 15. 413.)

Nearly insol. in boiling amyl alcohol, 10 cc. dissolving only an amt. equal to 1.3 mg  $BaO$ . (Browning, Sill. Am. J. 144. 459.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II. 1014.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Barium cadmium bromide,  $BaBr_2$ ,  $CdBr_2 + 4H_2O$ .**

Sol. in  $H_2O$ . (v. Hauer, W. A. B. 20. 40.)

**Barium rhodium bromide.**

See Bromorhodite, barium.

**Barium bromide ammonia,  $BaBr_2 \cdot 8NH_3$ .**

Decomp. by  $H_2O$ . (Joannis, C. R. 1905, 140. 1244.)

**Barium bromide hydrazine,  $BaBr_2 \cdot 2N_2H_4$ .**

Hygroscopic. Very sol. in  $H_2O$ . Insol. in alcohol. (Franzen, Z. anorg. 1908, 60. 291.)

**Barium bromofluoride,  $BaBr_2 \cdot BaF_2$ .**

Insol. in and undecomp. by boiling alcohol. Sol. in HBr and in  $HNO_3$ . Decomp. by  $H_2O$ , hot  $H_2SO_4$ , dil. HCl, dil.  $HNO_3$ , or dil. acetic acid. (Defacqz, C. R. 1904, 138. 199.)

**Barium carbide,  $BaC_2$ .**

Decomp. by  $H_2O$ . (Maquenne, C. R. 144. 360.)

Sp. gr. 3.75. Easily decomp. by  $H_2O$  and dil. acids. (Moissan, Bull. Soc. 1894, (3) 11. 1008.)

**Barium carbonyl, Ba(CO)<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Guntz and Mentrel, Bull. Soc. 1903, (3) 29. 586.)

**Barium subchloride, BaCl.**

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136. 751.)

**Barium subchloride sodium chloride, BaCl, NaCl.**

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136. 750.)

**Barium chloride, BaCl<sub>2</sub>, and +2H<sub>2</sub>O.**

Permanent in dry air.

100 pts. H<sub>2</sub>O at t° dissolve (a) pts. BaCl<sub>2</sub> and (b) pts. BaCl<sub>2</sub>+2H<sub>2</sub>O.

t°	a	b	t°	a	b
15.64	34.86	43.50	74.89	59.94	65.51
49.31	43.84	55.63	105.48	59.58	77.89

(Gay-Lussac, A. ch. (2) 11. 309.)

100 pts. H<sub>2</sub>O at t° dissolve 32.62+0.2711t pts. BaCl<sub>2</sub>. (Kopp.)

100 pts. H<sub>2</sub>O dissolve pts. BaCl<sub>2</sub>+2H<sub>2</sub>O at t°.

t°	Pts. BaCl <sub>2</sub> +2H <sub>2</sub> O	t°	Pts. BaCl <sub>2</sub> +2H <sub>2</sub> O
16.25	39.66	62.50	48.0
20.00	42.22	75.00	63.0
22.50	43.7	87.00	65.0
37.50	51.0	100	72.0
50.00	65.0	.....	....

(Brandes.)

Sol. in 2.67 pts. H<sub>2</sub>O at 18.75°. (Abl.)

1 pt. BaCl<sub>2</sub> is sol. in 2.86 pts. H<sub>2</sub>O at 15.5°, and 1.67 pts. at boiling temp. (M. R. and P.)

100 pts. H<sub>2</sub>O at 15.5° dissolve 20 pts. BaCl<sub>2</sub>, and 43 pts. at 87.7°. (Ure's Dict.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>
0	31.1	77.5	51.9
12.2	33.9	95.65	57.7
38.4	41.2	102.5	58.9
62.75	47.7	105	59.7

(Nordenskiöld, Pogg. 136. 316.)

100 pts. H<sub>2</sub>O dissolve pts. BaCl<sub>2</sub> at t°.

t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>
9	33.2	50	43.7
30	38.1	58	45.9
37	40.0	..	....

(Gerardin, A. ch. (4) 8. 143.)

1 pt. BaCl<sub>2</sub>+2H<sub>2</sub>O is sol. in 2.18 pts. H<sub>2</sub>O at 21.5°, and the solution has sp. gr. = 1.2878. (Schiff, A. 109. 326.)

1 pt. anhydrous BaCl<sub>2</sub> is sol. in 2.86 pts. H<sub>2</sub>O at 15°. (Gerlach.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>	t°	Pts. BaCl <sub>2</sub>
0	30.9	36	39.7	71	49.7
1	31.2	37	40.0	72	50.0
2	31.5	38	40.2	73	50.3
3	31.7	39	40.5	74	50.6
4	31.9	40	40.7	75	50.9
5	32.2	41	41.0	76	51.2
6	32.4	42	41.3	77	51.5
7	32.6	43	41.6	78	51.8
8	32.8	44	41.9	79	52.1
9	33.1	45	42.2	80	52.4
10	33.3	46	42.5	81	52.7
11	33.5	47	42.7	82	53.0
12	33.8	48	43.0	83	53.3
13	34.0	49	43.3	84	53.6
14	34.2	50	43.6	85	54.0
15	34.5	51	43.9	86	54.3
16	34.7	52	44.2	87	54.6
17	35.0	53	44.4	88	55.0
18	35.2	54	44.7	89	55.3
19	35.5	55	45.0	90	55.6
20	35.7	56	45.3	91	55.9
21	36.0	57	45.6	92	56.2
22	36.2	58	45.9	93	56.6
23	36.5	59	46.2	94	56.9
24	36.7	60	46.4	95	57.2
25	37.0	61	46.7	96	57.6
26	37.2	62	47.0	97	57.9
27	37.5	63	47.3	98	58.2
28	37.7	64	47.6	99	58.5
29	38.0	65	47.9	100	58.8
30	38.2	66	48.2	101	59.2
31	38.5	67	48.5	102	59.5
32	38.7	68	48.8	103	59.8
33	39.0	69	49.1	104	60.2
34	39.2	70	49.4	104.1	60.3
35	39.5	..	....	...	....

(Mulder, calculated from his own and other observations. Scheik. Verhandel. 1864. 45.)

The saturated solution contains—

60.3 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 104.1°. (Mulder.)

60.1 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 104.4°. (Legrand.)

61.8 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 104.5°. (Griffith.)

59.58 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and boils at 105.48° (Gay-Lussac); at 106° (Kremers).

54.1 pts. BaCl<sub>2</sub> to 100 pts. H<sub>2</sub>O, and forms crust at 104.4°; highest temperature observed, 104.9°. (Gerlach, Z. anal. 26. 426.)

Sat. BaCl<sub>2</sub>+Aq contains at:

100° 130° 144° 160° 180° 215°  
36 37.3 37.5 38.9 40.7 43.1% BaCl<sub>2</sub>  
(Étard, A. ch. 1894, (7) 2. 535.)

Aq. solution contains 27.6% BaCl<sub>2</sub> at 30°. (Shreinemakers, C. C. 1910, I. 9.)

Solubility of  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  equals 1.745 mol.-litre at  $30^\circ$ . (Masson, Chem. Soc. 1911, 99, 1136.)

$\text{BaCl}_2 + \text{Aq}$  sat. at  $8^\circ$  has sp. gr. 1.27. (Anthon.)  
 $\text{BaCl}_2 + \text{Aq}$  sat. at  $15^\circ$  has sp. gr. 1.282. (Michel and Kraft.)

$\text{BaCl}_2 + \text{Aq}$  sat. at  $18.1^\circ$  has sp. gr. 1.285, and contains 44.31 pts.  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  to 100 pts.  $\text{H}_2\text{O}$ . (Karsten.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{BaCl}_2$	Sp. gr.	% $\text{BaCl}_2$	Sp. gr.
8.88	1.0760	27.53	1.2245
18.24	1.1521	35.44	1.2837

(Kremers, Pogg. 99, 444.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $15^\circ$ .

% $\text{BaCl}_2$	Sp. gr.	% $\text{BaCl}_2$	Sp. gr.
1	1.00917	14	1.13778
2	1.01834	15	1.14846
3	1.02750	16	1.15999
4	1.03667	17	1.17152
5	1.04584	18	1.18305
6	1.05569	19	1.19458
7	1.06554	20	1.20681
8	1.07538	21	1.21892
9	1.08523	22	1.23173
10	1.09508	23	1.24455
11	1.10576	24	1.25736
12	1.11643	25	1.27017
13	1.12711	..	.....

(Gerlach, Z. anal. 8, 283.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $21.5^\circ$ .

% $\text{BaCl}_2 + 2\text{H}_2\text{O}$	Sp. gr.	% $\text{BaCl}_2 + 2\text{H}_2\text{O}$	Sp. gr.
1	1.0073	16	1.1302
2	1.0147	17	1.1394
3	1.0222	18	1.1488
4	1.0298	19	1.1584
5	1.0374	20	1.1683
6	1.0452	21	1.1783
7	1.0530	22	1.1884
8	1.0610	23	1.1986
9	1.0692	24	1.2090
10	1.0776	25	1.2197
11	1.0861	26	1.2304
12	1.0947	27	1.2413
13	1.1034	28	1.2523
14	1.1122	29	1.2636
15	1.1211	30	1.2750

(Schiff, calculated by Gerlach, l.c.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{BaCl}_2$	Sp. gr.	% $\text{BaCl}_2$	Sp. gr.
5	1.0445	20	1.2047
10	1.0939	24	1.2559
15	1.1473	..	.....

(Kohlrausch, W. Ann. 1879, 1.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $20^\circ$ .

g. mols. $\text{BaCl}_2$ per l.	Sp. gr.
0.01	1.001878
0.025	1.00475
0.05	1.00929
0.075	1.01369
0.10	1.01766
0.25	1.0456
0.40	1.0726

(Jones and Pearce, Am. Ch. J. 1907, 38, 701.)

$\text{BaCl}_2 + \text{Aq}$  containing 6.94%  $\text{BaCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0640$ .

$\text{BaCl}_2 + \text{Aq}$  containing 11.38%  $\text{BaCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1086$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 279.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$  at  $25^\circ$ .

$\text{BaCl}_2 + \text{Aq}$	Sp. gr.
1-normal	1.0684
$\frac{1}{2}$ "	1.0441
$\frac{1}{4}$ "	1.0226
$\frac{1}{8}$ "	1.0114

(Wagner, Z. phys. Ch. 1890, 5, 35.)

Sp. gr. of  $\text{BaCl}_2 + \text{Aq}$ .

$t^\circ$	Concentration of $\text{BaCl}_2 + \text{Aq}$	Sp. gr.
$25^\circ$	1 pt. $\text{BaCl}_2$ in 3.684 pts. $\text{H}_2\text{O}$	1.2194
$22.8^\circ$	1 " " " 52.597 " "	1.0145

(Hittorf, Z. phys. Ch. 1902, 39, 628.)

Temp. of Maximum Density.

Weight of $\text{BaCl}_2$ in 1000 grams $\text{H}_2\text{O}$	Temp. of maximum density	Molecular reduction of temp. of M. D.
0	$3.982^\circ$	
6.73	$3.207^\circ$	23.94
10.42	$2.783^\circ$	23.88
20.83	$1.572^\circ$	24.04
41.72	$-0.843^\circ$	24.04

(De Coppet, C. R. 1897, 125, 533.)

$\text{BaCl}_2 + \text{Aq}$  containing 10%  $\text{BaCl}_2$  boils at  $100.6^\circ$ . (Gerlach.)

$\text{BaCl}_2 + \text{Aq}$  containing 20%  $\text{BaCl}_2$  boils at  $101.9^\circ$ . (Gerlach.)

B.-pt. of  $\text{BaCl}_2 + \text{Aq}$  containing pts.  $\text{BaCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26, 443); L=according to Legrand (A. ch. (2) 59, 452).

B.-pt.	G	L
100.5°	6.4	11.0
101.0	12.7	19.6
101.5	19.0	26.2
102.0	25.3	32.5
102.5	31.6	38.6
103.0	37.7	44.5
103.5	43.7	50.3
104.0	49.5	56.0
104.4	55.2	60.1
104.5	55.2	60.1

Less sol. in  $H_2O$  containing  $HCl$  than in pure  $H_2O$ , and scarcely sol. in conc.  $HCl + Aq.$  (Berselius.)

Solubility of  $BaCl_2$  in  $HCl + Aq$  at  $0^\circ$ .  $BaCl_2$  = no.  $\frac{1}{2}$  mols. (in milligrammes) dissolved in 10 cc. of the liquid;  $HCl$  = no. mols. (in milligrammes) contained in the same quantity of liquid.

$BaCl_2$	$HCl$	Sum of mols.	Sp. gr.
29.45	0	29.45	1.250
27.8	1.1	28.9	1.242
26.075	2.8	28.875	1.228
23.4	5.0	28.4	1.210
14.0	14.36	28.36	1.143
10.2	18.775	28.975	1.118
6.67	22.75	29.42	1.099
2.74	32.0	34.74	1.079
0.29	50.5	50.79	1.088

(Engel, Bull. Soc. (2) 45. 653.)

Sol. in about 8000 pts. conc.  $HCl + Aq.$   
Sol. in about 20,000 pts. conc.  $HCl + Aq$  through which  $HCl$  gas was passed.  
Practically insol. in conc.  $HCl + Aq$  containing  $\frac{1}{2}$  vol. ether. (Mar, Sil. Am. J. 143.)

Solubility in  $HCl + Aq$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $HCl$	% by wt. $BaCl_2$	
0	27.6	$BaCl_2, 2H_2O$
5.94	12.97	"
11.55	3.85	"
18.11	0.46	"
32.35	0.00	"
37.34	0.00	$BaCl_2, 2H_2O + BaCl_2, H_2O$
38.63	0.00	$BaCl_2, H_2O$

(Schreinemakers, Z. phys. Ch. 1909, 68. 89.)

Much less sol. in  $HNO_3 + Aq$  than in  $H_2O$ , because  $Ba(NO_3)_2$  is nearly insol. therein. (Wurts.)

$BaCl_2$  is sol. in about—

4.00 pts.  $H_2O$ .

5.00 pts.  $NH_4OH + Aq$  (conc.).

5.33 pts.  $NH_4OH + Aq$  (1 vol. conc.: 3 vols.  $H_2O$ ).

5.33 pts.  $HCl + Aq$  (1 vol. conc.: 4 vols.  $H_2O$ ).

8.00 pts.  $HC_2H_3O_2 + Aq$  (1 vol. commercial acid: 1 vol.  $H_2O$ ).

6.00 pts.  $NH_4Cl + Aq$  (1 pt.  $NH_4Cl$ : 10 pts.  $H_2O$ ).

6.00 pts.  $NH_4C_2H_3O_2 + Aq$  (dil.  $NH_4OH + Aq$  neutralized by dil.  $HC_2H_3O_2 + Aq$ ).

6.67 pts.  $NaC_2H_3O_2 + Aq$  (commercial  $HC_2H_3O_2$  neutralized by  $Na_2CO_3$ , and dil. with 4 vols.  $H_2O$ ).

6.33 pts.  $Cu(C_2H_3O_2)_2 + Aq$ . See Stolba (Z. anal. 2. 390).

5.67 pts. grape sugar (1 pt. grape sugar: 10 pts.  $H_2O$ ). (Pearson, Zeit. Chem. 1869. 662.)

$BaCl_2 + NH_4Cl$ . Solubility of  $BaCl_2$  in  $NH_4Cl + Aq$  at  $30^\circ$ .

Composition of the solution		Solid phase
% $NH_4Cl$	% $BaCl_2$	
0	27.6	$BaCl_2, 2H_2O$
5.71	22.16	"
10.06	18.36	"
13.84	15.42	"
20.00	10.89	"
24.69	8.33	"
25.79	7.95	$BaCl_2, 2H_2O + NH_4Cl$
26.06	7.99	"
27.47	3.56	$NH_4Cl$
29.5	0	"

(Schreinemakers, Z. phys. Ch. 1909, 66. 688.)

See also under Ammonium chloride.

$BaCl_2 + Ba(OH)_2$ . Solubility of  $BaCl_2$  in  $BaO + Aq$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $BaO$	% by wt. $BaCl_2$	
0	27.6	$BaCl_2, 2H_2O$
1.78	27.42	"
1.79	27.31	$BaCl_2, 2H_2O + BaCl(OH), 2H_2O$
1.75	27.41	"
2.33	24.98	$BaCl(OH), 2H_2O$
2.50	24.20	"
3.27	21.46	"
4.67	19.18	"
4.86	18.97	$BaCl(OH), 2H_2O + BaO, 9H_2O$
4.29	18.83	"
4.64	18.77	"
4.65	18.10	"
4.62	18.04	$BaO, 9H_2O$
4.60	17.08	"
4.58	12.81	"
4.45	10.77	"
4.99	0	"

(Schreinemakers, Z. phys. Ch. 1909, 68. 88.)

Sol. in  $CuCl_2, NH_4Cl + Aq$  at  $30^\circ$ . (Schreinemakers, Z. phys. Ch. 1909, 66. 688.)

The solubility data for the system  $BaCl_2 + CuCl_2 + KCl + Aq$  have been determined at  $40^\circ$  and  $60^\circ$ . (Schreinemakers, C. C. 1915, I. 933.)

$BaCl_2 + HgCl_2$ . Solubility of  $BaCl_2$  in  $HgCl_2$  in  $H_2O$ .

$t^\circ$	Gms. per 100 g. solution		Solid phase
	$BaCl_2$	$HgCl_2$	
10.4°	23.58	50.54	$BaCl_2, 2H_2O + HgCl_2$
10.4	23.44	50.74	$BaCl_2, 3HgCl_2, 6H_2O$
10.4	22.58	51.23	
10.4	22.48	51.41	
10.4	22.10	51.66	$BaCl_2, 2H_2O + HgCl_2$
10.4	21.64	51.74	
25.0	23.02	54.83	

(Foote and Bristol, Am. Ch. J. 32. 248.)

Solubility of  $\text{BaCl}_2 + \text{HgCl}_2$  in  $\text{H}_2\text{O}$ .

Temp. = 30			Temp. = 0°		
% $\text{HgCl}_2$	% $\text{BaCl}_2$	Solid phase	% $\text{HgCl}_2$	% $\text{BaCl}_2$	Solid phase
0	27.77	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	0	23.70	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
2.90	27.56	"	14.25	24.0	"
7.09	27.47	"	36.20	24.89	"
12.98	26.99	"	46.12	24.07	$\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O} +$
22.61	26.89	"	46.05	24.03	" $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
34.57	26.69	"	46.07	24.05	"
46.50	25.22	"	46.59	23.28	$\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O}$
55.16	23.46	$\text{HgCl}_2 + \text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	47.78	21.05	"
55.32	23.08	"	48.43	20.64	$\text{BaCl}_2 \cdot 3\text{HgCl}_2 \cdot 6\text{H}_2\text{O} + \text{HgCl}_2$
55.19	22.98	"	48.49	20.71	"
48.97	17.87	$\text{HgCl}_2$	44.33	18.50	$\text{HgCl}_2$
41.30	14.26	"	29.0	11.59	"
27.62	8.41	"	16.36	6.11	"
14.19	2.65	"	3.95	0	"
7.67	0	"			
Temp. = 40°			56.57	22.98	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{HgCl}_2$

(Schreinemakers, Ch. Weekbl. 1911, 7. 202.)

$\text{BaCl}_2 + \text{KCl}$ . Sol. in sat.  $\text{KCl} + \text{Aq}$ , at first without pptn. The  $\text{KCl}$  is pptd. after a time until a state of equilibrium is reached.

100 pts.  $\text{H}_2\text{O}$  at 16.6° dissolve 33.8–27.2 pts.  $\text{KCl}$  and 18.2–34.9 pts.  $\text{BaCl}_2$ . (Kopp, A. 34. 267.)

100 g. sat. solution of  $\text{BaCl}_2 + \text{KCl}$  contain 13.83 g.  $\text{BaCl}_2$  and 18.97 g.  $\text{KCl}$  at 25°. (Foote, Am. Ch. J. 32. 253.)

$\text{BaCl}_2 + \text{Ba}(\text{NO}_3)_2$ .  $\text{BaCl}_2$  is sol. in sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ .

Solubility of  $\text{BaCl}_2 + \text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$ . Both salts present in solid phase.

t°	Gms. per 100 gms. solution		t°	Gms. per 100 gms. solution	
	$\text{BaCl}_2$	$\text{Ba}(\text{NO}_3)_2$		$\text{BaCl}_2$	$\text{Ba}(\text{NO}_3)_2$
0	22.5	4.3	100	31	14
20	24.5	6.0	140	32	20
40	26.5	7.5	180	33	26
60	28.5	9.5	210	32	32

(Etard, A. Ch. (7) 2. 535.)

Very slowly sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  with separation of  $\text{Ba}(\text{NO}_3)_2$ .

Rapidly sol. in sat.  $\text{KNO}_3 + \text{Aq}$ , forming  $\text{Ba}(\text{NO}_3)_2$ , which separates out. (Karsten.)

$\text{BaCl}_2 + \text{NaCl}$ .  $\text{BaCl}_2$  is sol. in  $\text{NaCl} + \text{Aq}$  at first without separation of  $\text{NaCl}$ , which, however, finally separates.

100 pts.  $\text{H}_2\text{O}$  dissolve, when both salts are in excess—

	1	2	3	4	5	6
$\text{NaCl}$ . . .	35.9	4.1	....	40.4	35.3	....
$\text{BaCl}_2$ . . .	....	34.5	35.0	....	19.4	60.3
		38.6			54.7	

1, 2, and 3 are at 17°. (Kopp, A. 34. 268.)  
4, 5, and 6 are at b.-pt. (Mulder.)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$ .  
100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{BaCl}_2$  and  $\text{NaCl}$  at t°.

t°	Pts. $\text{BaCl}_2$	Pts. $\text{NaCl}$	t°	Pts. $\text{BaCl}_2$	Pts. $\text{NaCl}$
10	4.1	33.9	60	9.7	33.5
20	4.1	33.8	70	11.7	33.6
30	5.0	33.7	80	13.9	33.6
40	6.3	33.6	90	15.9	33.6
50	7.9	33.5	100	17.9	33.6

(Precht and Wittgen, B. 14. 1667.)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$  in  $\text{HCl} + \text{Aq}$  at 30°.

Solid phase, $\text{NaCl}$			Solid phase, $\text{BaCl}_2 + 2\text{H}_2\text{O}$		
Sp. gr. of sat. solution	G. mol. litre		Sp. gr. of sat. solution	G. mol. litre	
	$\text{HCl}$	$\text{NaCl}$		$\text{HCl}$	$\text{BaCl}_2$
1.2018	0.0000	5.400	1.3056	0.0000	1.745
1.1906	0.4575	4.932	1.2651	0.4709	1.468
1.1801	0.969	4.386	1.2147	1.107	1.122
1.1633	1.786	3.589	1.1789	1.622	0.861
1.1512	2.412	2.978	1.1419	2.234	0.592
1.1427	3.052	2.463	1.1068	3.041	0.307
1.1289	4.152	1.628	1.0880	3.953	0.124
1.1188	5.950	0.630	1.0895	3.059	0.020
1.1258	7.205	0.268	1.1024	6.234	0.00
			1.1609	10.25	0.00

(Masson, Chem. Soc. 1911, 99. 1136.)

Solubility of  $\text{BaCl}_2 + \text{NaCl}$  in  $\text{HCl} + \text{Aq}$  at  $30^\circ$ .

% HCl	% NaCl	% $\text{BaCl}_2$	Solid phase
0	23.85	3.8	$\text{NaCl}, \text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
4.84	18.07	2.27	"
12.02	9.55	0.82	"
17.20	4.65	0.29	"
23.16	1.54	0.00	"
28.66	0.47	0.00	"
36.51	0.12	0.00	$\text{NaCl} + \text{BaCl}_2 \cdot \text{H}_2\text{O}$

(Schreinemakers, Arch. Néer. Sc. ex. nat. (2) 15. 91.)

Insol in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Solubility in alcohol: 100 pts. alcohol of given sp. gr. dissolve pts. of the anhydrous, and crystallized salt.

Sp. gr.	Pts. $\text{BaCl}_2$	Pts. $\text{BaCl}_2 + 2\text{H}_2\text{O}$
0.900	1.00	1.56
0.848	0.29	0.43
0.834	0.185	0.32
0.817	0.09	0.06

(Kirwan.)

Insol. in abs. alcohol, or below  $19^\circ$  in alcohol of over 91%. Dil. alcohol dissolves less  $\text{BaCl}_2$  than corresponds to the amount of  $\text{H}_2\text{O}$  present. (Gerardin, A. ch. (4) 5. 142.)

Solubility in 100 pts. alcohol at  $t^\circ$ . D = sp. gr. of alcohol; S = solubility.

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
$t^\circ$	s	$t^\circ$	s	$t^\circ$	s	$t^\circ$	s
14	29.1	14	25.0	11	19.6	15	15.6
25	32.0	32	29.1	15	20.4	23	17.0
32	33.5	39	30.9	20	21.7	33	19.1
47	37.4	50	33.2	35	24.6	50	22.0
60	39.8	63	37.6	45	26.8	..	....

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8429	
$t^\circ$	s	$t^\circ$	s	$t^\circ$	s	$t^\circ$	s
13	10	12	6.5	12	0.1	12	0.00
24	11.4	23	7.2	30	4.3	19	0.00
34	12.9	31	8.3	47	4.9	25	0.04
39	13.8	37	9.0	..	...	50	0.28
50	15.2	47	10.1	..	...	67	0.377

(Gerardin, A. ch. (4) 5. 142.)

Solubility in dil. alcohol of  $x\%$  by weight at  $15^\circ$ .

% alcohol	0	10	20	30	40	60	80
Pts. $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$	30.25	23.7	18.0	12.8	9.3	3.4	0.5

(Schiff, A. 118. 365.)

Sol. in 6885–8108 pts. 99.3% alcohol at  $14.5^\circ$ , and in 1857 pts. at ebullition. (Fresenius.)

Solubility of  $\text{BaCl}_2$  in alcohol + Aq.

$t^\circ$	% alcohol	% $\text{BaCl}_2$	Solid phase
30°	0	27.95	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
"	32.67	10.63	"
"	50.16	5.68	"
"	66.72	2.23	"
"	92.53	0.05	"
"	94.83	0.07	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{BaCl}_2 \cdot \text{H}_2\text{O}$
"	94.75	0.05	"
"	94.60	0.07	"
"	97.14	.....	$\text{BaCl}_2 \cdot \text{H}_2\text{O}$
"	98.17	0.08	$\text{BaCl}_2 \cdot \text{H}_2\text{O} + \text{BaCl}_2$
"	99.41	.....	$\text{BaCl}_2$
60°	0	31.57	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$
"	16.68	20.16	"
"	34.10	13.21	"
"	66.02	2.82	"
"	88.55	0.25	"
"	90.11	0.09	$\text{BaCl}_2 \cdot 2\text{H}_2\text{O} + \text{BaCl}_2 \cdot \text{H}_2\text{O}$
"	90.39	.....	"
"	93.95	.....	$\text{BaCl}_2 \cdot \text{H}_2\text{O}$

(Schreinemakers and Massink, Chem. Weekbl. 1910, 7. 213.)

100 pts. absolute methyl alcohol dissolve 2.18 pts.  $\text{BaCl}_2$  at  $15.5^\circ$ , and 7.3 pts.  $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$  at  $6^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

At  $15^\circ \text{C}$ . 1 pt. by weight is sol. in—

78 pts. methyl alcohol of sp. gr. 0.790

7,000 " ethyl " " " " 0.8035

100,000 " propyl " " " " 0.8085

(Rohland, Z. anorg. 1897, 15. 413.)

Absolutely insol. in boiling amyl alcohol. (Browning, Sil. Am. J. 144. 459.)

Absolutely insol. in acetic ether. (Cann, C. R. 102. 363.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

100 pts. by weight of glycerine dissolve 10 pts.  $\text{BaCl}_2$  at  $15.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.) (Eidmann, C. C. 1899, II. 1014.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in anhydrous pyridine, 97% pyridine + Aq. and 95% pyridine + Aq. Sl. sol. in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

+  $\text{H}_2\text{O}$ . Solution of monohydrate sat. at  $6^\circ$  contains 31.57%  $\text{BaCl}_2$ . (Schreinemakers, Chem. Weekbl. 1910, 7. 213.)

2.5 grams of the monohydrate are sol. in 100 cc. of methyl alcohol at  $14^\circ$ . (Kirschner, Z. phys. Ch. 1911, 76. 176.)

Exact solubility in methyl alcohol cannot be determined as  $\text{BaCl}_2 + \text{H}_2\text{O}$  separates out from a sat. solution of the dihydrate. (Kirschner, Z. phys. ch. 1911, 76. 177.)

Barium cadmium chloride,  $\text{BaCl}_2 \cdot \text{CdCl}_2 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	100 pts. solution contain pts.			100 g. of solution contain g. salt	100 g. $H_2O$ dissolve g. salt	100 mols. $H_2O$ dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.5	15.19	14.71	11.98	41.88	72.06	3.32
32.9	16.18	16.09	12.40	44.59	80.73	3.72
41.4	16.95	16.81	13.05	46.87	88.01	4.06
53.4	18.21	18.13	13.95	50.30	101.21	4.66
62.0	18.81	18.74	14.73	52.28	109.56	5.05
97.8	22.48	22.00	17.57	62.05	163.50	7.53
108.3	23.51	22.79	18.53	64.83	184.33	8.49
109.2	23.69	29.95	18.67	65.31	188.27	8.67

(Rimbach, B. 1897, 30. 3083.)

 $BaCl_2 \cdot 2CdCl_2 + 5H_2O$ . Quite difficultly sol. in  $H_2O$ . (v. Hauer.)Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	100 pts. by wt. of solution contain pts. by wt.			100 g. of solution contain g. salt	100 g. $H_2O$ dissolve g. salt	100 mols. $H_2O$ dissolve mols. of anhydrous salt
	Cl	Ba	Cd			
22.6	16.89	11.00	17.71	45.60	83.82	2.63
41.3	18.15	11.77	19.22	49.14	96.62	3.03
53.9	18.78	12.41	19.85	51.04	104.25	3.27
62.2	19.66	12.83	20.59	53.08	113.13	3.55
69.5	20.18	13.09	21.20	54.47	119.64	3.76
107.2	23.31	14.87	24.11	62.29	165.18	5.19
107.2	23.16	14.93	24.39	62.48	166.53	5.23

(Rimbach, B. 1897, 30. 3083.)

**Barium mercuric chloride, basic,  $BaCl_2, HgO + 6H_2O$ .**Decomp. by  $H_2O$ . (André, C. R. 104. 431.)**Barium mercuric chloride,  $BaCl_2, 2HgCl_2 + 2H_2O$ .**Efflorescent in dry air; sol. in  $H_2O$ . (v. Bonsdorff, Pogg. 17. 130.)The salt  $BaCl_2, 2HgCl_2 + 2H_2O$  described by Bonsdorff does not form under the conditions which he gives. (Foote, Am. Ch. J. 1904, 32. 251.) $BaCl_2, 3HgCl_2 + 6H_2O$ . Solubility determinations with mixtures of  $BaCl_2$  and  $HgCl_2$  show that these chlorides do not form a double salt at  $25^\circ$ , but that a transition temp. exists at about  $17.2^\circ$  below which the salt  $BaCl_2, 3HgCl_2 + 6H_2O$  forms. (Foote, Am. Ch. J. 1904, 32. 251.) $+8H_2O$ . Less sol. in  $H_2O$  than the Sr and Mg double salts. (Swan, Am. Ch. J. 1898, 20. 633.)**Barium rhodium chloride,  $3BaCl_2, Rh_2Cl_6$ .**

See Chlororhodite, barium.

**Barium stannous chloride,  $BaCl_2, SnCl_2 + 4H_2O$ .**Sol. in  $H_2O$ . (Poggiale, C. R. 20. 1183.)**Barium stannic chloride.**

See Chlorostannate, barium.

**Barium uranium chloride,  $BaCl_2, UCl_4$ .**Decomp. by  $H_2O$ . (Aloy, Bull. Soc. 1899, (3) 21. 265.)**Barium zinc chloride,  $BaCl_2, ZnCl_2 + 4H_2O$ .**Deliquescent, and sol. in  $H_2O$ . (Warner, C. N. 27. 271.)Pptd. from warm solution only. (Ephraim, Z. anorg. 1910, 67. 381.)  
 $+2\frac{1}{2}H_2O$ . Pptd. from cold solution. (Ephraim.)**Barium chloride hydrazine,  $BaCl_2, 2N_2H_4$ .**

Hydroscopic. (Fransen, Z. anorg. 1908, 60. 290.)

**Barium chloride hydroxylamine,  $BaCl_2, 2NH_2OH$ .**Very sol. in  $H_2O$ . (Crismer, Bull. Soc. (3) 3. 118.)**Barium chloride sulphuric anhydride,  $BaCl_2, 2SO_3$ .**Decomp. by  $H_2O$ . (Schultz-Sellack, B. 4. 113.)**Barium chlorofluoride,  $BaClF$ .**Difficultly sol. in  $H_2O$ , but much more sol. than  $BaF_2$ . Decomp. by  $H_2O$ , so that when washed on filter, the filtrate contains more  $BaCl_2$  than  $BaF_2$ . (Berzelius, Pogg. 1. 19.)Insol. in and undecomp. by boiling alcohol; sol. in conc.  $HCl$  and  $HNO_3$ . Decomp. by hot  $H_2O$ , hot  $H_2SO_4$ , dil. acetic acid, dil.  $HCl$  or dil.  $HNO_3$ . (Defacqz, C. R. 1904, 138. 198.)**Barium cyanamide,  $BaCN_2$ .**Decomp. by  $H_2O$ . (Frank, C. C. 1903, II. 774.)

**Barium subfluoride sodium fluoride, BaF, NaF.**

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136. 750.)

**Barium fluoride, BaF<sub>2</sub>.**

Scarcely sol. in H<sub>2</sub>O (Berzelius); less sol. in H<sub>2</sub>O than CaF<sub>2</sub>.

1 liter H<sub>2</sub>O dissolves 1630 mg. BaF<sub>2</sub> at 18°.

(Kohlrausch, Z. phys. Ch. 1904, 50. 356.)  
1605 mg. are contained in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Insol. in molten MnCl<sub>2</sub>, MnBr<sub>2</sub>, MnI<sub>2</sub>, MnCl<sub>2</sub>+BaCl<sub>2</sub>, MnBr<sub>2</sub>+BaBr<sub>2</sub> and MnI<sub>2</sub>+BaI<sub>2</sub>. (Defacqz, A. ch. 1904, (8) 1. 350.)

Easily sol. in HCl, HNO<sub>3</sub>, or HF+Aq. (Gay-Lussac and Thénard.)

Sol. in liquid HF. (Franklin, Z. anorg. 1905, 46. 2.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol. in an aqueous solution of sodium citrate. (Spiller.)

**Barium tin (stannic) fluoride.**

See Fluostannate, barium.

**Barium tellurium fluoride, BaF<sub>2</sub>, 2TeF<sub>4</sub>.**

Decomp. by H<sub>2</sub>O. (Högbom, Bull. Soc. (2) 35. 60.)

**Barium titanium fluoride.**

See Fluotitanate, barium.

**Barium titanyl fluoride, TiO<sub>2</sub>F<sub>2</sub>, BaF<sub>2</sub>.**

See Fluoxypertitanate and fluoxytitanate, barium.

**Barium uranyl fluoride.**

See Fluoxuryanate, barium.

**Barium vanadyl fluoride.**

See Fluoxylvanadate, barium.

**Barium zirconium fluoride, 3BaF<sub>2</sub>, 2ZrF<sub>4</sub>+2H<sub>2</sub>O.**

Insoluble precipitate. (Marignac.)

See also Fluozirconate, barium.

**Barium fluoiodide, BaF<sub>2</sub>, BaI<sub>2</sub>.**

Decomp. by H<sub>2</sub>O, dil. HCl, dil. HNO<sub>3</sub> or hot H<sub>2</sub>SO<sub>4</sub>. Sol. in HI and HNO<sub>3</sub>. Insol. in and undecomp. by boiling alcohol. Decomp. by dil. acetic acid. (Defacqz, C. R. 1904, 138. 199.)

**Barium hydride, BaH.**

Decomp. by H<sub>2</sub>O or HCl+Aq. (Winkler, B. 24. 1979.)

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1901, 132. 964.)

**Barium hydrosulphide, BaS<sub>2</sub>H<sub>2</sub>.**

Easily sol. in H<sub>2</sub>O. Insol. in alcohol. +4H<sub>2</sub>O. Sol. in H<sub>2</sub>O, and the solution dissolves S. (Veley, Chem. Soc. 49. 369.)

**Barium hydroxide, BaO<sub>2</sub>H<sub>2</sub>.**

100 pts. cold H<sub>2</sub>O dissolve 5 pts. BaO<sub>2</sub>H<sub>2</sub>.  
boiling 50

(Davy.)

100 pts. H<sub>2</sub>O at 20° dissolve 3.45 pts. BaO.

(Bineau, C. R. 41. 509.)

100 pts. H<sub>2</sub>O at 13° dissolve 2.86 pts. BaO.

" " 47° " 13.3 "

" " 70° " 17.9 "

(Osann.)

100 pts. H<sub>2</sub>O dissolve pts. BaO at t°.

t°	Pts. BaO	t°	Pts. BaO	t°	Pts. BaO
0	1.5	30	5.0	60	18.76
5	1.75	35	6.17	65	24.67
10	2.22	40	7.36	70	31.9
15	2.89	45	9.12	75	56.85
20	3.48	50	11.75	80	90.77
25	4.19	55	14.71	..	....

(Rosenthal and Rühlmann, J. B. 1870. 314.)

100 pts. H<sub>2</sub>O dissolve at 25° 55.08 millimols. BaO<sub>2</sub>H<sub>2</sub>.

2 (Hers and Knoch, Z. anorg. 1904, 41. 315.)

Sp. gr. of BaO<sub>2</sub>H<sub>2</sub>+Aq.

%BaO	Sp. gr.	%BaO	Sp. gr.
30	1.6	1.8	1.02
19	1.3	0.9	1.01
2.6	1.03	...	....

(Dalton.)

Sp. gr. of BaO<sub>2</sub>H<sub>2</sub>+Aq at 18° containing 1.25% BaO<sub>2</sub>H<sub>2</sub>=1.0120; containing 2.5%=1.0253. (Kohlrausch, W. Ann. 1879, 6. 41.)

Sp. gr. of BaO<sub>2</sub>H<sub>2</sub>+Aq at 80°.

Sp. gr.	% BaO <sub>2</sub> H <sub>2</sub> by volume	% BaO <sub>2</sub> H <sub>2</sub> by weight	Sp. gr.	% BaO <sub>2</sub> H <sub>2</sub> by volume	% BaO <sub>2</sub> H <sub>2</sub> by weight
1.514	58.22	38.45	1.219	24.53	20.12
1.500	56.31	37.54	1.200	23.00	19.17
1.479	54.14	36.60	1.195	22.15	18.53
1.458	49.38	33.87	1.174	19.83	16.89
1.450	48.90	33.72	1.152	17.78	15.43
1.413	45.99	32.55	1.129	16.01	14.18
1.400	45.00	32.14	1.125	15.80	14.04
1.390	44.22	31.81	1.114	14.56	13.07
1.375	42.40	30.84	1.100	13.06	11.87
1.368	41.45	30.30	1.076	10.58	9.83
1.350	38.60	28.59	1.062	9.16	8.62
1.338	37.30	27.88	1.049	7.55	7.20
1.312	35.02	26.69	1.040	6.51	6.26
1.301	34.02	26.13	1.031	5.18	5.02
1.278	31.48	24.67	1.022	4.78	4.67
1.249	28.14	22.52	1.015	3.90	3.84
1.236	26.41	21.36	1.009	3.37	3.34

(Haff, C. N. 1902, 86. 284.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

More sol. in NaCl+Aq, KNO<sub>3</sub>+Aq, or NaNO<sub>3</sub>+Aq than in H<sub>2</sub>O. (Karsten.)

Not precipitated by alcohol.



Sol. with combination in absolute alcohol and anhydrous methyl alcohol. Insol. in ether.

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Solubility in acetone + Aq at 25°.

A = cc. acetone in 100 cc. acetone + Aq.

$\frac{\text{BaO}_2\text{H}_2}{2}$  = millimols.  $\text{BaO}_2\text{H}_2$  in 100 cc. of the solution.

S = sp. gr. of the solution.

A	$\frac{\text{BaO}_2\text{H}_2}{2}$	S
0	55.08	1.04790
10	31.84	1.01677
20	17.79	0.99268
30	9.10	0.97630
40	4.75	0.95605
50	1.54	0.93980
60	0.48	0.91790
70	0.08	0.89562

(Herz, Z. anorg. 1904, 41. 321.)

$\text{BaO}_2\text{H}_2$  is sol. in an aqueous solution of cane sugar (Hunton, Phil. Mag. (3) 11. 156); also in an aqueous sol. of mannite (Favre, A. ch. (3) 11. 76); sorbine (Pelouze); hot solution of quercite, separating on cooling (Des-saignes).

+  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  free from carbonic acid. Sl. sol. in alcohol and ether. (Bauer, Z. anorg. 1905, 47, 416.)

Solubility in  $\text{H}_2\text{O}$  the same as that of the comp. with  $8\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, 17. 341.)

Nearly insol. in alcohol and ether. (Bauer, Zeit. angew. Ch. 1903, 16. 349.)

+  $8\text{H}_2\text{O}$ . Sol. in 20 pts. cold, and 3 pts. boiling  $\text{H}_2\text{O}$  (Graham); 17.5 pts.  $\text{H}_2\text{O}$  at 15.5°, and in all proportions of hot  $\text{H}_2\text{O}$ . (Hope.) Sol. in 19 pts.  $\text{H}_2\text{O}$  at 15°, and 2 pts. at 100°. (Wittstein.)

If  $\text{BaO}_2\text{H}_2 + 8\text{H}_2\text{O}$  is heated it dissolves in the crystal  $\text{H}_2\text{O}$  and the solution has the following bpts.

%BaO 49.05 50.05 52.43 53.72  
B.-pt. 103° 104° 105° 106°

%BaO 55.35 57.49 58.74 61.44  
B.-pt. 107° 108° 108.5° 109°

$\text{BaO}_2\text{H}_2 + 3\text{H}_2\text{O}$  separates at 109°. (Bauer, Zeit. angew. Ch. 1903, 17. 345.)

B.-pt. of  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O} + \text{Aq}$  at 732 mm.

Bpt.	Time	%BaO
78° (mpt.)	0	48.45
78	4'	48.45
103	6' 30"	49.05
104	6' 45"	50.05
105	7' 30"	52.43
106	9' 25"	53.72
107	10' 45"	55.35

B.-pt. of  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O} + \text{Aq}$ , etc.—Continued.

Bpt.	Time	%BaO
108	12'	57.49
108.5	—	58.74
109	13'	61.44
109	17' 40"	63.65
108	17' 50"	66.53
105	18'	67.51
100	18' 45"	68.17

(Bauer, Z. anorg. 1905, 47. 407.)

Solubility in  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at 25°. Solution sat. with respect to both  $\text{Ba}(\text{NO}_3)_2$  and  $\text{BaO}_2\text{H}_2 \cdot 8\text{H}_2\text{O}$ .

Sp. gr. 25°/25°	g. BaO as $\text{Ba}(\text{OH})_2$ in 100 g. $\text{H}_2\text{O}$	g. Ba $(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$
1.1448	5.02	11.48
1.1371	4.93	10.21
1.1288	4.83	8.66
1.1220	4.72	7.55
1.1133	4.72	7.01
1.1062	4.65	6.82
1.1044	4.61	6.55
1.1010	4.64	6.08
1.0975	4.60	5.66
1.0949	4.55	5.46
1.0937	4.54	5.32
1.0885	4.52	4.44
1.0864	4.53	4.41
1.0840	4.52	4.04
1.0790	4.48	3.47
1.0774	4.46	3.14
1.0731	4.40	2.79
1.0711	4.42	2.53
1.0651	4.35	1.88
1.0626	....	....
1.0640	4.35	1.45
1.0538	4.29	0.43
1.0512	4.29	0

(Parsons and Corson, J. Am. Chem. Soc. 1910, 32. 1385.)

Solubility of  $\text{Ba}(\text{OH})_2 + 8\text{H}_2\text{O}$  (solid phase) in  $\text{MCl} + \text{Aq}$  (mol. per litre of solution) at 25°.

Solution of	(Cl')	(OH')
LiCl	0	0.555
"	0.75	0.745
"	1.42	0.937
"	2.30	1.336
KCl	0.86	0.645
"	1.75	0.660
"	3.40	0.676
NaCl	0	0.555
"	0.73	0.630
"	1.43	0.699
"	2.82	0.806
RbCl	1.25	0.648

(Herz, Z. anorg. 1910, 67. 366.)

Solubility of BaO in NaOH + Aq at 30°.

% Na <sub>2</sub> O	% BaO	Solid phase
0	4.99	BaO. 9H <sub>2</sub> O
4.78	1.29	"
6.43	0.89	"
9.63	0.57	"
11.62	0.53	"
17.87	0.47	"
23.28	1.06	"
24.63	1.87	BaO. 9H <sub>2</sub> O + BaO. 4H <sub>2</sub> O
26.14	1.84	BaO. 4H <sub>2</sub> O
27.72	1.75	"
28.43	1.58	"
29.24	1.34	BaO. 4H <sub>2</sub> O + BaO. 2H <sub>2</sub> O
32.12	0.82	BaO. 2H <sub>2</sub> O
34.72	0.59	"
41.09	0.57	BaO. 2H <sub>2</sub> O + NaOH. H <sub>2</sub> O
42	0	NaOH. H <sub>2</sub> O

(Schreinemakers, Z. phys. Ch. 1909, 68. 84.)

50% alcohol dissolves less than 0.5% of its wt. of BaO<sub>2</sub>H<sub>2</sub>+8H<sub>2</sub>O. (Beckmann, J. pr. 1883, (2) 27. 138.)

**Barium subiodide sodium iodide, BaI, NaI.**  
Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1903, 136. 750.)

**Barium iodide, BaI<sub>2</sub>.**

Not deliquescent. Very sol. in H<sub>2</sub>O and alcohol. 100 pts. of anhydrous salt dissolve: at 0° 19.5° 30° 40° 60° 90° 106° in 59 48 44 43 41 37 35 pts. H<sub>2</sub>O. (Kremers, Pogg. 103. 66.)

Sp. gr. of BaI<sub>2</sub>+Aq containing:

5	10	15	20	25	30% BaI <sub>2</sub>
1.045	1.091	1.143	1.201	1.265	1.333
35	40	45	50	55	60% BaI <sub>2</sub>
1.412	1.495	1.596	1.704	1.825	1.970

(Kremers, Pogg. 111. 63, calculated by Gerlach, Z. anal. 8. 279.)

Easily sol. in alcohol. (Henry.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II. 1014.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

+2H<sub>2</sub>O. At 15° C., 1 pt. by weight in sol. in:  
22 pts. methyl alcohol sp. gr. 0.790  
93 " " " " 0.8035  
307 " " " " 0.8085

(Rohland, Z. anorg. 1897, 15. 413.)

+7H<sub>2</sub>O. (Thomson, B. 10. 1343.)

The composition of the hydrates formed by BaI<sub>2</sub> at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by BaI<sub>2</sub> and of the conductivity and sp. gr. of BaI<sub>2</sub>+Aq. (Jones, Am. Ch. J. 1905, 34. 306.)

**Barium iodide, basic, Ba(OH)I+9H<sub>2</sub>O.**

See Barium oxyiodide.

**Barium bismuth iodide, BaI<sub>2</sub>, 2BiI<sub>3</sub>+18H<sub>2</sub>O.**  
Deliquescent; decomp. by H<sub>2</sub>O. (Linau, Pogg. 111. 240.)

**Barium cadmium iodide, BaI<sub>2</sub>, CdI<sub>2</sub>+5H<sub>2</sub>O.**  
Deliquescent. (Croft.)

**Barium mercuric iodide, BaI<sub>2</sub>, 2HgI<sub>2</sub>.**

Decomp. by much H<sub>2</sub>O. (Boullay.)  
BaI<sub>2</sub>, HgI<sub>2</sub>. Sol. in H<sub>2</sub>O. (Boullay.)  
Sp. gr. of sat. solution = 3.575-3.588. (Rohrbach, W. Ann. 20. 169.)  
+5H<sub>2</sub>O. (Duboin, C. R. 1906, 143. 314.)  
2BaI<sub>2</sub>, 3HgI<sub>2</sub>+16H<sub>2</sub>O. (Duboin, C. R. 1906, 142. 888.)  
BaI<sub>2</sub>, 5HgI<sub>2</sub>+8H<sub>2</sub>O. As the corresponding Ca salt. (Duboin, C. R. 1906, 142. 888.)  
3BaI<sub>2</sub>, 5HgI<sub>2</sub>+21H<sub>2</sub>O. Very deliquescent. (Duboin, C. R. 1906, 142. 889.)

**Barium stannous iodide.**

Very sol. in H<sub>2</sub>O. (Boullay.)

**Barium zinc iodide, BaI<sub>2</sub>, 2ZnI<sub>2</sub>.**

Deliquescent, and sol. in H<sub>2</sub>O. (Rammelsberg.)  
+4H<sub>2</sub>O. Very hygroscopic. (Ephraim, Z. anorg. 1910, 87. 385.)

**Barium nitride, Ba<sub>3</sub>N<sub>2</sub>.**

Decomp. H<sub>2</sub>O violently, not alcohol. (Maquenne, A. ch. (6) 29. 219.)  
BaN<sub>2</sub>.

See Barium azoimide.

**Barium oxide, BaO.**

Sol. in H<sub>2</sub>O with evolution of heat.  
Easily sol. in dil. HNO<sub>3</sub>, or HCl+Aq.  
Solubility in NaOH+Aq. See Barium hydroxide.

Solubility in Na<sub>2</sub>O, HCl, +H<sub>2</sub>O at 30°. (Schreinemakers, Z. phys. Ch. 1909, 68. 98.)

Solubility in Na<sub>2</sub>O, NaCl, BaCl<sub>2</sub>+Aq at 30°. (Schreinemakers.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 827.)

Sol. with combination in absolute alcohol and anhydrous wood-spirit. Insol. in ether.

Easily sol. in absolute methyl alcohol.

1 l. absolute ethyl alcohol sat. with BaO at 9° contains 213.8 g. BaO. (Berthelot, Bull. Soc. 8. 389.)

Sol. in methyl alcohol. (Neuberg and Neimann, Biochem. Z. 1906, 1. 173.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

See also Barium hydroxide.

**Barium peroxide, BaO<sub>2</sub>.**

Insol. in H<sub>2</sub>O; decomp. by boiling H<sub>2</sub>O.

Sol. in acids with formation of hydrogen dioxide.

Forms hydrate with  $8\text{H}_2\text{O}$ ; also  $10\text{H}_2\text{O}$  (Berthelot, A. ch. (5) 21. 157); also a compound  $\text{BaO}_2 \cdot \text{H}_2\text{O}_2$ , which is very unstable, sl. sol. in cold  $\text{H}_2\text{O}$ , and insol. in alcohol or ether. (Schöne, A. 192. 257.)

+  $8\text{H}_2\text{O}$ . 100 cc. pure  $\text{H}_2\text{O}$  dissolve 0.168 g.  $\text{BaO}_2 + 8\text{H}_2\text{O}$ ; if  $\text{H}_2\text{O}$  contains 0.3 g.  $\text{Ba}(\text{OH})_2 + 8\text{H}_2\text{O}$ , only 0.102 g.  $\text{BaO}_2 + 8\text{H}_2\text{O}$  are dissolved; if 0.6 g.  $\text{Ba}(\text{OH})_2 + 8\text{H}_2\text{O}$  only 0.019 g.  $\text{BaO}_2 + 8\text{H}_2\text{O}$  are dissolved. (Schöne, A. 1878, 192. 266.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Barium oxybromide**,  $\text{Ba}(\text{OH})\text{Br} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Beckmann, J. pr. (2) 27. 132.)

$\text{BaBr}_2 \cdot \text{BaO} + 5\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Tassilly, C. R. 1895, 120. 1340.)

**Barium oxychloride**,  $\text{Ba}(\text{OH})\text{Cl} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Beckmann, J. pr. (2) 26. 388, 474.)

**Barium mercury oxychloride**,  $\text{BaCl}_2 \cdot \text{HgO} + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (André, C. R. 104. 431.)

**Barium oxyiodide**,  $\text{Ba}(\text{OH})\text{I} + 9\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Beckmann, B. 14. 2154.)

$\text{BaI}_2 \cdot \text{BaO} + 9\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Tassilly, C. R. 1895, 120. 1340.)

**Barium oxysulphides**,  $\text{Ba}_2\text{O}_3\text{S}_2 + 58\text{H}_2\text{O}$ ,  
 $\text{Ba}_2\text{OS} + 10\text{H}_2\text{O}$ ,  $\text{Ba}_4\text{OS}_3 + 28\text{H}_2\text{O}$ .

Very unstable; decomp. by recrystallization into  $\text{BaS}_2\text{H}_2$  and  $\text{BaO}_2\text{H}_2$ .

**Barium phosphide**,  $\text{BaP}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Dumas, A. ch. 32. 364.)

$\text{BaP}_2$ . Crystallized. Sol. in dil. acids; insol. in conc. acids; decomp. by  $\text{H}_2\text{O}$ . Insol. in organic solvents at ord. temp. (Jaboin, C. R. 1899, 129. 765.)

**Barium selenide**,  $\text{BaSe}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sl. sol. in  $\text{H}_2\text{O}$ . (Favre, C. R. 102. 1469.)

**Barium silicide**,  $\text{Ba}_2\text{Si}$ .

(Jüngst, C. C. 1906, I. 195.)

$\text{BaSi}_2$ . Slowly decomp. by  $\text{H}_2\text{O}$ , not by  $\text{NH}_4\text{OH} + \text{Aq}$ . Rapidly decomp. by conc.  $\text{NaOH}$ . Sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$  with evolution of spontaneously inflammable gas. Sol. in  $\text{HF}$  and  $\text{HCl}$ . Sol. in acetic acid without evolution of gas. (Moissan, Traité ch. min. 1904, III. 680.)

Decomp. rapidly in both hot and cold  $\text{H}_2\text{O}$ . (Bradley, C. N. 1900, 82. 150.)

**Barium sulphide**,  $\text{BaS}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Crystallized. Decomp. by  $\text{H}_2\text{O}$ .

Attacked by cold conc.  $\text{HNO}_3$ . (Mourlot, A. ch. 1899, (7) 17. 521.)

Cryst. modification is less readily acted on by air and other reagents than the amorphous modification; sol. in fuse oxidizing agents. (Mourlot, C. R. 1898, 126. 645.)

+  $\text{H}_2\text{O}$ . (Neuberg and Neimann, Biochem. Z. 1906, 1. 174.)

+  $6\text{H}_2\text{O}$ . Slowly sol. in boiling  $\text{H}_2\text{O}$ , with decomp.; insol. in, but decomp. by boiling alcohol. (Schöne.)

**Barium sulphide**,  $\text{Ba}_2\text{S}_7 + 25\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Schöne, Pogg. 112. 215.)

**Barium trisulphide**,  $\text{BaS}_3$ .

Sol. in large amount of boiling  $\text{H}_2\text{O}$ . (Schöne, Pogg. 112. 215.)

**Barium tetrasulphide**,  $\text{BaS}_4 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , especially if hot; sol. in 2.42 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; insol. in  $\text{CS}_2$  or alcohol. (Schöne, Pogg. 112. 224.)

+  $2\text{H}_2\text{O}$ . (Velej, Chem. Soc. 49. 369.)

**Barium pentasulphide**,  $\text{BaS}_5$ .

Known only in solution.

**Barium mercuric sulphide**,  $\text{BaS} \cdot \text{HgS} + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wagner, J. pr. 98. 23.)

**Barium nickel sulphide**,  $\text{BaS} \cdot 4\text{NiS}$ .

Sol. in warm conc.  $\text{HCl}$ . (Bellucci, C. A. 1909, 293.)

**Barium stannic sulphide**.

See Sulphostannate, barium.

**Barium uranyl sulphide**,  $6\text{BaS} \cdot \text{UO}_2\text{S} + x\text{H}_2\text{O}$  (?).

Decomp. by  $\text{HCl} + \text{Aq}$ . (Remelé, Pogg. 124. 159.)

**Baryta**.

See Barium oxide,  $\text{BaO}$ .

**Beryllium**,  $\text{Be}$ .

For beryllium and its salts, see Glucinum and the corresponding salts.

**Bismuth**,  $\text{Bi}$ .

Not attacked by  $\text{H}_2\text{O}$ . Very slowly attacked by  $\text{HCl} + \text{Aq}$  (Troost). Very sl. sol. in conc.  $\text{HCl} + \text{Aq}$  (Schützenberger, Willm). Not attacked by dil.  $\text{HCl} + \text{Aq}$  (Naquet and Hanriot). Very slowly attacked by cold  $\text{HCl} + \text{Aq}$  (Godeffroy). According to very careful experiments pure Bi is absolutely unattacked by hot or cold, dil. or conc.  $\text{HCl} + \text{Aq}$  except in presence of oxygen. (Ditte and Metzner, A. ch. (6) 29. 397.)

Not attacked by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp.

by hot conc.  $\text{H}_2\text{SO}_4$ . Easily sol. in dil. or conc.  $\text{HNO}_3$ +Aq. or aqua regia.

Not attacked by pure  $\text{HNO}_3$ +Aq of 1.52 to 1.42 sp. gr. at  $20^\circ$ ; violently attacked by a more dil. acid, but the acid becomes concentrated thereby. Conc.  $\text{HNO}_3$ +Aq attacks only by heating or adding  $\text{NO}_2$ . (Millon, A. ch. (3) 6. 95.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0091 g. Bi in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

#### Bismuth arsenide, $\text{Bi}_2\text{As}_3$ .

(Descamp, C. R. 86. 1065.)

#### Bismuth dibromide, $\text{Bi}_2\text{Br}_4$ .

Not known in a pure state. (Weber, Pogg. 107. 599.)

#### Bismuth tribromide, $\text{BiBr}_3$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol or ether.

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

#### Bismuth hydrogen bromide, $\text{BiBr}_3 \cdot 2\text{HBr} + 4\text{H}_2\text{O}$ .

Deliquescent.

Decomp. in the air. (Aloy, Bull. Soc. 1906, (3) 35. 398.)

#### Bismuth caesium bromide, $2\text{BiBr}_3 \cdot 3\text{CsBr}$ .

Ppt. Insol. in  $\text{HBr}$ .

Sol. in  $\text{HCl}$  and in  $\text{HNO}_3$ . (Hutchins, J. Am. Chem. Soc. 1907, 29. 33.)

#### Bismuth potassium bromide, $\text{BiBr}_3 \cdot 2\text{KBr}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1906, (3) 35. 398.)

#### Bismuth bromide ammonia, $\text{BiBr}_3 \cdot 3\text{NH}_3$ .

Sol. in  $\text{HCl}$ +Aq.

$\text{BiBr}_3 \cdot 2\text{NH}_3$  (?).

$2\text{BiBr}_3 \cdot 5\text{NH}_3$ . Not deliquescent; not decomp. by  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Muir, Chem. Soc. 29. 144.)

#### Bismuth bromide potassium chloride,

$\text{K}_2\text{BiCl}_2\text{Br}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Atkinson, Chem. Soc. 43. 289.)

#### Bismuth dichloride, $\text{Bi}_2\text{Cl}_4$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ , dil. acids, or conc.  $\text{NH}_4\text{Cl}$ +Aq. (Weber, Pogg. 107. 596.)

#### Bismuth trichloride, $\text{BiCl}_3$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$ +Aq. and alcohol. Not decomp. by  $\text{H}_2\text{O}$  in presence of citrates. (Spiller.)

0.08 g. sol. in 100 ccm. liquid  $\text{H}_2\text{S}$ . (Antony, C. C. 1905, I. 1692.)

Moderately sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

1 g.  $\text{BiCl}_3$  is sol. in 5.59 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.9194$ . (Naumann, B. 1904, 37. 4331.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

1 pt. is sol. in 60.36 pts. ethyl acetate at  $18^\circ$ . Sp. gr at  $18^\circ/40^\circ = 0.9106$ . (Naumann, B. 1910, 43. 320.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

#### Bismuth chloride, $\text{Bi}_2\text{Cl}_6$ (?).

Decomp. by  $\text{H}_2\text{O}$ . (Dehérain, C. R. 54. 724.)

#### Bismuth hydrogen chloride, $2\text{BiCl}_3 \cdot \text{HCl} + 3\text{H}_2\text{O}$ .

Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Engel, C. R. 106. 1797.)

$\text{BiCl}_3 \cdot 2\text{HCl}$ . (Jacquelain, A. ch. (2) 62. 363.)

#### Bismuth caesium chloride, $\text{BiCl}_3 \cdot 3\text{CsCl}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold dil.  $\text{HCl}$ +Aq. but easily sol. on warming. (Brigham, Am. Ch. J. 14. 181.)

$2\text{BiCl}_3 \cdot 3\text{CsCl}$ . As above. (Brigham.)

$\text{BiCl}_3 \cdot 6\text{CsCl}$ . Easily sol. in  $\text{H}_2\text{O}$  and dil.

$\text{HCl}$ +Aq. (Godefroy, B. 8. 9.)

Does not exist. (Brigham.)

#### Bismuth hydrazine chloride, $\text{BiCl}_3 \cdot 3\text{N}_2\text{H}_4\text{HCl}$ .

Sol. in acids, from which it is pptd. by  $\text{H}_2\text{O}$ . (Ferratini, C. A. 1912. 1613.)

#### Bismuth nitrosyl chloride, $\text{BiCl}_3 \cdot \text{NOCl}$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Sudborough, Chem. Soc. 59. 662.)

#### Bismuth potassium chloride, $\text{BiCl}_3 \cdot \text{KCl} + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Cannot be recryst. except from conc.  $\text{BiCl}_3$ + $\text{HCl}$ . Decomp. by  $\text{HCl}$ +Aq into  $\text{BiCl}_3 \cdot 2\text{KCl} + 2\text{H}_2\text{O}$ . (Brigham, Am. Ch. J. 14. 167.)

$\text{BiCl}_3 \cdot 2\text{KCl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe, Pogg. 64. 37.)

Deliquescent.

Sol. in  $\text{H}_2\text{O}$  with decomp. into the oxychloride when excess  $\text{H}_2\text{O}$  is used. (Aloy, Bull. Soc. 1906, (3) 35. 397.)

+ $2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Jacquelain, J. pr. 14. 1.)

Sol. in moderately conc.  $\text{HCl}$ +Aq.

$\text{BiCl}_3 \cdot 3\text{KCl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe.)

Does not exist. (Brigham.)

**Bismuth rubidium chloride,  $\text{BiCl}_3$ ,  $\text{RbCl} + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl} + \text{Aq}$ , from which  $\text{BiCl}_3$ ,  $3\text{RbCl}$  crystallizes. (Brigham, Am. Ch. J. 14. 174.)

$\text{BiCl}_3$ ,  $3\text{RbCl}$ . Decomp. by  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl} + \text{Aq}$  without decomp. (Brigham.)

$\text{BiCl}_3$ ,  $6\text{RbCl}$ . Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$  (Godefroy, B. 8. 9); does not exist. (Brigham.)

$10\text{BiCl}_3$ ,  $23\text{RbCl}$  (?). As above. (Brigham.)

**Bismuth sodium chloride,  $\text{BiCl}_3$ ,  $2\text{NaCl} + \text{H}_2\text{O}$ .**

$+3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Arppe, Pogg. 64. 237.)

$\text{BiCl}_3$ ,  $3\text{NaCl}$ .

**Bismuth thalious chloride,  $\text{BiCl}_3$ ,  $3\text{TlCl}$ .**

Ppt. (Ephraim, Z. anorg. 1909, 61. 254.)

$\text{BiCl}_3$ ,  $6\text{TlCl}$ . Ppt. (Ephraim.)

**Bismuth chloride ammonia,  $2\text{BiCl}_3$ ,  $\text{NH}_3$ .**

Stable. (Dehérain, C. R. 54. 724.)

$\text{BiCl}_3$ ,  $2\text{NH}_3$ . (D.)

$\text{BiCl}_3$ ,  $3\text{NH}_3$ . (D.)

**Bismuth chloride nitric oxide,  $\text{BiCl}_3$ ,  $\text{NO}$ .**

Very hygroscopic. (Thomas, C. R. 1895, 121. 129.)

**Bismuth chloride nitrogen peroxide,  $\text{BiCl}_3$ ,  $\text{NO}_2$ .**

Decomp. by moist air, but stable in dry air. (Thomas, C. R. 1896, 122. 612.)

**Bismuth chloride selenide.**

See Bismuth selenochloride.

**Bismuth trifluoride,  $\text{BiF}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. (Gott and Muir, Chem. Soc. 53. 138.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

**Bismuth hydrogen fluoride,  $\text{BiF}_3$ ,  $3\text{HF}$ .**

Deliquescent. Decomp. by boiling  $\text{H}_2\text{O}$ . (Muir, Chem. Soc. 39. 21.)

**Bismuth gold,  $\text{Au}_2\text{Bi}$ .**

Insol. in equal pts. of  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 71.)

**Bismuthous hydroxide,  $\text{Bi}(\text{OH})_3$ .**

Sol. in strong acids. Insol. in solutions of alkalis, alkali carbonates,  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NH}_4\text{NO}_3$ ; or of amyl amine (Wurtz). When recently pptd. is sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , but insol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett, 1837). Not pptd. in presence of Na citrates (Spiller).

**Solubility of freshly pptd.  $\text{Bi}(\text{OH})_3$  in  $\text{NaOH} + \text{Aq}$ .**

g. $\text{NaOH}$ per l.	g. $\text{Bi}$ dissolved per l. at $20^\circ$	g. $\text{Bi}$ dissolved per l. at $100^\circ$
400	0.16	1.70
320	0.11	1.20
240	0.11	....
200	0.10	0.5
160	0.08	0.5
120	0.07	....
80	0.04	0.35
40	trace	0.2
20	0	0.15

(Moser, Z. anorg. 1909, 61. 386.)

**Solubility of freshly pptd.  $\text{Bi}(\text{OH})_3$  in  $\text{KOH} + \text{Aq}$ .**

$\text{KOH}$ per l. g.	g. $\text{Bi}$ dissolved per l. at $20^\circ$	g. $\text{Bi}$ dissolved per l. at $100^\circ$
560	0.14	1.65
448	0.11	1.20
336	0.11	....
280	0.10	0.5
224	0.08	0.5
168	0.06	....
112	0.03	0.3
56	trace	0.2
28	0	0.15

(Moser, Z. anorg. 1909, 61. 386.)

 **$\text{Bi}_2\text{O}_3$ ,  $2\text{H}_2\text{O}$ .**

$\text{Bi}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ . (Muir, Chem. Soc. 32. 131.)

See also Bismuth trioxide.

**Bismuth tetrahydroxide,  $\text{Bi}_2\text{O}_4$ ,  $\text{H}_2\text{O}$ .**

$\text{Bi}_2\text{O}_4$ ,  $2\text{H}_2\text{O}$ . (Wernicke, Pogg. 141. 109.)

**Bismuthic hydroxide (Bismuthic acid),  $\text{Bi}_2\text{O}_5$ ,  $\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily decomp. by acids. (Fremy, A. ch. (3) 12. 495.) Decomp. by  $\text{H}_2\text{SO}_4$ ; not attacked by  $\text{SO}_2 + \text{Aq}$ ; neither dissolved nor decomp. by dil.  $\text{HNO}_3 + \text{Aq}$ , but slowly converted into an allotropic modification (?). Partially decomp. by conc.  $\text{HNO}_3$ . Slowly but wholly dissolved by hot conc.  $\text{HNO}_3$ . Sl. sol. in conc.  $\text{KOH} + \text{Aq}$ . (Arppe.)

Sol. in about 100 pts. boiling  $\text{KOH} + \text{Aq}$ , so conc. that it solidifies on removing the lamp. (Muir, Chem. Soc. 51. 77.)

$\text{Bi}_2\text{O}_5$ ,  $2\text{H}_2\text{O}$ . (Bödeker, A. 123. 61.)

Does not exist. (Hoffmann and Geuther.)

**Bismuth iodide,  $\text{BiI}_3$ .**

Not attacked by cold  $\text{H}_2\text{O}$ , but by boiling,  $\text{BiOI}$  is formed. 100 pts. absolute alcohol dissolve  $3\frac{1}{2}$  pts. salt at  $20^\circ$ . (Gott and Muir, Chem. Soc. 57. 138.)

Sol. in  $\text{HNO}_3$ , and  $\text{HI} + \text{Aq}$ , from which it is repptd. by  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{KI} + \text{Aq}$  or  $\text{KOH} + \text{Aq}$ . (Rammelsberg.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

100 g. absolute alcohol dissolve 3.5 g.  $\text{BiI}_3$  at  $20^\circ$ . (Gott and Muir, Chem. Soc. 57. 138.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

100 pts. methylene iodide dissolve 0.15 pt.  $\text{BiI}_3$  at  $12^\circ$ , and very little more at higher temperatures. (Retgers, Z. anorg. 3. 343.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Bismuth hydrogen iodide,  $\text{BiI}_3$ ,  $\text{HI} + 4\text{H}_2\text{O}$ .**  
(Arppe, Pogg. 44. 248.)

**Bismuth cesium iodide,  $3\text{CsI} \cdot 2\text{BiI}_3$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Wells, Am. J. Sci. 1897, (4) 3. 464.)

**Bismuth calcium iodide,  $2\text{BiI}_3$ ,  $\text{CaI}_2 + 18\text{H}_2\text{O}$ .**  
Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Linau, Pogg. 111. 240.)

**Bismuth magnesium iodide,  $2\text{BiI}_3$ ,  $\text{MgI}_2 + 12\text{H}_2\text{O}$ .**

Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Linau, Pogg. 111. 240.)

**Bismuth potassium iodide,  $\text{BiI}_3$ ,  $4\text{KI}$ .**

Ppt. (Arppe, Pogg. 44. 237.)

$\text{BiI}_3$ ,  $3\text{KI}$ . (Astre, C. R. 110. 1137.)

$\text{BiI}_3$ ,  $2\text{KI}$ . Sol. in acetic ether. (Astre.)  
+  $4\text{H}_2\text{O}$ . Sol. in small amt.  $\text{H}_2\text{O}$  without pptn., but decomp. by much  $\text{H}_2\text{O}$ .

$\text{BiI}_3$ ,  $2\text{KI}$ ,  $\text{HI}$ . (Arppe.)

$2\text{BiI}_3$ ,  $3\text{KI} + 2\text{H}_2\text{O}$ . (Astre.)

$\text{BiI}_3$ ,  $\text{KI} + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 61. 1097.)

$2\text{BiI}_3$ ,  $\text{KI}$ . Sol. in acetic ether. (Astre.)

**Bismuth sodium iodide,  $\text{BiI}_3$ ,  $\text{NaI} + \text{H}_2\text{O}$ .**

Deliquescent; decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 61. 1097.)

$2\text{BiI}_3$ ,  $3\text{NaI} + 12\text{H}_2\text{O}$ . As above. (Linau, Pogg. 111. 240.)

**Bismuth zinc iodide,  $2\text{BiI}_3$ ,  $\text{ZnI}_2 + 12\text{H}_2\text{O}$ .**

Very deliquescent. (Linau, Pogg. 111. 240.)

**Bismuth iodide ammonia,  $\text{BiI}_3$ ,  $3\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Bismuth iodide zinc bromide.**

Sol. in  $\text{H}_2\text{O}$ . (Linau, Pogg. 111. 240.)

**Bismuth nitride.**

Explosive. (Fischer, B. 1910, 43. 1471.)

$\text{BiN}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$  or dil. acids. (Franklin, J. Am. Chem. Soc. 1905, 27. 847.)

**Bismuth dioxide,  $\text{Bi}_2\text{O}_3$ .**

Sol. in conc.  $\text{HNO}_3 + \text{Aq}$ . Decomp. by strong acids, and boiling  $\text{KOH} + \text{Aq}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Tanatar, Z. anorg. 1901, 27. 438.)

**Bismuth trioxide,  $\text{Bi}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc. acids.

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $20^\circ$ .

In 100 g. of the liquid phase		Solid phase
g. $\text{Bi}_2\text{O}_3$	g. $\text{N}_2\text{O}_5$	
0.321	0.963	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot 2\text{H}_2\text{O}$
0.337	0.982	"
3.54	4.68	"
6.37	7.17	"
13.67	12.50	"
14.85	13.31	"
18.74	15.90	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$
23.50	19.21	"
23.50	19.29	"
27.15	20.96	"
28.11	21.64	"
29.50	22.53	"
30.19	22.90	"
31.48	23.70	"
32.93	24.83	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O} +$
32.80	24.86	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$ .
32.67	24.70	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$ .
32.59	24.60	"
32.24	24.68	"
30.74	25.13	"
29.83	25.30	"
24.16	28.25	"
16.62	35.40	"
12.17	43.37	"
11.66	46.62	"
11.19	49.38	"
11.19	50.20	"
15.20	54.66	"
20.76	53.75	"
27.85	51.02	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} +$
8.58	68.28	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$ .
4.05	74.90	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$ .

(Rutten, Z. anorg. 1902, 30. 386.)

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{Bi}_2\text{O}_3$	% $\text{N}_2\text{O}_5$	Solid phase
$9^\circ$	20.8	17.1	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$
	24.02	19.1	"
	31.09	23.8	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O} +$
	31.2	23.9	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$
$30^\circ$	34.2	26.5	"
	28.2	29.6	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$
	16.1	47.7	"
$65^\circ$	5.55	7.44	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$
	27.62	22.46	"
	40.80	31.60	$\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O} + \text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$
	37.82	35.80	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O}$
	35.73	47.02	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} +$
	4.59	77.90	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$

(Rutten.)

Solubility of  $\text{Bi}_2\text{O}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{Bi}_2\text{O}_3$	% $\text{N}_2\text{O}_5$	Solid phase
72°	37.23	47.76	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 4\text{H}_2\text{O}$ " "
75°	36.74	47.91	
80°	39.75	45.16	
9°	31.2	23.9	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} +$ $\text{Bi}_2\text{O}_3 \cdot \text{N}_2\text{O}_5 \cdot \text{H}_2\text{O}$ " " "
20°	32.8	24.8	
30°	34.2	26.4	
50°	36.9	28.9	
64°	40.6	31.1	
65°	40.8	31.6	"
75.5°	45.4	34.6	
72°	45.9	35.6	
11.5°	25.36	52.57	$\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 10\text{H}_2\text{O} +$ $\text{Bi}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 \cdot 3\text{H}_2\text{O}$ " " "
20°	27.85	51.02	
50°	32.22	49.29	
65°	35.73	47.02	

(Rutten.)

Solubility in  $\text{NaOH} + \text{Aq}$  at 25°.

Conc. of $\text{NaOH}$ Mol./l.	g. $\text{Bi}_2\text{O}_3$ in 100 cc. of solution. Mean result.
1.0	0.0013 $\pm$ 0.0002
2.0	0.0026 $\pm$ 0.0002
3.0	0.0049 $\pm$ 0.0005

(Knox, Chem. Soc. 1909, 96. 1767.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Min. *Bismite*. Easily sol. in  $\text{HNO}_3 + \text{Aq}$ .

See also Bismuthous hydroxide.

**Bismuth tetroxide,  $\text{Bi}_2\text{O}_4$ .**

Sol. in conc.  $\text{HCl} + \text{Aq}$ , with evolution of  $\text{Cl}_2$ ; in oxygen acids with evolution of  $\text{O}$ . Less easily sol. in conc.  $\text{H}_2\text{SO}_4$  than in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ .

**Bismuth oxide,  $\text{Bi}_2\text{O}_3$  (?).**

(Hoffmann and Geuther.)

**Bismuth pentoxide,  $\text{Bi}_2\text{O}_5$ .**

Sol. in dil. acids. Combines with  $\text{H}_2\text{O}$  to form bismuthic hydroxide, which see. (Hasebroek, B. 20. 213.)

**Bismuth oxybromide, etc.**

See Bismuthyl bromide, etc.

**Bismuth palladium,  $\text{PdBi}_2$ .**

Insol. in equal pts.  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 70.)

**Bismuth platinum,  $\text{PtBi}_2$ .**

Insol. equal pts.  $\text{HNO}_3$  and tartaric acids. (Roessler, Z. anorg. 1895, 9. 69.)

**Bismuth phosphide,  $\text{BiP}$ .**

(Cavazzi.)

**Bismuth triselenide,  $\text{Bi}_2\text{Se}_3$ .**

Insol. in  $\text{H}_2\text{O}$ , alkalis, or alkali sulphides +  $\text{Aq}$ ; sl. attacked by  $\text{HCl} + \text{Aq}$ ; oxidized by  $\text{HNO}_3 + \text{Aq}$ . (Schneider, Pogg. 94. 628.)  
Min. *Frenzelite*.

**Bismuth potassium selenide.**

See Selenobismuthite, potassium.

**Bismuth selenochloride,  $\text{BiSeCl}$ .**

Not attacked by  $\text{H}_2\text{O}$ ; very sl. sol. in  $\text{HCl} + \text{Aq}$ ; easily and completely sol. with decomp. in  $\text{HNO}_3 + \text{Aq}$ . (Schneider.)

**Bismuth disulphide,  $\text{Bi}_2\text{S}_3 + 2\text{H}_2\text{O}$  (?).**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{HCl} + \text{Aq}$ .

**Bismuth trisulphide,  $\text{Bi}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $0.35 \times 10^{-4}$  moles  $\text{Bi}_2\text{S}_3$  at 18°. (Weigel, Z. phys. Ch. 1907, 58. 294.)

Easily sol. in moderately dil.  $\text{HNO}_3 + \text{Aq}$ , and conc.  $\text{HCl} + \text{Aq}$ , with separation of  $\text{S}$ . Insol. in alkalis, alkali sulphides,  $\text{Na}_2\text{S}_2\text{O}_3$ , or  $\text{KCN} + \text{Aq}$ ; insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$  (Brett). Insol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26. 15.)

Insol. in alkali hydroxides or alkali hydro-sulphides.

Insol. in  $2\text{N} - (\text{NH}_4)_2\text{S} + \text{Aq}$ .

0.0090 g.  $\text{Bi}_2\text{S}_3$  is sol. in 100 cc.  $\text{N} - \text{Na}_2\text{S}_2 + \text{Aq}$  at 25°. (Knox, Chem. Soc. 1909, 96. 1764.)

Somewhat sol. in  $\text{Na}_2\text{S} + \text{Aq}$ . 75 cc. of  $\text{Na}_2\text{S} + \text{Aq}$  (sp. gr. 1.06) dissolve an amt. of  $\text{Bi}_2\text{S}_3$  corresponding to 0.031 g.  $\text{Bi}_2\text{O}_3$ . (Stillman, J. Am. Chem. Soc. 1896, 18. 683.)

Solubility in  $\text{Na}_2\text{S} + \text{NaOH} + \text{Aq}$  at 25°.

Conc. of $\text{Na}_2\text{S}$ Mol./l.	Conc. of $\text{NaOH}$ Mol./l.	g. $\text{Bi}_2\text{S}_3$ in 100 cc. of solution
0.5	1.0	0.0185
1.0	1.0	0.0638

(Knox, Chem. Soc. 1909, 96. 1763.)

Bismuth sulphide pptd. from acid solution is not dissolved by subsequent treatment with  $\text{K}_2\text{S} + \text{Aq}$ . (Stone, J. Am. Chem. Soc. 1896, 18. 1091.)

Sol. in  $\text{K}_2\text{S} + \text{Aq}$ . (Ditte, C. R. 1895, 120. 187.)

Solubility in  $\text{K}_2\text{S} + \text{KOH} + \text{Aq}$  at 25°.

Conc. of $\text{K}_2\text{S}$ Mol./l.	Conc. of $\text{KOH}$ Mol./l.	g. $\text{Bi}_2\text{S}_3$ in 100 cc. of solution
0.5	1.0	0.0240
1.0	1.0	0.1230
1.25	1.25	0.2354

(Knox, Chem. Soc. 1909, 96. 1763.)

## Solubility in alkali sulphides + Aq at 25°.

Alkali sulphide	Conc. of alkali sulphide Mol./l.	g. Bi <sub>2</sub> S <sub>3</sub> in 100 cc. of solution
Na <sub>2</sub> S	0.5	0.0040
	1.0	0.0238
	1.5	0.1023
K <sub>2</sub> S	0.5	0.0042
	1.0	0.0337
	1.25	0.0639

(Knox, Chem. Soc. 1909, 95. 1762.)

Decomp. by FeCl<sub>3</sub> + Aq. (Cammerer, C. C. 1891, II. 525.)

Insol. in KCN + Aq. (Hoffmann, A. 1884, 223. 134.)

Min. *Bismuthinite*. Easily sol. in HNO<sub>3</sub> + Aq.Bismuth cuprous sulphide, Bi<sub>2</sub>S<sub>3</sub>, Cu<sub>2</sub>S.Insol. in H<sub>2</sub>O. Sol. with decomp. in HNO<sub>3</sub> + Aq. (Schneider, J. pr. (2) 40. 564.)Min. *Emplectonite*.Bismuth potassium sulphide, Bi<sub>2</sub>S<sub>3</sub>, K<sub>2</sub>S.

(Schneider, Pogg. 136. 460.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Bi<sub>2</sub>S<sub>3</sub>. 4K<sub>2</sub>S + 4H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. Very sol. in K<sub>2</sub>S + Aq. Efflorescent in dry air. (Ditte, C. R. 1895, 120. 186.)

See also Sulphobismuthite, potassium.

Bismuth silver sulphide, Bi<sub>2</sub>S<sub>3</sub>, Ag<sub>2</sub>S.Insol. in cold HCl, or HNO<sub>3</sub>. Sol. in warm HNO<sub>3</sub> with separation of S, in boiling HCl with separation of H<sub>2</sub>S.Min. *Plenargyrite*, *Matildite*.

(Schneider, J. pr. 1890, (2) 41. 414.)

Bismuth sodium sulphide, Bi<sub>2</sub>S<sub>3</sub>, Na<sub>2</sub>S.

(Schneider.)

Bismuth sulphide telluride, Bi<sub>2</sub>S<sub>3</sub>, 2Bi<sub>2</sub>Te<sub>3</sub>.Min. *Tetradymite*. Sol. in HNO<sub>3</sub> with separation of S.Bi<sub>2</sub>S<sub>3</sub>, 2Bi<sub>2</sub>Te.Min. *Joseite*. As above.Bismuth sulphobromide, BiSBr<sub>3</sub>.

(Muir and Eagles, Chem. Soc. 1895, 67. 91.)

Bismuth sulphochloride, BiSCl<sub>3</sub>.Insol. in H<sub>2</sub>O or dil. HCl + Aq. Sol. in conc. HCl, or HNO<sub>3</sub> + Aq. Decomp. by alkalis + Aq. (Schneider, Pogg. 93. 464.)

Bismuth sulphoiodide, BiSI.

Not attacked by boiling H<sub>2</sub>O, and dil. acids. Decomp. by hot conc. HCl + Aq, and HNO<sub>3</sub> + Aq. KOH + Aq dissolves out I<sub>2</sub>. (Schneider, Pogg. 110. 114.)Bismuth telluride, Bi<sub>2</sub>Te<sub>3</sub>.Min. *Tetradymite*. Sol. in HNO<sub>3</sub> + Aq.

See also Bismuth sulphide telluride.

Bismuthic acid, HBiO<sub>3</sub>.

See Bismuthic hydroxide.

Potassium bismuthate, KBiO<sub>3</sub>.Sol. in H<sub>2</sub>O. (Arppe.)KH(BiO<sub>3</sub>)<sub>2</sub>. Insol. in H<sub>2</sub>O.Not decomp. by boiling H<sub>2</sub>O. (André, C. R. 113. 860.)No salts of HBiO<sub>3</sub> can exist. (Muir and Carnegie, Chem. Soc. 51. 77.)

Bismuthicotungstic acid.

Ammonium bismuthicotungstate, 3(NH<sub>4</sub>)<sub>2</sub>O, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 10H<sub>2</sub>O.

A yellow oil which dries to a yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1232.)

Potassium bismuthicotungstate, 3K<sub>2</sub>O, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 15H<sub>2</sub>O.

A yellow oil which dried to a pale yellow glass. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1233.)

Strontium bismuthicotungstate, 3SrO, 2Bi<sub>2</sub>O<sub>3</sub>, 11WO<sub>3</sub> + 11H<sub>2</sub>O.A yellow wax, insol. in pure H<sub>2</sub>O, but sol. in H<sub>2</sub>O containing a few drops HNO<sub>3</sub>. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1233.)

Bismuthyl bromide, BiOBr.

Insol. in H<sub>2</sub>O; sol. in moderately conc. HBr + Aq.Insol. in H<sub>2</sub>O. (Herz, Z. anorg. 1903, 36. 348.)Bi<sub>2</sub>O<sub>3</sub>Br<sub>3</sub>. Insol. in H<sub>2</sub>O; easily sol. in conc. HCl, or HNO<sub>3</sub> + Aq; less sol. in dil. HNO<sub>3</sub> + Aq.Bi<sub>2</sub>O<sub>3</sub>Br<sub>3</sub>. As the preceding comp. (Muir.)

Bismuthyl chloride, BiOCl.

Insol. in H<sub>2</sub>O or dil. acids. Sol. in conc. HCl, or HNO<sub>3</sub> + Aq.Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1893, 20. 827.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+ H<sub>2</sub>O. (Heintz, Pogg. 63. 55.)+ 3H<sub>2</sub>O. (Phillips, Br. Arch. (1) 39. 41.)Bi<sub>2</sub>O<sub>3</sub>Cl<sub>3</sub>. (Arppe.)BiO<sub>2</sub>Cl<sub>3</sub>. Insol. in H<sub>2</sub>O; sol. in hot HCl, or HNO<sub>3</sub> + Aq. (Muir.)

Bismuthyl fluoride, BiOF.

Insol. in H<sub>2</sub>O; sol. in HCl, HBr, or HI + Aq. (Gott and Muir, Chem. Soc. 33. 139.)BiOF, 2HF. Insol. in H<sub>2</sub>O.



**Bismuthyl iodide, BiOI.**

Not decomp. by  $H_2O$  or alkaline solutions.  
Sol. in  $HCl + Aq.$  Decomp. by  $HNO_3 + Aq.$   
(Schneider, J. pr. 79. 424.)

Insol. in  $KCl$ , or  $KI + Aq.$

$3BiOI \cdot 7Bi_2O_3$ . Sol. in dil.  $HCl$ ; decomp. by  $HNO_3$ ; insol. in boiling  $H_2O$  and alkali.  
(Blyth, C. N. 1896, 74. 200.)

$BiI_3 \cdot 5Bi_2O_3$ . Ppt. Sl. sol. in  $HC_2H_3O_2 + Aq.$  Not decomp. by  $H_2O$ . (Fletcher and Cooper, Pharm. J. (3) 13. 254.)

$4BiI_3 \cdot 5Bi_2O_3$ . Easily sol. in  $HCl + Aq.$  Decomp. by  $HNO_3 + Aq.$  Sl. attacked by  $H_2SO_4$ ; somewhat sol. in  $H_2C_4H_4O_6$ , and  $KHC_4H_4O_6 + Aq.$

Sol. in  $(NH_4)_2S$ , and  $KOH + Aq.$  (Storer's Dict.)

**Bismuthyl sulphide,  $Bi_2O_3S$ .**

(Hermann, J. pr. 75. 452.)

$Bi_2O_3S$ . Insol. in  $H_2O$ . (Scherpenberg, C. C. 1889, II. 641.)

$Bi_2O_3S$ .

Min. *Karelinite*.

**Boracic acid.**

See Boric acid.

**Borax.**

See Tetraborate, sodium.

**Boric acid, anhydrous,  $B_2O_3$ .**

See Boron trioxide.

**Metaboric acid,  $HBO_3$ .**

Sol. in  $H_2O$ .

Sl. sol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, 100. (2) 720.)

**Orthoboric acid,  $H_3BO_3$ .**

Sol. in 33 pts.  $H_2O$  at  $10^\circ$ .

" 25 " "  $20^\circ$ .

" 3 " "  $100^\circ$ .

(Berzelius.)

Sol. in 20 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)

100 pts.  $H_2O$  at  $100^\circ$  dissolve 2 pts. (Ure's Dict.)

1 pt. crystallized acid dissolves in—

25.66 pts.  $H_2O$  at  $19^\circ$ .

14.88 " "  $25^\circ$ .

12.66 " "  $37.5^\circ$ .

10.16 " "  $50^\circ$ .

6.12 " "  $62.5^\circ$ .

4.73 " "  $75^\circ$ .

3.55 " "  $87.5^\circ$ .

2.97 " "  $100^\circ$ .

Or, 100 pts.  $H_2O$  dissolve at—

$19^\circ$  3.9 pts.  $H_3BO_3$ .

$25^\circ$  6.8 " "

$37.5^\circ$  7.8 " "

$50^\circ$  9.8 " "

$62.5^\circ$  16.0 " "

$75^\circ$  21.0 " "

$87.5^\circ$  28.0 " "

$100^\circ$  34.0 " "

Or, sat. aqueous solution contains at—

$19^\circ$  3.75%  $H_3BO_3$ .

$25^\circ$  6.27 " "

$37.5^\circ$  7.32 " "

$50^\circ$  8.96 " "

$62.5^\circ$  14.04 " "

$75^\circ$  17.44 " "

$87.5^\circ$  21.95 " "

$100^\circ$  25.17 " "

(Brandes and Firnhaber, Arch. Pharm. 7. 50.)

1 litre  $H_2O$  dissolves at—

$0^\circ$  19.47 g.  $H_3BO_3$ .

$12^\circ$  29.20 " "

$20^\circ$  39.92 " "

$40^\circ$  69.91 " "

$62^\circ$  114.16 " "

$80^\circ$  168.15 " "

$102^\circ$  291.16 " "

(Ditte, C. R. 85. 1069.)

1 l.  $H_2O$  dissolves 0.901 mol.  $H_3BO_3$  at  $25^\circ$ .  
(Herr, Z. anorg. 1910, 66. 359.)

1 l.  $H_2O$  dissolves 0.898 mol.  $H_3BO_3$  at  $25^\circ$ .  
Sp. gr. of the solution = 1.0168. (Müller, Z. phys. Ch. 1907, 57. 529.)

1 l.  $H_2O$  dissolves 0.887 mol.  $H_3BO_3$  at  $25^\circ$  and 1.025 mol. at  $30^\circ$ . (Ageno and Valla, Ist. Ven. (VIII) 14. II, 331.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g. $H_3BO_3$ in 100 g. of the solution
0	2.59
12.2	3.69
21	4.90
31	6.44
40	8.02
50	10.35
60	12.90
69.5	15.58
80	19.11
90	23.30
99.5	28.10
108	36.7
115	45.0
120	52.4

(Nasini and Ageno, Z. phys. Ch. 1909, 69. 483.)

Solubility curve for orthoboric acid in  $H_2O$  at various temp. up to  $120^\circ$ . (Nasini and Ageno, Gazz. ch. it. 1911, 41. (1) 131.)

Sp. gr. of  $H_3BO_3 + Aq$  sat. at  $8^\circ$  = 1.014. (Anthon, A. 24. 241.)

Sp. gr. of  $H_3BO_3 + Aq$  sat. at  $15^\circ$  = 1.0243. (Stolba, J. pr. 90. 457.)

Sp. gr. of  $H_3BO_3 + Aq$  at  $15^\circ$ .

% $H_3BO_3$	Sp. gr.	% $H_3BO_3$	Sp. gr.
1	1.0034	4	1.0147
2	1.0069	Sat. sol.	1.015
3	1.0106	...	...

(Gerlach, Z. anal. 28. 473.)

Sp. gr. of  $\text{H}_2\text{BO}_3 + \text{Aq}$  at  $18^\circ$ .  
 $\gamma\text{H}_2\text{BO}_3$  0.776 1.92 2.88 3.612  
 Sp. gr. 1.0029 1.0073 1.0109 1.0131  
 (Bock, W. Ann. 1887, 30. 638.)

Volatile with steam.  
 More sol. in dil.  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .  
 Sol. in warm conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ .

Solubility in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ .

Millimols $\text{HCl}$ in 10 ccm. of the solution	Millimols $\text{H}_2\text{BO}_3$ in 10 ccm. of the sat. solution
7.0	9.01
13.7	7.69
	6.66

(Herz, Z. anorg. 1910, 66. 359.)

Solubility of  $\text{H}_2\text{BO}_3$  in  $\text{HCl} + \text{Aq}$  at  $16^\circ$ .

Normality of $\text{HCl}$	Normality of $\text{H}_2\text{BO}_3$
0.	0.907
0.130	0.895
0.260	0.870
0.390	0.842
1.30	0.645
2.16	0.542
4.32	0.308
6.00	0.338
7.08	0.327
8.74	0.327
9.51	0.338

(Herz, Z. anorg. 1902, 33. 354.)

Solubility in  $\text{HF} + \text{Aq}$  at  $26^\circ$ .

(1) Titer of $\text{HF}$	(2) Titer after saturation with $\text{H}_2\text{BO}_3$ at $26^\circ$	(3) Titer after addition of mannitol	(3)-(2) equals free boric acid
3.21n.	1.61	2.36	0.75
2.80n.	1.25(1.40?)	2.21	0.96(0.81?)

The values 0.75 and 0.81 represent the solubility of  $\text{H}_2\text{BO}_3$  in the concentrations of fluorboric acid resulting from the original concentration of  $\text{HF} + \text{Aq}$ .

(Abegg, Z. anorg. 1903, 35. 145.)

Solubility of  $\text{H}_2\text{BO}_3$  in acids +  $\text{Aq}$  at  $26^\circ$ .

Acid	Normality of the acid	Normality of $\text{H}_2\text{BO}_3$
$\text{H}_2\text{SO}_4$	0.548	0.746
	2.74	0.518
	5.48	0.312
	8.75	0.092
$\text{HNO}_3$	0.241	0.818
	1.206	0.676
	1.607	0.593
	2.411	0.567
	5.96	0.268
	7.38	0.238

(Herz, Z. anorg. 1903, 34. 205.)

Solubility in  $\text{KOH} + \text{Aq}$ .

See Borates, potassium.

Solubility in  $\text{NaOH} + \text{Aq}$ .

See Borates, sodium.

Solubility in  $\text{LiCl} + \text{Aq}$  at  $25^\circ$ .

Millimols $\text{LiCl}$ in 10 ccm. of the solution	Millimols $\text{H}_2\text{BO}_3$ in 10 ccm. of the sat. solution
7.1	9.01
10.3	8.13
22.3	7.65
37.2	6.42
	5.02

(Herz, Z. anorg. 1910, 66. 359.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ .

Millimols $\text{KCl}$ in 10 ccm. of the solution	Millimols $\text{H}_2\text{BO}_3$ in 10 ccm. of the sat. solution
1.9	9.01
7.9	9.20
15.6	9.44
30.6	9.80
	10.75

(Herz.)

Solubility in  $\text{RbCl} + \text{Aq}$  at  $25^\circ$ .

Millimols $\text{RbCl}$ in 10 ccm. of the solution	Millimols $\text{H}_2\text{BO}_3$ in 10 ccm. of the sat. solution
14.0	9.01
25.3	9.66
	10.60

(Herz.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $25^\circ$ .

Millimols $\text{NaCl}$ in 10 ccm. of the solution	Millimols $\text{H}_2\text{BO}_3$ in 10 ccm. of the sat. solution
8.2	9.01
15.2	8.49
29.4	8.25
	8.20

(Herz.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{KCl}$ ,  $\text{KNO}_3$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{NaNO}_3$ , and  $\text{Na}_2\text{SO}_4$ .

In general the solubility in  $\text{H}_2\text{O}$  is increased by the presence of both electrolytes and non-electrolytes. (Bogdan, C. C. 1903, II. 2.)

Sol. in borax +  $\text{Aq}$ . (McLauchlan, Z. anorg. 1903, 37. 371.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Unattacked and undissolved by liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1362.)

Sol. in 6 pts. alcohol (Wittstein), 5 pts. boiling alcohol (Wenzel). Only traces dissolve in anhydrous ether. (Schiff.) Sol. in 100 pts. ether. (Hager's Comm.) Sol. in several essential oils.

1 l.  $\text{H}_2\text{O}$  sat. with amyl alcohol dissolves 0.8952 mol.  $\text{H}_2\text{BO}_3$  at  $25^\circ$ . (Auerbach, Z. anorg. 1903, 37. 357.)

Solubility of  $H_2BO_3$  in amyl alcohol + Aq at  $t^\circ$ .M = millimols  $H_2BO_3$  in 1 l. of  $H_2O$ .A = millimols  $H_2BO_3$  in 1 l. of alcohol.

$t^\circ$	M	A
15°	607.2	176.4
	589.3	177.4
	589.0	177.1
	586.0	173.4
	427.4	127.6
	425.8	127.0
	289.1	84.9
	894.0	264.0
	372.0	110.0
	371.8	110.8
25°	301.2	85.7
	180.8	54.0
	49.15	15.45
	51.04	15.45
	26.02	8.05
35°	146.3	44.27

(Müller, Z. phys. Ch. 1907, 57. 514.)

Sp. gr. of amyl alcohol + Aq sat. with  $H_2BO_3$ .

g. water in 1 l. of alcohol + Aq	d <sub>25°/4°</sub>
32.481	0.82229
35.465	0.82324
37.339	0.82321
42.479	0.82392
45.175	0.82447
45.636	0.82456
47.883	0.82454
51.461	0.82527
52.043	0.82585
59.270	0.82699
63.179	0.82739
64.254	0.82779
66.403	0.82701
66.624	0.82670
68.253	0.82856
69.211	0.82884
75.610	0.82999(?)

(Müller.)

Solubility of  $H_2BO_3$  in amyl alcohol and NaCl + Aq at 25°.

Water phase		Amyl alcohol phase			
NaCl normality	mol. $H_2BO_3$	Sp. gr. 25°/4°	1 l. contains		
			mol. $H_2O$	mol. amyl alcohol	mol. $H_2BO_3$
0.00	0.880	0.8296	4.10	8.39	0.2640
0.945	0.866	0.8277	3.55	8.49	0.2638
1.490	0.850	0.8268	3.27	8.54	0.2689
1.865	0.844	0.8259	3.03	8.56	0.2724
2.355	0.833	0.8254	2.86	8.59	0.2850
2.845	0.827	0.8247	2.62	8.62	0.2877
3.06	0.810	0.8241	2.39	8.66	0.2891
3.48	0.810	0.8240	2.32	8.69	0.3006
3.57	0.807	0.8236	2.15	8.70	0.3066
4.01	0.801	0.8233	1.99	8.72	0.3162
4.28	0.798	0.8229	1.78	8.75	0.3210

(Müller)

Solubility in hydroxy-compounds + Aq at 25°.

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol. in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Lactic acid	2.321	1.07	1.0252	1.0444
	6.819	1.61	1.0722	1.0986
	18.77	1.86	1.1405	1.1635
	36.33	2.08	1.2023	1.2254
Glycerine	24.64	1.208	1.1574	1.1707
	46.75	2.132	.....	1.2260
	67.71	2.96	1.2370	1.2526
	90.58	3.78	1.2531	1.2710

Solubility in hydroxy-compounds, etc.—*Continued*

Organic substance added	Mol. of organic substance in 100 mol. of the mixture	Mol. of boric acid sol. in 1 l. of solution	Sp. gr. of the pure mixture	Sp. gr. of the mixture sat. with boric acid
Mannitol	0.790	1.007	.....	1.0425
	0.810	1.015	1.0244	1.0433
	0.945	1.029	1.0288	.....
	1.585	1.136	1.0475	.....
Dulcitol	0.065	0.8876	0.9995	1.0686
	0.130	0.9078	1.0018	1.0212
	0.260	0.9360	1.0060	1.0260

(Müller.)

Solubility of  $H_3BO_3$  in alcohols + Aq at 25°.

M = Mol. of alcohol in 100 mol. of alcohol + Aq.

 $H_3BO_3$  = Mol. of  $H_3BO_3$  in 1 l. of the solution. $d_1$  = Sp. gr. of alcohol + Aq. $d_2$  = Sp. gr. of alcohol + Aq sat. with  $H_3BO_3$ .

Alcohol added	M	$H_3BO_3$	$d_1$	$d_2$
Methyl alcohol	11.74	0.895		
	28.64	1.012		
	36.02	1.098		
	43.95	1.161		
	52.31	1.307		
	100	2.900	0.7924	0.8904
Ethyl alcohol	8.996	0.829		
	22.28	0.800		
	44.46	0.729		
	55.62	0.700		
	79.89	0.893		
	88.10	1.105		
	99.26	1.527	0.7860	0.8353
n-Propyl alcohol	23.66	0.6437	0.9043	0.9193
	53.63	0.4569	0.8231	0.8570
	83.65	0.5776	0.8133	0.8466
	100	0.961	0.8010	0.8297
i-Butyl alcohol	0.70	0.884	0.9923	1.0124
	2.15	0.857	0.9853	0.0038
	2.18	0.857	0.9855	0.0046
	71.4	0.323	0.8173	0.8351
	77.1	0.347	0.8133	0.8220
	85.6	0.4212	0.8081	0.8195
	100	0.6927	0.7984	0.8172
i-Amyl alcohol	0.448	0.883	0.9943	1.0132
	0.520	0.880	0.9936	1.0125
	0.525 <sup>1</sup>	0.880	0.9931	1.0123
	67.26 <sup>2</sup>	0.2584	0.8232	0.829
	75.54	0.2722	0.8183	0.8253
	83.40	0.3190	0.8142	0.8223
	100	0.5703	0.8068	0.8220

<sup>1</sup> Water sat. with alcohol.<sup>2</sup> Alcohol sat. with water.

(Müller.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Solubility in acetone+Aq at 20°.

A = ccm. acetone in 100 ccm. acetone+Aq.  
H<sub>3</sub>BO<sub>3</sub> = millimols H<sub>3</sub>BO<sub>3</sub> in 100 ccm. of the solution.

A	H <sub>3</sub> BO <sub>3</sub>
0	79.15
20	81.71
30	83.35
40	82.74
50	81.61
60	76.40
70	67.62
80	55.05
100	8.06

(Herz, Z. anorg. 1904, 41. 319.)

100 g. pure anhydrous ether dissolve 0.00775 g. H<sub>3</sub>BO<sub>3</sub>.

100 g. ether sat. with H<sub>2</sub>O dissolve 0.2391 g. H<sub>3</sub>BO<sub>3</sub>.

(J. A. Rose, Dissert. 1902.)

Sol. in 10 pts. glycerine. (Hager.)

100 pts. glycerine (sp. gr. 1.26 at 15.5°) dissolve pts. H<sub>3</sub>BO<sub>3</sub> at t°.

t°	Pts. H <sub>3</sub> BO <sub>3</sub>	t°	Pts. H <sub>3</sub> BO <sub>3</sub>	t°	Pts. H <sub>3</sub> BO <sub>3</sub>
0	20	40	38	80	61
10	24	50	44	90	67
20	28	60	50	100	72
30	33	70	56	..	..

(Hooper, Ph. J. Trans. (3) 13. 258.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in glycerine+Aq at 25°.

G = g. glycerine in 100 g. glycerine+Aq.  
H<sub>3</sub>BO<sub>3</sub> = Millimols H<sub>3</sub>BO<sub>3</sub> in 100 cc. of the solution.

G	H <sub>3</sub> BO <sub>3</sub>	Sp. gr.
0	90.1	1.0170
7.15	90.1	1.0379
20.44	90.6	1.0629
31.55	92.9	1.0897
40.95	97.0	1.1130
48.7	103.0	1.1328
69.2	140.2	1.1871
100	390.3	1.2719

(Herz, Z. anorg. 1905, 45. 268.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in organic acids+Aq at 26°.

Acid	Normality of the acid	Normality of H <sub>3</sub> BO <sub>3</sub>
Acetic	0.570	0.887
	2.85	0.538
	5.70	0.268

Solubility of H<sub>3</sub>BO<sub>3</sub>, etc.—Continued.

Acid	Normality of the acid	Normality of H <sub>3</sub> BO <sub>3</sub>
Tartaric	0.955	0.890
	1.909	0.923
	2.51	0.962
	3.316	1.07

(Herz, Z. anorg. 1903, 34. 206.)

The solubility of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O is increased by the presence of racemic acid.

Millimols racemic acid in 10 ccm. of the solvent	Millimols boric acid in 10 ccm. of the solution
0	9.01
6.3	9.86
12.6	10.46
24.7	11.65

(Herz, Z. anorg. 1911, 70. 71.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in H<sub>2</sub>O is increased by the presence of tartaric acid.

Millimols tartaric acid in 10 ccm. of the solvent	Millimols boric acid in 10 ccm. of the solution
0	9.01
7.5	10.00
15	10.70
30	12.07

(Herz, Z. anorg. 1911, 70. 71.)

Solubility in oxalic acid+Aq at 25°.

Millimols oxalic acid in 10 ccm. of the solution	Millimols H <sub>3</sub> BO <sub>3</sub> in 10 ccm. of the sat. solution
...	9.01
2.97	9.95
5.95	10.80
13.77	11.98

(Herz, Z. anorg. 1910, 66. 93.)

Solubility in H<sub>2</sub>O is increased by the presence of urea, acetone or propyl alcohol. (Bogdan, C. C. 1903, II. 2.)

Readily sol. in hot glacial acetic acid. (Holt Chem. Soc. 1911, 100 (2). 720.)

Sol. in 250 pts. benzene. (Hager.)

Solubility of H<sub>3</sub>BO<sub>3</sub> in mannite+Aq at t°.

Solid phase, H<sub>3</sub>BO<sub>3</sub>

t°	Mg.-mols. in 1 l.		t°	Mg.-mols in 1 l.	
	Mannite	H <sub>3</sub> BO <sub>3</sub>		Mannite	H <sub>3</sub> BO <sub>3</sub>
25°	0	0.887	30°	0	1.025
"	0.1	0.951	"	0.1	1.056
"	0.3	1.015	"	0.2	1.086
"	0.4	1.039	"	0.3	1.118
"	0.5	1.071	"	0.4	1.157
"	0.6	1.102	"	0.5	0.193
"	0.7	1.142	"	0.6	1.219
"	0.8	1.173	"	0.7	1.258
"	1.043	1.244			
"	1.409	1.404			
"	1.781	1.521			

Solid phase, mannite		
t°	Mg. mols. in 1 l.	
	Mannite	H <sub>2</sub> BO <sub>3</sub>
25°	1.075	0
"	1.1424	0.2646
"	1.259	0.463
"	1.265	0.559
"	1.354	0.794
"	1.409	0.927
"	1.536	1.243
"	1.781	1.521

(Ageno and Valla, Ist. Ven. (VIII) 14. 331.)

Distribution between H<sub>2</sub>O and amyl alcohol at 25°.

w = concentration of H<sub>2</sub>BO<sub>3</sub> in H<sub>2</sub>O layer expressed in millimols.

a = concentration of H<sub>2</sub>BO<sub>3</sub> in alcohol layer expressed in millimols.

w	a
265.8	76.6
196.5	59.5
159.6	47.5
126	37.1
87.9	33.2
75.2	22.7
64.6	19.76

(Abegg, Z. anorg. 1903, 35. 130.)

Partition of H<sub>2</sub>BO<sub>3</sub> between water and mixtures of amyl alcohol and CS<sub>2</sub>.

W = Millimols H<sub>2</sub>BO<sub>3</sub> in 10 ccm. of the aqueous layer.

G = Millimols H<sub>2</sub>BO<sub>3</sub> in 10 ccm. of the amyl alcohol—CS<sub>2</sub> layer.

Composition of the solvent mixture	G	W	W/G
75% by vol. amyl alcohol + 25% by vol. CS <sub>2</sub>	0.145	0.624	4.31
	0.275	1.198	4.36
	0.429	1.844	4.30
	0.589	2.565	4.45
50% by vol. amyl alcohol + 50% by vol. CS <sub>2</sub>	0.145	0.756	5.47
	0.259	1.353	5.21
	0.364	1.946	5.34
	0.555	2.889	5.22
25% by vol. amyl alcohol + 75% by vol. CS <sub>2</sub>	0.085	0.699	8.24
	0.175	1.467	8.40
	0.264	2.165	8.12
	0.384	3.129	8.14

(Herz, Z. Elektrochem. 1910, 16. 870.)

Distribution between HF + Aq and amyl alcohol at 25°.

c = HF concentration (millimols).

a = H<sub>2</sub>BO<sub>3</sub> concentration in alcohol layer (expressed in millimols).

w = H<sub>2</sub>BO<sub>3</sub> concentration in water layer (expressed in millimols).

c	a	w
500	14.3	71.2
"	19.2	99.2
"	25.3	144.2
"	114.3	979.0
250	30.1	144.5
"	37.0	194.8
"	56.8	321.5
"	108.0	652.0
125	39.0	170.5
"	47.2	214.0
"	52.8	240.5
"	96.0	442.0
62.5	30.4	111.2
"	39.4	151.8
"	65 (68?)	272.8
"	90.0	362.2

(Abegg, Z. anorg. 1903, 35. 131.)

See also Boron trioxide.

Pyroboric (tetraboric) acid, H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>.

Sol. in H<sub>2</sub>O.

Sp. gr. of solutions of boric acid, calculated as H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, containing—

6.3 1.27 1.91 2.54% H<sub>2</sub>B<sub>4</sub>O<sub>7</sub>  
1.0034 1.0069 1.0106 1.0147 sp. gr.

Sat. solution at 15° has sp. gr. 1.015. (Gerlach, Z. anal. 28. 473.)

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, 100. (2) 720.)

Borates.

No borate is quite insol. in H<sub>2</sub>O; the alkali borates are very sol. The less sol. borates are easily decomp. by H<sub>2</sub>O; the easily sol. salts are also decomp., but less quickly. The less sol. borates are easily sol. in H<sub>2</sub>BO<sub>3</sub>, HNO<sub>3</sub>, etc. They are more sol. in H<sub>2</sub>O containing tartaric acid or potassium tartrate than in pure H<sub>2</sub>O. (Souberain.) The normal borates of the alkaline-earths are sol. to no inconsiderable extent in H<sub>2</sub>O, and more readily in hot, than in cold H<sub>2</sub>O. (Berzelius, Pogg. 34. 568.)

All borates are insol., or sl. sol. in alcohol.

Aluminum borate, 2Al<sub>2</sub>O<sub>3</sub>, B<sub>2</sub>O<sub>3</sub>.

Min. *Jeremciwite*.

+3H<sub>2</sub>O. Ppt. (Rose, Pogg. 91. 452.)

3Al<sub>2</sub>O<sub>3</sub>, B<sub>2</sub>O<sub>3</sub>. *Crystallized*. Insol. in HNO<sub>3</sub> + Aq. (Ebelen, A. ch. (3) 33. 62.)

3Al<sub>2</sub>O<sub>3</sub>, 2B<sub>2</sub>O<sub>3</sub> + 7H<sub>2</sub>O. Ppt. (Rose, l. c.)

Ammonium borate.

The system (NH<sub>4</sub>)<sub>2</sub>O, B<sub>2</sub>O<sub>3</sub>, H<sub>2</sub>O at 60° has

been studied by *Sborgi*. (*Real. Ac. Linc.* 1915 (5) **24**, 1, 1225.)

$2(\text{NH}_4)_2\text{O} \cdot 4\text{B}_2\text{O}_3 + 5\text{H}_2\text{O}$ . (*Sborgi*.)

#### Ammonium diborate.

Difficultly sol. in acetone. (*Naumann*, *B.* 1904, **37**, 4328.)

**Ammonium tetraborate**,  $(\text{NH}_4)_2\text{B}_4\text{O}_7 + 4\text{H}_2\text{O}$ ,  
or perhaps  $\text{NH}_4\text{H}(\text{BO}_3)_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in 12 pts. cold  $\text{H}_2\text{O}$ ; decomp. by heat. (*Rammelsberg*, *Pogg.* **90**, 21.)

Sol. in acetone. (*Eidmann*, *C. C.* 1899, **II**, 1014.)

+  $\text{H}_2\text{O}$ . (*Arfvedson*.)

**Ammonium octoborate**,  $(\text{NH}_4)_2\text{B}_8\text{O}_{13} + 6\text{H}_2\text{O}$ .

Sol. in 8 pts. cold, decomp. by boiling  $\text{H}_2\text{O}$ . (*Rammelsberg*, *Pogg.* **90**, 21.)

+  $4\text{H}_2\text{O}$ .

Min. *Livdellerite*. Sol. in  $\text{H}_2\text{O}$  with decomp.

**Ammonium dekaborate**,  $(\text{NH}_4)_2\text{B}_{10}\text{O}_{16} + 6\text{H}_2\text{O}$ .

Permanent. Sol. in  $\text{H}_2\text{O}$ . (*Rammelsberg*.)  
+  $8\text{H}_2\text{O}$ . (*Atterberg*, *Bull. Soc.* (2) **23**, 350.)

**Ammonium dodekaborate**,  $(\text{NH}_4)_2\text{B}_{12}\text{O}_{18} + 9\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (*Bechi*, *Sill. Am. J.* (2) **17**, 129.)

**Ammonium perborate**,  $\text{NH}_4\text{BO}_3$ .

See *Perborate, ammonium*.

**Ammonium calcium borate**,  $(\text{NH}_4)_2\text{CaB}_4\text{O}_{11}$   
=  $\text{CaB}_4\text{O}_7 + 4(\text{NH}_4)_2\text{O}$ .

(*Ditte*, *C. R.* **96**, 1663.)

**Ammonium magnesium borate.**

Sol. in  $\text{H}_2\text{O}$ , decomp. by boiling. (*Rammelsberg*, *Pogg.* **49**, 451.)

**Ammonium zinc borate**,  $4(\text{NH}_4)_2\text{B}_4\text{O}_7$ ,  
 $\text{Zn}(\text{BO}_3)_2 + 5\text{H}_2\text{O}$ .

(*Ditte*, *C. R.* **96**, 1663.)

**Barium borate**,  $\text{Ba}(\text{BO}_3)_2$ .

Ppt. (*Ouvrard*, *C. R.* 1906, **142**, 283.)

+  $2\text{H}_2\text{O}$ . (*Atterberg*.)

+  $4\text{H}_2\text{O}$ . (*Benedikt*, *B.* **7**, 703.)

Sol. in 3,300 pts. 45% alcohol.

" 7,800 " 50 "

" 25,000 " 60 "

" 55,000 " 75 "

(*Berg*, *Z. anal.* **18**, 25.)

+  $10\text{H}_2\text{O}$ . Sl. sol. in cold, more readily in hot  $\text{H}_2\text{O}$ , especially in presence of ammonium salts. (*Berzelius*, *Pogg.* **34**, 568.) Sol. in sodium citrate + Aq. (*Spiller*.) Insol. in wood spirit. (*Ebelmen*.)

$2\text{BaO} \cdot \text{B}_2\text{O}_3$ . Decomp. by  $\text{H}_2\text{O}$  forming  $\text{BaO}$ ,  $\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$ . (*Ouvrard*, *C. R.* 1906, **142**, 283.)

$3\text{BaO} \cdot \text{B}_2\text{O}_3$ . Easily sol. in mineral acids. Sl. attacked by dil. acetic acid. (*Ouvrard*, *C. R.* 1901, **132**, 258.)

$\text{BaB}_2\text{O}_6$ . Slowly sol. in warm dilute  $\text{HNO}_3$  + Aq. (*Ditte*, *C. R.* **77**, 892.)

+  $5\text{H}_2\text{O}$ . Sol. in 100 pts. cold, and more freely in hot  $\text{H}_2\text{O}$ . When freshly pptd. sol. in cold  $\text{NH}_4\text{Cl}$  + Aq. (*Wackenroder*, *A.* **41**, 315);  $\text{NH}_4\text{NO}_3$  + Aq. (*Brett*, *Phil. Mag.* (3) **10**, 96); and  $\text{BaCl}_2$  + Aq. (*Rose*.)

$\text{BaB}_4\text{O}_{10} + 13\text{H}_2\text{O}$ . (*Laurent*, *A. ch.* (2) **67**, 215.)

$\text{Ba}_2\text{B}_4\text{O}_{11}$ . (*Bloxam*, *Chem. Soc.* **14**, 143.)  
 $5\text{BaO} \cdot 2\text{B}_2\text{O}_3$ .

$\text{Ba}_3\text{B}_4\text{O}_{13} + 6\text{H}_2\text{O}$ . Sol. in 100 pts. cold  $\text{H}_2\text{O}$ . Easily sol. in ammonium nitrate, or chloride, or barium chloride + Aq. (*Rose*, *Pogg.* **87**, 1.)

$\text{Ba}_2\text{B}_4\text{O}_{11}$ . Easily sol. in warm dilute acids. +  $6\text{H}_2\text{O}$ .

+  $7\text{H}_2\text{O}$ .

+  $15\text{H}_2\text{O}$ . (*Laurent*, *A. ch.* (2) **67**, 215.)

**Barium borate bromide**,  $3\text{BaO} \cdot 5\text{B}_2\text{O}_3$ ,  $\text{BaBr}_2$ . (*Ouvrard*, *C. R.* 1906, **142**, 283.)

**Barium borate chloride**,  $3\text{BaO} \cdot 5\text{B}_2\text{O}_3$ ,  $\text{BaCl}_2$ .

Unaffected by  $\text{H}_2\text{O}$ . Sol. in acids. (*Ouvrard*, *C. R.* 1906, **142**, 283.)

**Bismuth borate**,  $\text{BiBO}_3 + 2\text{H}_2\text{O}$ .

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{S}$ . Not decomp. by  $\text{KOH}$  + Aq. (*Vanino*, *J. pr.* 1906, (2) **74**, 152.)

**Cadmium borate**,  $\text{Cd}_2(\text{BO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$ , easily sol. in dil. acids. (*Ouvrard*, *C. R.* 1900, **130**, 174.)

$\text{Cd}(\text{BO}_3)_2$ . Difficultly sol. in  $\text{H}_2\text{O}$  (*Stromeyer*); insol. in  $\text{H}_2\text{O}$ , sol. in  $\text{HCl}$  + Aq. (*Odling*); easily sol. in warm  $\text{NH}_4\text{Cl}$  + Aq. (*Rose*.)

(*Guertler*, *Z. anorg.* 1904, **40**, 242.)

$3\text{CdO} \cdot 2\text{B}_2\text{O}_3 + 3\text{H}_2\text{O}$ . Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (*Rose*, *Pogg.* **88**, 299.)

$\text{CdO} \cdot 2\text{B}_2\text{O}_3 + 2\text{H}_2\text{O}$ . (*Ditte*, *A. ch.* 1883, (5) **30**, 255.)

$\text{CdO} \cdot 4\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; decomp. on heating. (*Ditte*, *A. ch.* 1883, (5) **30**, 255.)

**Cadmium borate bromide**,  $6\text{CdO} \cdot 8\text{B}_2\text{O}_3$ ,  $\text{CdBr}_2$ .

Insol. in  $\text{H}_2\text{O}$  and fuming  $\text{HCl}$  or  $\text{HBr}$  + Aq. (*Rousseau* and *Allaire*, *C. R.* 1894, **119**, 72.)

**Cadmium borate chloride**,  $6\text{CdO} \cdot 8\text{B}_2\text{O}_3$ ,  $\text{CdCl}_2$ .

(*Rousseau* and *Allaire*, *C. R.* 1894, **118**, 1256.)

**Cadmium borate iodide**,  $6\text{CdO} \cdot 8\text{B}_2\text{O}_3$ ,  $\text{CdI}_2$ .

(*Allaire*, *C. R.* 1898, **127**, 557.)

**Cæsium borate**,  $\text{Cs}_2\text{B}_6\text{O}_{10}$ .

Very sol. in  $\text{H}_2\text{O}$ , less in alcohol. (*Reischle*, *Z. anorg.* **4**, 116.)

**Calcium borate,  $\text{Ca}(\text{BO}_2)_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alkali chlorides, or boiling conc. acetic acid + Aq; sol. in cold or hot solutions of ammonium salts, especially ammonium nitrate, in  $\text{CaCl}_2$  + Aq, and also easily sol. in dilute mineral acids at  $50^\circ$ . (Ditte, C. R. 80. 490, 561.)

+  $2\text{H}_2\text{O}$ .

+  $4\text{H}_2\text{O}$ ; two modifications of which one is very unstable. (van't Hoff and Meyerhoffer, A. 1906, 351. 101.)

+  $6\text{H}_2\text{O}$ . When warmed in  $\text{H}_2\text{O}$  it goes over into  $\text{CaB}_2\text{O}_7 + 4\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer.)

Sol. in  $\text{H}_2\text{O}$  without decomp.; 1 l. solution contains 2 g. salt. (Ditte, C. R. 96. 1663.)

$\text{CaB}_2\text{O}_7$ . Decomp. by  $\text{H}_2\text{O}$ . (Blount, C. N. 54. 208.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $3\text{H}_2\text{O}$ . (Ditte, C. R. 96. 1663.)

+  $4\text{H}_2\text{O}$ . Min. *Bechilite*.

+  $6\text{H}_2\text{O}$ . Min. *Borocalcite*. Sol. in acids.

$\text{CaB}_2\text{O}_{10} + 4\text{H}_2\text{O}$ .

+  $8\text{H}_2\text{O}$ . Unstable. On standing in the solution in which it is formed it changes into  $\text{CaB}_4\text{O}_{13} + 4\text{H}_2\text{O}$ .

+  $12\text{H}_2\text{O}$ . Unstable. Goes over into  $\text{CaB}_4\text{O}_{13} + 8\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer, A. 1906, 351. 104.)

$\text{CaB}_2\text{O}_{11} + 12\text{H}_2\text{O}$ . (Ditte, C. R. 96. 1663.)

$2\text{CaO} \cdot \text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , sol. in dil. acids. (Ouvrard, C. R. 1905, 141. 353.)

$\text{Ca}_2\text{B}_4\text{O}_{11}$ . (Ditte, C. R. 77. 785.)

+  $3\text{H}_2\text{O}$ . Min. *Pandermite*, *Priceite*. See  $4\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ .

+  $5\text{H}_2\text{O}$ . Min. *Colemanite*.

If all the Ca is in form of colemanite, the solution contains in 100 g., 4.8 g.  $\text{H}_3\text{BO}_3$  and 0.1 g. CaO. (van't Hoff, B. A. B. 1907, 653.)

+  $7\text{H}_2\text{O}$ .

+  $9\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer, A. 1906, 351. 101.)

$3\text{CaO} \cdot \text{B}_2\text{O}_3$ . Easily sol. in dil. acids. (Ouvrard, C. R. 1901, 132. 258.)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ . (van't Hoff, B. A. B. 1906, II. 568.)

$4\text{CaO} \cdot 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ . True composition of *Pandermite*. (van't Hoff, B. A. B. 1906, II. 572.)

**Calcium iron (ferrous) borate silicate,**

$\text{Ca}_2\text{FeB}_2\text{Si}_2\text{O}_{14}$ .

Min. *Homilite*. Easily sol. in  $\text{HCl}$  + Aq.

**Calcium magnesium borate,  $\text{CaO} \cdot \text{MgO} \cdot 3\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$ .**

Min. *Hydroboracile*. Somewhat sol. in  $\text{H}_2\text{O}$ . Easily sol. in warm  $\text{HCl}$  + Aq or  $\text{HNO}_3$  + Aq.

$3\text{CaO} \cdot 3\text{MgO} \cdot 4\text{B}_2\text{O}_3$ . (Ditte, C. R. 77. 894.)

**Calcium sodium borate,  $2\text{CaO} \cdot \text{Na}_2\text{O} \cdot 5\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$ .**

(van't Hoff, B. A. B. 1907, 303.)

$\text{Ca}_2\text{B}_{10}\text{O}_{18} \cdot \text{Na}_2\text{B}_4\text{O}_7 + 15$ , or  $24\text{H}_2\text{O}$ .

Min. *Natroborocalcite*, *Ulexite*. Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol. in acids.

$\text{Ca}_2\text{Na}_2\text{B}_{11}\text{O}_{32} + 15\text{H}_2\text{O}$ . Min. *Franklandite*. Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl}$ , and  $\text{HNO}_3$  + Aq.

**Calcium borate bromide,  $3\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CaBr}_2$ .**

Sl. attacked by  $\text{H}_2\text{O}$ . Very sol. in dilute acetic acid. (Ouvrard, C. R. 1905, 141. 1023.)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{CaBr}_2$ . Hardly attacked by cold  $\text{H}_2\text{O}$  or very dil. acetic acid. Sol. in strong acids, even when dilute. (Ouvrard, C. R. 1905, 141. 1023.)

**Calcium borate chloride,  $\text{Ca}_2\text{B}_4\text{O}_{13} \cdot \text{CaCl}_2$ .**

Decomp. quickly by moist air or  $\text{H}_2\text{O}$ , slowly by absolute alcohol. (Chatelier, C. R. 99. 276.)

$3\text{CaO} \cdot 3\text{B}_2\text{O}_3 \cdot \text{CaCl}_2$ . (Ouvrard, C. R. 1905, 141. 353.)

$3\text{CaO} \cdot 5\text{B}_2\text{O}_3 \cdot \text{CaCl}_2$ . Sl. attacked by cold  $\text{H}_2\text{O}$  and dil. acetic acid + Aq. Strong acids dissolve even when very dilute. (Ouvrard, C. R. 1905, 141. 352.)

**Calcium borate silicate,  $2\text{CaO} \cdot \text{B}_2\text{O}_3 \cdot 2\text{SiO}_2 + \text{H}_2\text{O}$ .**

Min. *Dalolite*. Sol. in  $\text{HCl}$  + Aq with separation of gelatinous silica.

+  $2\text{H}_2\text{O}$ . Min. *Botryolite*.

$\text{CaO} \cdot \text{B}_2\text{O}_3 \cdot \text{SiO}_2$ . Min. *Danburite*. Very sl. attacked by  $\text{HCl}$  + Aq before ignition.

**Chromous borate.**

Precipitate. Sol. in free acids; insol. in borax + Aq. (Moberg.)

**Chromic borate,  $7\text{Cr}_2\text{O}_3 \cdot 4\text{B}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in excess of borax + Aq. (Hebberling, C. C. 1870. 122.)

**Chromic magnesium borate,  $3\text{Cr}_2\text{O}_3 \cdot 6\text{MgO} \cdot 2\text{B}_2\text{O}_3$ .**

Not attacked by acids. (Ebelmen, A. ch. (3) 33. 52.)

$2\text{Cr}_2\text{O}_3 \cdot 9\text{MgO} \cdot 3\text{B}_2\text{O}_3$ . (Mallard, C. R. 105. 1260.)

**Cobaltous borate,  $3\text{CoO} \cdot 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 88. 299.)

$3\text{CoO} \cdot \text{B}_2\text{O}_3$ . (Mallard, C. R. 105. 1260.)

$2\text{CoO} \cdot \text{B}_2\text{O}_3$ . (Ouvrard, C. R. 1900, 130. 337.)

**Cobaltous borate bromide,  $6\text{CoO} \cdot 8\text{B}_2\text{O}_3 \cdot \text{CoBr}_2$ .**

(Rousseau and Allaire, C. R. 1894, 119. 73.)

**Cobaltous borate chloride,  $6\text{CoO} \cdot 8\text{B}_2\text{O}_3 \cdot \text{CoCl}_2$ .**

(Rousseau and Allaire, C. R. 1894, 118. 1257.)

**Cobaltous borate iodide,  $6\text{CoO} \cdot 8\text{B}_2\text{O}_3 \cdot \text{CoI}_2$ .**

(Allaire, C. R. 1898, 127. 557.)

**Cuprous borate,  $3\text{Cu}_2\text{O} \cdot 2\text{B}_2\text{O}_3$ .**

(Guertler, Z. anorg. 1904, 38. 459.)



**Cupric borate.**

Composition depends on temperature and concentration of solutions. Boiling  $\text{H}_2\text{O}$  dissolves out all the boric acid. Sol. in acids; slowly sol. in hot conc.  $\text{NH}_4\text{Cl} + \text{Aq.}$

$\text{Cu}(\text{BO}_2)_2$ . Insol. in cold dil. acids, even  $\text{HF}$ . Slowly sol. in hot conc.  $\text{HCl}$ . Not attacked by alkalis or alkali carbonates +  $\text{Aq.}$  (Guertler, Z. anorg. 1904, **38**, 456.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

**Cupric borate ammonia**,  $\text{CuB}_2\text{O}_7$ ,  $4\text{NH}_3 + 6\text{H}_2\text{O}$ .

Efflorescent. Can be recrystallized from a little  $\text{NH}_4\text{OH} + \text{Aq.}$  (Pasternack, A. 151. 227.)

**Didymium borate**,  $\text{DiBO}_3$ .

Insol. in  $\text{H}_2\text{O}$  acidulated with  $\text{HCl} + \text{Aq.}$  (Cleve, Bull. Soc. (2) **43**, 363.)

$\text{Di}_2(\text{B}_2\text{O}_7)_2$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Frerichs and Smith, A. 191. 355.)

**Glucinum borate, basic**,  $5\text{GHO}$ ,  $\text{B}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Krüss and Moraht, B. **23**, 735.)

**Iron (ferrous) borate.**

Ppt.  $\text{H}_2\text{O}$  dissolves out all the boric acid. (Tünnerman.)

**Iron (ferric) borate**,  $\text{Fe}_2(\text{BO}_2)_6 + 3\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ .

Min. *Lagonile*. Sol. in acids.

$2\text{Fe}_2\text{O}_3$ ,  $3\text{B}_2\text{O}_3$ . (Mallard, C. R. **105**, 1260.)  
 $6\text{Fe}_2\text{O}_3$ ,  $\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$ . Ppt. (Rose, Pogg. **89**, 473.)

$9\text{Fe}_2\text{O}_3$ ,  $\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ . Ppt. (Rose.)

**Iron (ferric) magnesium borate**,  $3\text{Fe}_2\text{O}_3$ ,  $6\text{MgO}$ ,  $2\text{B}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl} + \text{Aq.}$  (Ebelmen, A. ch. (3) **33**, 53.)

$2\text{Fe}_2\text{O}_3$ ,  $9\text{MgO}$ ,  $3\text{B}_2\text{O}_3$ . (Mallard, C. R. **105**, 1260.)

**Iron (ferroferric) magnesium borate**,  $3\text{MgO}$ ,  $\text{FeO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{B}_2\text{O}_3$ .

Min. *Ludwigite*. Slowly sol. in  $\text{HCl} + \text{Aq.}$  when finely powdered.

**Iron (ferrous) borate bromide**,  $6\text{FeO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{FeBr}_2$ .

Slowly sol. in hot  $\text{HNO}_3 + \text{Aq.}$  (Rousseau and Allaire, C. R. **116**, 1445.)

**Iron (ferrous) borate chloride**,  $6\text{FeO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{FeCl}_2$ .

Slowly sol. in hot  $\text{HNO}_3 + \text{Aq.}$  (Rousseau and Allaire, C. R. **116**, 1195.)

**Lanthanum borate**,  $2\text{La}_2\text{O}_3$ ,  $\text{B}_2\text{O}_3$ .

(Nordenskjöld, Pogg. **114**, 618.)

$\text{La}_2(\text{B}_4\text{O}_7)_2$ . Ppt. (Smith.)

Formula is  $\text{La}_2\text{B}_6\text{O}_{13} + x\text{H}_2\text{O}$ . (Cleve, B. **11**, 910.)

**Lead borate, basic,**

$2\text{PbO}$ ,  $\text{B}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Ppt.

$4\text{PbO}$ ,  $3\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$ . Ppt.  
+  $5\text{H}_2\text{O}$ . Ppt.

$6\text{PbO}$ ,  $5\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$ . Ppt.

$8\text{PbO}$ ,  $3\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$ . Ppt.

$9\text{PbO}$ ,  $5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ . Ppt. (Rose, Pogg. **87**, 470.)

**Lead borate**,  $\text{Pb}(\text{BO}_2)_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HNO}_3$ , or boiling  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  Decomp. by  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , also by boiling  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq.}$  Insol. in alcohol. (Herapath, Phil. Mag. (3) **34**, 375.)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$ ; sol. in sat.  $\text{NaCl} + \text{Aq.}$   
 $2\text{PbO}$ ,  $3\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$ . (Herapath.)

$\text{PbB}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Slightly sol. in pure  $\text{H}_2\text{O}$ , but insol. in solutions of Na salts as  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq.}$  (Soubeiran.)

**Lead borate chloride**,  $\text{Pb}(\text{BO}_2)_2$ ,  $\text{PbCl}_2 + \text{H}_2\text{O}$ .

Insol. in cold, very slowly decomp. by hot  $\text{H}_2\text{O}$  into its constituents. Easily sol. in dil. hot  $\text{HNO}_3 + \text{Aq.}$ ; insol. in alcohol. (Herapath, Phil. Mag. (3) **34**, 375.)

**Lead borate nitrate**,  $\text{Pb}(\text{BO}_2)_2$ ,  $\text{Pb}(\text{NO}_3)_2 + \text{H}_2\text{O}$ .

Insol. in alcohol. (Herapath.)

**Lithium borate**,  $\text{LiBO}_2$ .

Solubility in  $\text{H}_2\text{O}$ .  
100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{LiBO}_2$  at  $t^\circ$ .

$t^\circ$	g. $\text{LiBO}_2$	$t^\circ$	g. $\text{LiBO}_2$
0	0.7	30	4.9
10	1.4	40	11.12
20	2.6	45	20.

(Le Chatelier, C. R. 1897, **124**, 1094.)

Insol. in acetone. (Eidmann, C. C. **1899**, II. 1014; Naumann, B. 1904, **37**, 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**, 314.)

+  $8\text{H}_2\text{O}$ . (Le Chatelier, Bull. Soc. 1899, (3) **21**, 35.)

+  $16\text{H}_2\text{O}$ . Effloresces in the air; slowly sol. in cold  $\text{H}_2\text{O}$ , rapidly in hot  $\text{H}_2\text{O}$ . (Le Chatelier, C. R. 1897, **124**, 1092.)

$\text{Li}_2\text{H}_4(\text{BO}_3)_2 + 14\text{H}_2\text{O}$ . (Reischle, Z. anorg. **4**, 166.)

$\text{Li}_2\text{B}_2\text{O}_7$ . Deliquescent; easily sol. in  $\text{H}_2\text{O}$ . (Arfvedson, A. ch. **10**, 82.)

Sol. in acetone. (Eidmann, C. C. **1899**, II. 1014.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

+  $5\text{H}_2\text{O}$ . Insol. in alcohol. (Filsinger, Arch. Ph. (3) **8**, 198.)

$\text{Li}_2\text{O}$ ,  $3\text{B}_2\text{O}_3 + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Filsinger.)

$\text{Li}_2\text{O}$ ,  $4\text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Le Chatelier, Bull. Soc. 1899, (3) 21. 35.)

+  $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Filsinger.)

"Acid lithium borate" is less sol. than the tetraborate. (Gmelin.)

$\text{Li}_2\text{O}$ ,  $5\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$ . (Dukelski, C. A. 1908. 1089.)

**Magnesium borate**,  $\text{Mg}(\text{BO}_2)_2$ .

(Ditte, C. R. 77. 893.)

+  $3\text{H}_2\text{O}$ . Min. *Pinnoite*.

+  $4\text{H}_2\text{O}$ . (Laurent, A. ch. (2) 67. 215.)

+  $8\text{H}_2\text{O}$ . Insol. in cold or hot  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by conc.  $\text{HCl} + \text{Aq}$  into  $\text{H}_2\text{BO}_3$  and  $\text{MgCl}_2$ . (Wöhler.)

$\text{MgO}$ ,  $3\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$ . (Popp, A. Suppl. 8. 1.)

$\text{MgO}$ ,  $3\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$ . Very slowly sol. in  $\text{H}_2\text{O}$ . (Rose, A. 84. 221.)

Sol. in 75 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 49. 445.)

$2\text{MgO}$ ,  $\text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Guertler, Z. anorg. 1904, 40. 236.)

+  $\text{H}_2\text{O}$ . Very sl. sol. in  $\frac{1}{10}$  N  $\text{HCl} + \text{Aq}$ . (van't Hoff, B. A. B. 1907, 658.)

Min. *Ascharite*.

$3\text{MgO}$ ,  $\text{B}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Ebelmen, A. 80. 208.)

Very sl. sol. in cold, but somewhat decomp. by boiling  $\text{H}_2\text{O}$ . (Rammelsberg.)

+  $9\text{H}_2\text{O}$ . Somewhat sol. in cold  $\text{H}_2\text{O}$ . (Wöhler, Pogg. 28. 525.)

$3\text{MgO}$ ,  $2\text{B}_2\text{O}_3$ . Sol. in warm  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . (Ditte, C. R. 77. 893.)

$\text{MgO}$ ,  $6\text{B}_2\text{O}_3 + 18\text{H}_2\text{O} = \text{Mg}(\text{BO}_3)_2$ ,  $10\text{HBO}_2 + 13\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 49. 445.)

$3\text{MgO}$ ,  $4\text{B}_2\text{O}_3$ . Sol. in hot dil. acids; insol. in acetic acid. (Ditte, C. R. 77. 893.)

$5\text{MgO}$ ,  $2\text{B}_2\text{O}_3 + 1\frac{1}{2}$ , and  $3\text{H}_2\text{O}$ . Min. *Szibelyite*. Difficultly sol. in  $\text{HCl} + \text{Aq}$ .

$9\text{MgO}$ ,  $\text{B}_2\text{O}_3$ . (Mallard, C. R. 105. 260.)

**Magnesium manganous borate**,  $3\text{Mg}_2\text{B}_2\text{O}_5$ ,  $4\text{Mn}_2\text{B}_2\text{O}_5 + 7\text{H}_2\text{O}$ .

Min. *Sussexite*. Sol. in  $\text{HCl} + \text{Aq}$ .

**Magnesium potassium borate**,  $\text{KMg}_2\text{B}_{10}\text{O}_{19} + 9\text{H}_2\text{O}$ .

Min. *Kaliborite*. Insol. in  $\text{H}_2\text{O}$ . (Feit, Ch. Z. 1889, 13. 1188.)

$2\text{MgO}$ ,  $2\text{K}_2\text{O}$ ,  $11\text{B}_2\text{O}_3 + 20\text{H}_2\text{O}$ . (van't Hoff and Lichtenstein, B. A. B. 1904, 936.)

**Magnesium sodium borate**,  $\text{Mg}_2\text{B}_4\text{O}_{11}$ ,  $\text{Na}_2\text{B}_4\text{O}_7 + 30\text{H}_2\text{O}$ .

Efflorescent. About as sol. in cold  $\text{H}_2\text{O}$  as borax; solution separates out a  $\text{Mg}$  borate on warming, which redissolves on cooling.

Decomp. by boiling  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Magnesium strontium borate**,  $3\text{MgO}$ ,  $3\text{SrO}$ ,  $4\text{B}_2\text{O}_3$ .

Easily sol. in dil. acids. (Ditte, C. R. 77. 895.)

**Magnesium borate bromide**,  $2\text{Mg}_2\text{B}_4\text{O}_{11}$ ,  $\text{MgBr}_2$ , or  $6\text{MgO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MgBr}_2$ .

(Rousseau and Allaire, C. R. 1894, 119. 71.)

**Magnesium borate chloride**,  $2\text{Mg}_2\text{B}_4\text{O}_{11}$ ,  $\text{MgCl}_2$ .

Min. *Boracile*. Insol. in  $\text{H}_2\text{O}$ ; slowly sol. in acids. (Kraut.)

*Stassfurthite*. Easily sol. in warm acids. (Bischof.)

**Magnesium borate iodide**,  $6\text{MgO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MgI}_2$ .

(Allaire, C. R. 1898, 127. 556.)

**Magnesium borate phosphate**,  $\text{Mg}(\text{BO}_2)_2$ ,  $2\text{MgHPO}_4 + 7\text{H}_2\text{O}$ .

Min. *Lunenburgite*.

**Magnesium borate sulphate**,  $2\text{Mg}_2\text{B}_4\text{O}_{11}$ ,  $3\text{MgSO}_4 + 12\text{H}_2\text{O}$ .

Min. *Magnesium sulphoborite*.

Sol. in mineral acids when ground. (Nauert, B. 1893, 26. 874.)

**Manganous borate**,  $\text{MnB}_2\text{O}_7$  (?).

Insol. in  $\text{H}_2\text{O}$  (Berzelius); very sl. sol. in  $\text{H}_2\text{O}$  (Thomas, Am. Ch. J. 4. 358); decomp. by warm, slowly by cold  $\text{H}_2\text{O}$ . Sol. in  $\text{MgSO}_4 + \text{Aq}$  (Berzelius).

+  $3\text{H}_2\text{O}$ . (Endemann and Paisley, Zeit. angew. Ch. 1903, 16. 176.)

+  $5\text{H}_2\text{O}$ . Ppt. (Endemann and Paisley.)

Very hygroscopic. (Endemann, Am. Ch. J. 1903, 29. 72.)

$3\text{MnO}$ ,  $\text{B}_2\text{O}_3$ . (Mallard, C. R. 105. 1260.)

Not attacked by  $\text{H}_2\text{O}$ . Very sol. in acids. (Ouvrard, C. R. 1900, 130. 336.)

$3\text{MnO}$ ,  $2\text{B}_2\text{O}_3$ . (Mallard.)

$\text{MnH}_4(\text{BO}_3)_2$ . Very sl. sol. in  $\text{H}_2\text{O}$ .

Solubility in 2%  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . At  $18.5^\circ$ , 0.77 g.  $\text{MnH}_4(\text{BO}_3)_2$  are dissolved per litre;

at  $40^\circ$ , 0.65 g.; at  $60^\circ$ , 0.36 g.; at  $80^\circ$ , 0.12 g.

Solubility in 2%  $\text{NaCl} + \text{Aq}$ . 1 l. solution dissolves 1.31 g. salt at  $18.2^\circ$ ; 0.6 g. at  $59^\circ$ ; and 0.29 g. at  $80^\circ$ .

Solubility in 2%  $\text{CaCl}_2 + \text{Aq}$ . 1 l.  $\text{CaCl}_2 + \text{Aq}$  dissolves 2.91 g. salt at  $17.6^\circ$ ; 2.44 g. at  $43.0^\circ$ ; 2.25 g. at  $61^\circ$ ; and 1.35 g. at  $80^\circ$ . (Hartley and Ramage, Chem. Soc. 63. 129.)

**Manganous borate bromide**,  $6\text{MnO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MnBr}_2$ .

(Rousseau and Allaire, C. R. 1894, 119. 73.)

**Manganous borate chloride**,  $6\text{MnO}$ ,  $8\text{B}_2\text{O}_3$ ,  $\text{MnCl}_2$ .

(Rousseau and Allaire, C. R. 1894, 118. 1257.)

**Molybdenum borate**,  $\text{MoO}_3$ ,  $2\text{B}_2\text{O}_3$  (?).

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{BO}_3 + \text{Aq}$ . (Berzelius.)

**Molybdenum borate,  $\text{Mo}_2\text{O}_3, \text{B}_2\text{O}_3$ .**

Precipitate. Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in a solution of boric acid. (Berzelius.)

See Boromolybdic Acid.

**Nickel borate,  $\text{Ni}(\text{BO}_2)_2 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Easily sol. in warm  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose, Pogg. 88. 299.)

$2\text{NiO}, \text{B}_2\text{O}_3 + x\text{H}_2\text{O}$ . Easily sol. in acids. (Rose.)

$3\text{NiO}, 2\text{B}_2\text{O}_3 + 5\text{H}_2\text{O}$ . Easily sol. in acids. (Rose.)

$3\text{NiO}, \text{B}_2\text{O}_3$ . Not attacked by  $\text{H}_2\text{O}$ ; sol. in acids. (Ouvrard, C. R. 1900, 130. 337.)

**Nickel borate bromide,  $6\text{NiO}, 8\text{B}_2\text{O}_3, \text{NiBr}_2$ .**  
(Rousseau, C. R. 1894, 119. 73.)**Nickel borate chloride,  $6\text{NiO}, 8\text{B}_2\text{O}_3, \text{NiCl}_2$ .**  
(Rousseau, C. R. 1894, 118. 1257.)**Potassium borates.**

Solubility of  $\text{B}_2\text{O}_3$  in  $\text{K}_2\text{O} + \text{Aq}$  at  $30^\circ$ .

Solution contains		Solid phase
% by wt. $\text{K}_2\text{O}$	% by wt. $\text{B}_2\text{O}_3$	
47.50	.....	$\text{KOH}, 2\text{H}_2\text{O}$
46.45	0.72	"
46.36	0.91	$\text{K}_2\text{O}, \text{B}_2\text{O}_3, 2.5\text{H}_2\text{O}$
40.51	1.25	"
36.82	1.80	"
36.72	1.85	"
32.74	3.51	"
29.63	6.98	"
26.89	12.12	"
24.84	17.63	"
23.30	18.19	$\text{K}_2\text{O}, 2\text{B}_2\text{O}_3, 4\text{H}_2\text{O}$
16.21	13.10	"
11.78	9.82	"
9.18	8.00	"
6.22	9.13	"
7.79	13.20	"
7.73	13.37	$\text{K}_2\text{O}, 2\text{B}_2\text{O}_3, 4\text{H}_2\text{O} + \text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O}$
7.81	13.28	"
7.67	13.19	"
7.71	13.21	$\text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O}$
7.63	13.28	"
3.42	7.59	"
1.80	4.15	"
0.80	3.05	"
0.51	3.19	"
0.33	4.58	$\text{K}_2\text{O}, 5\text{B}_2\text{O}_3, 8\text{H}_2\text{O} + \text{B}(\text{OH})_3$
0.38	4.51	"
0.31	4.46	"
0.28	4.36	$\text{B}(\text{OH})_3$
.....	3.54	"

At  $30^\circ$  only the three potassium borates  $\text{K}_2\text{O}, \text{B}_2\text{O}_3 + 2.5\text{H}_2\text{O}$ ;  $\text{K}_2\text{O}, 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$  and  $\text{K}_2\text{O}, 5\text{B}_2\text{O}_3 + 8\text{H}_2\text{O}$  exist in stable form.

(Dukelski, Z. anorg. 1906, 50. 42.)

**Potassium metaborate,  $\text{KBO}_2$ .**

Sol. in small amount of  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 34. 568.)

$+1\frac{1}{2}\text{H}_2\text{O}$ . Only stabile hydrate. (Dukelski, Z. anorg. 1906, 50. 42.)

$+1\frac{1}{2}\text{H}_2\text{O}$ . (Atterberg, Bull. Soc. (2) 22. 350.)

**Potassium tetraborate,  $\text{K}_2\text{B}_4\text{O}_7$ .**

Very sol. in  $\text{H}_2\text{O}$ .

$+4\text{H}_2\text{O}$ . (Atterberg, Bull. Soc. (2) 22. 350.)

Only stabile hydrate. (Dukelski, l. c.)

$+5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; more sol. than  $\text{K}_2\text{B}_6\text{O}_{10}$  or  $\text{K}_2\text{B}_{12}\text{O}_{19}$ .

$+6\text{H}_2\text{O}$ . (Atterberg, l. c.)

**Potassium hexaborate,  $\text{K}_2\text{B}_6\text{O}_{10} + 5$ , and  $8\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ .

Does not exist. (Dukelski, l. c.)

**Potassium dekaborate,  $\text{K}_2\text{B}_{10}\text{O}_{16} + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

Only hydrate. (Dukelski.)

**Potassium dodekaborate,  $\text{K}_2\text{B}_{12}\text{O}_{18} + 10\text{H}_2\text{O}$ .**

Sl. sol. in cold, very sol. in hot  $\text{H}_2\text{O}$ . (Laurent, A. ch. 67. 215.)

$= \text{K}_2\text{B}_{10}\text{O}_{16}$ . (Rammelsberg.)

Does not exist. (Dukelski.)

**Potassium borate fluoride,  $\text{KBO}_2, \text{KF}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schiff and Sestini, A. 228. 72.)

$\text{KBO}_2, 2\text{KF}$ . Sol. in little, decomp. by much  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Schiff and Sestini, A. 228. 72.)

**Rubidium borate,  $\text{Rb}_2\text{B}_4\text{O}_7$ .**

Anhydrous. (Reischle, Z. anorg. 4. 166.)

$+6\text{H}_2\text{O}$ . Not deliquescent or efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Reissig, A. 127. 33.)

**Samarium borate,  $\text{SmBO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Cleve, Bull. Soc. (2) 43. 1670.)

**Scandium borate,  $\text{ScBO}_3$ .**

Sol. in dil. acids. (Crookes, Phil. Trans. 1910, 210. A. 364.)

**Silver borate,  $\text{AgBO}_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . By washing with  $\text{H}_2\text{O}$  the boric acid is dissolved out. (Rose, Pharm. Centralbl. 1853. 205.)

Sol. with decomp. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  (Herschel); sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  if pptd. cold.

1 l.  $\text{H}_2\text{O}$  dissolves ca.  $6 \times 10^{-2}$  gram-atoms at  $25^\circ$ . (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

$3\text{Ag}_2\text{O}, 4\text{B}_2\text{O}_3$ . (Rose, l. c.)

**Sodium borates.**Solubility of  $B_2O_3$  in  $Na_2O + Aq$  at  $30^\circ$ .

Solution contains		Solid phase
% by wt. $Na_2O$	% by wt. $B_2O_3$	
42.00	.....	$NaOH, H_2O$
40.85	2.71	"
41.37	5.10	"
38.85	5.55	$Na_2O, B_2O_3, 4H_2O$
34.44	3.73	"
29.39	2.51	"
28.61	2.38	"
27.78	2.44	"
26.13	2.75	"
25.08	2.98	"
23.00	3.82	"
16.61	13.69	"
21.58	4.63	$Na_2O, B_2O_3, 4H_2O + Na_2O, B_2O_3, 8H_2O$
20.58	4.69	$Na_2O, B_2O_3, 8H_2O$
18.31	4.97	"
15.32	6.21	"
13.25	8.18	"
12.39	9.12	"
8.85	10.49	$Na_2O, 2B_2O_3, 10H_2O$
5.81	6.94	"
4.00	4.76	"
1.88	2.41	"
1.38	5.16	"
1.84	7.36	"
2.02	7.79	"
2.40	9.48	"
4.08	17.20	$Na_2O, 2B_2O_3, 10H_2O + Na_2O, 5B_2O_3, 10H_2O$
3.79	15.84	$Na_2O, 5B_2O_3, 10H_2O$
3.47	13.30	"
2.26	12.14	"
1.99	11.84	$Na_2O, 5B_2O_3, 10H_2O + B(OH)_3$
1.86	11.78	$B(OH)_3$
1.81	11.18	"
0.64	6.11	"
.....	3.54	"

At  $30^\circ$ , only the four sodium borates  $Na_2O, B_2O_3 + 4H_2O$ ;  $Na_2O, B_2O_3 + 8H_2O$ ;  $Na_2O, 2B_2O_3 + 10H_2O$ ; and  $Na_2O, 5B_2O_3 + 10H_2O$  exist as stable phases.

(Dukelski, Z. anorg. 1906, 50. 46.)

**Sodium metaborate,  $NaBO_2$ .***Anhydrous.* Easily sol. in  $H_2O$ , with evolution of heat. $+H_2O$ . Easily sol. in  $H_2O$ . (Benedikt.) $+2H_2O$ . Easily sol. in  $H_2O$ . (Benedikt, B. 7. 703.) $+3H_2O$ . Easily sol. in  $H_2O$ . (Berzelius.) $+4H_2O$ . Sl. efflorescent. Sol. in hot, less sol. in cold  $H_2O$ . Melts at  $57^\circ$  in its crystal  $H_2O$ . (Dukelski, Z. anorg. 50. 42.) $+4\frac{1}{2}H_2O$ . (Atterberg, Z. anorg. 1906, 48. 370.) $+5\frac{1}{2}H_2O$ . (Atterberg.) $+8H_2O$ . (Atterberg.) $+4H_2O$  and  $+8H_2O$  are the only hydrates formed. (Dukelski.)System  $Na_2O, B_2O_3, H_2O$  at  $60^\circ$  investigated by Sborgi. (Real. Ac. Linc. 1915, (5) 24. I, 443.)**Sodium tetraborate,  $Na_2B_4O_7$  (Borax).**100 g.  $H_2O$  dissolve at: $5^\circ$   $10^\circ$   $21.5^\circ$   $30^\circ$   $37.5^\circ$ 

1.3 1.6 2.8 3.9 5.6 g. anhydrous salt.

 $45^\circ$   $50^\circ$   $54^\circ$   $55^\circ$   $56^\circ$   $57^\circ$ 

8.1 10.5 13.3 14.2 15.0 16.0 g. anhydrous salt.

(Horn and van Wagener, Am. Ch. J. 1903, 30. 347.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol. in amyl alcohol in the presence of meta-arsenious acid and excess of  $H_3BO_3$ . (Auerbach, Z. anorg. 1903, 37. 358.) $+4H_2O$ . $+5H_2O$ .100 g.  $H_2O$  dissolve at: $65^\circ$   $70^\circ$   $80^\circ$   $90^\circ$   $100^\circ$ 

22.0 24.4 31.4 40.8 52.3 g. anhydrous salt.

(Horn and van Wagener, Am. Ch. J. 1903, 30. 347.)

 $+6H_2O$ . Grows opaque in the air. (Bechi, Sill. Am. J. (2) 17. 129.) $+10H_2O$ . Only stable hydrate. (Dukelski, Z. anorg. 50. 30.) Efflorescent on surface in dry air. Not efflorescent when free from  $Na_2CO_3$ . (Sims.)Sol. in 12 pts. cold, and 2 pts. hot  $H_2O$ . Sat. cold  $Na_2B_4O_7 + Aq$  contains 9.23%, and sat. hot  $Na_2B_4O_7 + Aq$  contains 33.33%  $Na_2B_4O_7$ . (Gmelin.)Sol. in 20 pts. cold, and 6 pts. boiling  $H_2O$ . (Wallenius.)Sol. in 15 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)100 pts.  $H_2O$  at  $15.5^\circ$  dissolve 5 pts.; at  $65^\circ$ , 40 pts.; at  $100^\circ$ , 166 pts.  $Na_2B_4O_7 + 10H_2O$ . (Ure's Dictionary.)100 pts. sat.  $Na_2B_4O_7 + Aq$  at  $105.5^\circ$  contain 52.5 pts.  $Na_2B_4O_7$ , or 100 pts.  $H_2O$  dissolve 110.54 pts.  $Na_2B_4O_7$ , or 1 pt.  $Na_2B_4O_7$  is sol. in 0.9047 pt.  $H_2O$  at  $105.5^\circ$ . (Griffith, Quar. J. Sci. 18. 90.)**Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .**

$t^\circ$	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7 + 10H_2O$	$t^\circ$	Pts. $Na_2B_4O_7$	Pts. $Na_2B_4O_7 + 10H_2O$
0	1.49	2.83	60	18.09	40.43
10	2.42	4.65	70	24.22	57.85
20	4.05	7.88	80	31.17	76.19
30	6.00	11.90	90	40.14	116.66
40	8.79	17.90	100	55.16	201.43
50	12.93	27.41	...	...	...

(Poggiale, A. ch. (3) 8. 46.)

100 pts.  $H_2O$  dissolve 1.4 pts.  $Na_2B_4O_7$  at  $0^\circ$ , and 55.3 pts. at  $100^\circ$ . (Mulder.) $Na_2B_4O_7 + Aq$  sat. at  $15^\circ$  has sp. gr. = 1.0199, and contains 3.926 pts.  $Na_2B_4O_7$  to 100 pts.  $H_2O$ . (Michel and Krafft, A. ch. (3) 41. 471.)

$\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  sat. at  $17^\circ$  has sp. gr. = 1.0208. (Stolba, J. pr. 97. 503.)

Sp. gr. of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  at  $15^\circ$ .

$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7$	$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$	Sp. gr.	$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7$	$\frac{\%}{100} \text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$	Sp. gr.
1	0.52	1.0049	4	2.11	1.0199
2	1.06	1.0099	5	2.64	1.0249
3	1.59	1.0149	6	3.17	1.0299

(Gerlach, Z. anal. 28. 473.)

Sp. gr. of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  sat. at  $15^\circ = 1.032$ . (Gerlach.)

Sat.  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  boils at  $105.5^\circ$ , and contains 110.5 pts.  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts.  $\text{H}_2\text{O}$ . (Griffith.)

Sat.  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  forms a crust at  $103^\circ$ , and contains 60.14 pts.  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed,  $104.3^\circ$ . (Gerlach, Z. anal. 26. 427.)

B-pt. of  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$  containing pts.  $\text{Na}_2\text{B}_4\text{O}_7$  to 100 pts.  $\text{H}_2\text{O}$ .

B-pt.	Pts. $\text{Na}_2\text{B}_4\text{O}_7$	B-pt.	Pts. $\text{Na}_2\text{B}_4\text{O}_7$
100.5°	8.64	103.0°	61.2
101.0	17.2	103.5	75.4
101.5	26.5	104.0	90.8
102.0	37.5	104.5	109.0
102.5	48.5	104.6	112.3

(Gerlach, Z. anal. 26. 452.)

M.-pt. of  $\text{Na}_2\text{B}_4\text{O}_7 + 10\text{H}_2\text{O}$  is  $75.5^\circ$ . (Tilden, Chem. Soc. 46. 407.)

Insol. in alcohol.

100 g. alcohol (0.941 sp. gr.) dissolve 2.48 g. at  $15.5^\circ$  (U. S. P.).

Sol in alcoholic solution of  $\text{NaC}_2\text{H}_3\text{O}_2$ . (Stromeyer.)

Sol. in 14.7 pts. glycerine of 1.225 sp. gr. (Vogel.)

Sol. in 1 pt. glycerine. (Schultze, Arch. Pharm. (3) 6. 149.)

100 g. glycerine dissolve 60.3 g. at  $15.5^\circ$  (U. S. P.).

Min. Tincal.

**Sodium borate**,  $\text{Na}_2\text{B}_4\text{O}_{10} + 10\text{H}_2\text{O}$ .

Sol. in 5-6 pts. cold  $\text{H}_2\text{O}$ . (Bolley, A. 68. 122.) Perhaps sodium hydrogen tetraborate  $\text{NaHB}_4\text{O}_7 + 4\frac{1}{2}\text{H}_2\text{O}$ .

$\text{Na}_2\text{B}_{10}\text{O}_{16} + 10\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Atterberg, Z. anorg. 48. 370.)

Stabile. (Dukelski, Z. anorg. 50. 42.)

+  $11\text{H}_2\text{O}$ . (Laurent, C. R. 29. 5.)

**Sodium borate fluoride**,  $\text{NaBO}_2$ ,  $3\text{NaF} + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

Basarow (B. 7. 112) considers this salt to be a mixture.

$\text{Na}_2\text{B}_4\text{O}_7$ ,  $12\text{NaF} + 22\text{H}_2\text{O}$ . Can be separated into its constituents by  $\text{H}_2\text{O}$ . (Berzelius, Berz. J. B. 23. 96.)

**Strontium borate**,  $\text{Sr}(\text{BO}_2)_2$ .

(Ditte, C. R. 77. 788.)

Easily hydrated by  $\text{H}_2\text{O}$  forming  $\text{SrO} \cdot \text{B}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Very sol. in dil. acetic acid. (Ouvrard, C. R. 1906, 142. 282.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+  $2\text{H}_2\text{O}$ . (Ouvrard, l. c.)

+  $4\text{H}_2\text{O}$ . (Ouvrard, l. c.)

+  $5\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolves 2.3 g. at  $10^\circ$ .

(Ditte, A. ch. 1883 (5) 30. 253.)

$\text{SrB}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Guertler, Z. anorg. 1904, 40. 243.)

+  $4\text{H}_2\text{O}$ . Sol. in 130 pts. boiling  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $100^\circ$  dissolve 7.7 pts. (Ure's Dict.).

Easily sol. in cold  $\text{NH}_4$  salts +  $\text{Aq}$ ; sol. in cold  $\text{HNO}_3 + \text{Aq}$ .

$2\text{SrO} \cdot \text{B}_2\text{O}_3$ . Easily decomp. by  $\text{H}_2\text{O}$  forming  $\text{B}_2\text{O}_3$ ,  $\text{SrO}$ ,  $4\text{H}_2\text{O}$ . Very sol. in acids. (Ouvrard, C. R. 1906, 142. 282.)

$3\text{SrO} \cdot \text{B}_2\text{O}_3$ . Less easily attacked by  $\text{H}_2\text{O}$  than Ca comp. Very sol. in mineral acids.

Sl. attacked by dil. acetic acid. (Ouvrard, C. R. 1901, 132. 258.)

$\text{SrB}_6\text{O}_{10}$ . Very sl. sol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Laurent.)

$\text{SrB}_2\text{O}_7 + 7\text{H}_2\text{O}$ . Ppt. (Laurent.)

+  $12\text{H}_2\text{O}$ . (Ditte.)

$\text{Sr}_2\text{B}_4\text{O}_{11}$ . Sol. in cold mineral acids and acetic acid. (Ditte, C. R. 77. 785.)

$2\text{SrO} \cdot 3\text{B}_2\text{O}_3$ . Easily sol. in acids. (Ditte, l. c.)

**Strontium borate bromide**,  $3\text{SrO}$ ,  $5\text{B}_2\text{O}_3$ ,  $\text{SrBr}_2$ .

As the chloride. (Ouvrard, C. R. 1906, 142. 283.)

**Strontium borate chloride**,  $3\text{SrO}$ ,  $5\text{B}_2\text{O}_3$ ,  $\text{SrCl}_2$ .

Sl. attacked by cold  $\text{H}_2\text{O}$ , not attacked by dilute acetic acid. (Ouvrard, C. R. 1906, 142. 282.)

**Thallous borate**,  $\text{TlBO}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. in the air. (Buchta, J. pr. 1913, (2) 88. 784.)

$\text{Tl}_2\text{B}_2\text{O}_7$ . (Buchta.)

$\text{Tl}_2\text{B}_4\text{O}_7$ . Ppt. Sol. in boiling  $\text{H}_2\text{O}$ ; insol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Crookes.)

+  $2\text{H}_2\text{O}$ . (Buchta, J. pr. 1913 (2) 88. 774.)

$\text{Tl}_2\text{B}_6\text{O}_{10} + 3\text{H}_2\text{O}$ . (Buchta.)

$\text{Tl}_2\text{B}_8\text{O}_{13} + 4\text{H}_2\text{O}$ . (Buchta.)

$\text{Tl}_2\text{B}_{10}\text{O}_{16} + 8\text{H}_2\text{O}$ . (Buchta.)

$\text{Tl}_2\text{B}_{12}\text{O}_{19} + 7\text{H}_2\text{O}$ . (Buchta.)

**Thorium borate** (?).

Precipitate. Insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{BO}_3 + \text{Aq}$ . (Berzelius.)

**Tin (stannous) borate** (?).

Ppt. (Wenzel.)

**Divanadyl borate.**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{BO}_3 + \text{Aq.}$  (Berzelius.)

**Ytterbium borate,  $\text{YbBO}_3$ .**

Insol. in conc.  $\text{HCl}$ ; sol. in  $\text{HF}$ . (Cleve, Z. anorg. 1902, 32. 148.)

**Yttrium borate.**

Precipitate. (Berlin, Pogg. 43. 105.)

**Zinc borate,  $3\text{ZnO}, 2\text{B}_2\text{O}_3$ .**

(Mallard, C. R. 105. 1260.)

Decomp. by  $\text{H}_2\text{O}$ ; very sol. in dil. acids. (Ouvrard, C. R. 1900, 130. 336.)

$\text{ZnO}, 2\text{B}_2\text{O}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Ditte, A. ch. 1883, (5) 30. 256.)

$3\text{ZnO}, 4\text{B}_2\text{O}_3 + \text{H}_2\text{O}$ . Ppt. (Holdermann, Arch. Pharm. 1904, 242. 567.)

$\text{ZnO}, 4\text{B}_2\text{O}_3 + 10\text{H}_2\text{O}$ . (Ditte, A. ch. 1883, (5) 30. 256.)

$9\text{ZnO}, 4\text{B}_2\text{O}_3 + 9\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{BO}_3 + \text{Aq.}$  (Rose, Pogg. 88. 299.)

$3\text{ZnO}, \text{B}_2\text{O}_3$ . Insol. in mineral acids. (le Chatelier, C. R. 113. 1034.)

**Zinc borate ammonia,  $\text{ZnB}_4\text{O}_7, 4\text{NH}_3 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{NH}_4\text{OH}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq.}$  (Büchner, A. 151. 234.)

**Zinc borate bromide,  $6\text{ZnO}, 8\text{B}_2\text{O}_3, \text{ZnBr}_2$ .**

(Rousseau and Allaire, C. R. 116. 1446.)

**Zinc borate chloride,  $6\text{ZnO}, 8\text{B}_2\text{O}_3, \text{ZnCl}_2$ .**

Insol. in  $\text{HCl}$ . (Rousseau, C. R. 1894, 118. 1256.)

**Zinc borate iodide,  $6\text{ZnO}, 8\text{B}_2\text{O}_3, \text{ZnI}_2$ .**

(Allaire, C. R. 1898, 127. 556.)

**Zirconium borate, (?)**

Insol. in  $\text{H}_2\text{O}$ .

**Perboric acid.**

See Perboric Acid.

**Boric phosphoric acid.**

See Phosphoboric acid.

**Boric tungstic acid.**

See Borotungstic acid.

**Boric acid sulphur trioxide.**

See Borosulphuric acid.

**Borimide,  $\text{B}_2(\text{NH})_2$ .**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in all indifferent solvents; sol. in liquid  $\text{NH}_3 + \text{S}$  to form a dark blue solution. (Stock, B. 1901, 34. 3044.)

**Borimide hydrochloride,  $\text{B}_2(\text{NH})_2, 3\text{HCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in all ordinary organic solvents. (Stock, B. 1901, 34. 3045.)

**Borofluorhydric acid,  $\text{HBF}_4$ .**

See Fluoboric acid.

**Borofluorides.**

See Fluoborides.

**Boromolybdic acid.**

Sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol. (Berzelius.)

**Boron, B.**

(a) *Amorphous*. Somewhat sol. in pure  $\text{H}_2\text{O}$ , when not ignited. Salts and acids separate it out of aqueous solution. Upon evaporation of  $\text{H}_2\text{O}$  solution a crust is formed, which is only partially sol. in  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 2. 113.) Decomp. by hot  $\text{H}_2\text{SO}_4$ , and cold moderately conc.  $\text{HNO}_3 + \text{Aq.}$  Strongly ignited amorphous B is much less easily attacked by reagents than freshly pptd., and is insol. in  $\text{H}_2\text{O}$ . (Berzelius.) Insol. in caustic alkalis +  $\text{Aq.}$ ; also in alcohol and ether.

Above boron was very impure. (Moissan, C. R. 114. 392.)

Pure B is not attacked by acids, but has a strong reducing action on  $\text{KMnO}_4 + \text{Aq.}$ ,  $\text{FeCl}_3 + \text{Aq.}$ , etc. (Moissan, C. R. 114. 617.)

Does not melt at  $1500^\circ$ . Readily sol. in conc. acids, as  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{H}_3\text{PO}_4$ ; very sl. sol. in hydracids; decomp.  $\text{H}_2\text{O}$  at red heat. (Moissan, A. ch. 1895, (7) 6. 313-14.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

(b) *Crystallized*. 1. Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{KOH} + \text{Aq.}$  Very slightly and slowly attacked by boiling conc.  $\text{H}_2\text{SO}_4$ . Gradually sol. in hot conc.  $\text{HNO}_3$ . Formula is  $\text{Al}_2\text{B}_{10}$ . (Hampe, A. 183. 75.)

2. Very slightly attacked by conc.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ ; slowly but completely sol. in conc.  $\text{HNO}_3$ ; insol. in  $\text{KOH} + \text{Aq.}$  Formula is  $\text{C}_2\text{Al}_2\text{B}_{10}$ . (Hampe.)

$\text{C}_2\text{Al}_2\text{B}_{10}$ . *Crystalline*. Insol. in a solution of  $\text{CrO}_3$  in  $\text{H}_2\text{SO}_4$ . Insol. in hot conc.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . Sol. in hot conc.  $\text{HNO}_3$ . (Biltz, B. 1910, 43. 303.)

**Boron tribromide,  $\text{BBr}_3$ .**

Sol. in  $\text{H}_2\text{O}$  or alcohol with decomp. (Nicklès, C. R. 60. 800.)

**Boron phosphorus bromide,  $\text{BBr}_2, \text{PBr}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{CS}_2$ , and  $\text{CHCl}_3$ . Decomp. by alcohol, ether, etc. (Tarible, C. R. 116. 1521.)

$\text{BBr}_2, \text{PBr}_3$ . Sl. sol. in cold, easily in hot  $\text{CS}_2$ . (Tarible.)

**Boron bromide ammonia,  $\text{BBr}_3, 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  and alkalis. (Besson, C. R. 114. 542.)

**Boron bromide phosphine,  $\text{BBr}_3, \text{PH}_3$ .**

Violently decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 113. 78.)

**Boron bromide phosphorus trichloride,  $2\text{BBr}_3, \text{PCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{BBr}_3$ ,  $\text{PCl}_3$ ,  $\text{CS}_2$ , and  $\text{CHCl}_3$ . Insol. in petroleum ether. (Tarible, C. R. 1901, 132. 84.)

**Boron bromide phosphorus pentachloride,  $2\text{BBr}_3, \text{PCl}_5$ .**

Sol. in  $\text{BBr}_3$  and  $\text{CS}_2$ ; decomp. by  $\text{H}_2\text{O}$ ; insol. in light petroleum. (Tarible, C. R. 1901, 132. 85.)

**Boron bromide phosphorus diiodide,  $2\text{BBr}_3, \text{PI}_3$ .**

Sol. in  $\text{BBr}_3$ ,  $\text{CS}_2$ ,  $\text{CHCl}_3$ ; insol. in light petroleum; decomp. by  $\text{H}_2\text{O}$ . (Tarible, C. R. 1901, 132. 205.)

**Boron bromide phosphoryl chloride,  $\text{BBr}_3, \text{POCl}_3$ .**

Very easily decomp. (Oddo and Tealdi, Gazz. ch. it. 1903, 33. (2) 431.)

**Boron bromoiodide,  $\text{BBr}_2\text{I}$ .**

Decomp. violently by  $\text{H}_2\text{O}$ . (Besson, C. R. 112. 100.)

$\text{BBrI}_2$ . (Besson, C. R. 112. 100.)

**Boron bromosulphide,  $\text{B}_2\text{S}_3, \text{BBr}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Stock, B. 1901, 34. 3040.)

**Boron carbide,  $\text{B}_4\text{C}$ .**

Very stable; insol. in  $\text{HF}$  and in  $\text{HNO}_3$ ; sol. in  $\text{KOH}$  at red heat. (Moissan, Bull. Soc. 1894, (3) 11. 1101.)

Insol. in acids; sol. in fused alkali. (Moissan, C. R. 1894, 118. 559.)

$\text{BC}$  or  $\text{B}_2\text{C}_3$ . Insol. in all the usual solvents. (Müllhäuser, Z. anorg. 5. 92.)

**Boron trichloride,  $\text{BCl}_3$ .**

Rapidly absorbed by  $\text{H}_2\text{O}$  and alcohol with decomposition.

**Boron nitrosyl chloride,  $\text{BCl}_3, \text{NOCl}$ .**

Decomp. violently by  $\text{H}_2\text{O}$ . (Geuther, J. pr. (2) 8. 854.)

**Boron phosphoryl chloride,  $\text{BCl}_3, \text{POCl}_3$ .**

Decomp. immediately by  $\text{H}_2\text{O}$ . (Gustavson, Zeit. Chem. 1870. 521.)

**Boron chloride ammonia,  $2\text{BCl}_3, 3\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 2. 147.)

**Boron chloride phosphine,  $\text{BCl}_3, \text{PH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 110. 516.)

**Boron chlorosulphide,  $\text{B}_2\text{S}_3, \text{BCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Stock, B. 1901, 34. 3040.)

**Boron trifluoride,  $\text{BF}_3$ .**

$\text{H}_2\text{O}$  absorbs 700 vols.  $\text{BF}_3$  gas to form a

liquid of 1.77 sp. gr. On boiling,  $\frac{1}{3}$  of the  $\text{BF}_3$  is given off, and a residue boiling at  $165\text{--}200^\circ$ , with composition  $\text{BF}_3 + 2\text{H}_2\text{O}$  or  $\text{HBO}_2 + 3\text{HF}$ , is left. (J. Davy, A. ch. 86. 178.)

1 ccm.  $\text{H}_2\text{O}$  absorbs at  $0^\circ$  and 762 mm. pressure 1.057 ccm.  $\text{BF}_3$ .

1 vol. conc.  $\text{H}_2\text{SO}_4$  of 1.85 sp. gr. absorbs 50 vols.  $\text{BF}_3$ .

Absorbed by alcohol with decomp.

Cold oil of turpentine absorbs 6.8% of  $\text{BF}_3$ .

**Boron fluoride ammonia,  $\text{BF}_3, \text{NH}_3$ ,  $\text{BF}_3, 2\text{NH}_3$ , and  $\text{BF}_3, 3\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ .

**Boron fluoride cyanhydric acid,  $\text{BF}_3, \text{HCN}$ .**

Very unstable. (Patein, C. R. 113. 85.)

**Boron fluoride phosphine,  $2\text{BF}_3, \text{PH}_3$ .**

Very unstable at ordinary temp. Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 110. 80.)

**Boron hydride,  $\text{BH}_3$ .**

Not obtained free from  $\text{H}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Jones, Chem. Soc. 35. 41.)

See Cyclotriborene.

$\text{B}_2\text{H}_{10}$ . B.-pt.  $16\text{--}17^\circ$  at 760 mm.

Very unstable. Takes fire spontaneously in the air.

Decomp. by  $\text{H}_2\text{O}$ , dil.  $\text{HCl}$ , and oxidized by conc.  $\text{HNO}_3$  with explosive violence.

Absorbed by  $\text{NaOH} + \text{Aq}$ .

Decomp. by alcohol. Sol. in dry benzene. (Stock, B. 1912, 45. 3562.)

$\text{B}_2\text{H}_{12}$ . B.-pt.  $100^\circ$  at atmospheric pressure.

Decomp. by  $\text{H}_2\text{O}$ . With aqueous alkalis, hydrogen is evolved. (Stock, B. 1912, 45. 3565.)

$\text{B}_2\text{H}_6$ . Insol. in  $\text{HCl}$ . Sol. in aqua regia and  $\text{Br}_2 + \text{Aq}$ . (Winkler, B. 1890, 23. 778.)

$\text{B}_{10}\text{H}_{12}$ . M.-pt.  $99.5^\circ$ ; not attacked by cold or boiling  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NaOH} + \text{Aq}$ . Sol. in alcohol, ether, benzene, and  $\text{CS}_2$ . (Stock, B. 1913, 46. 3360.)

**Boron iodide,  $\text{BI}_3$ .**

Very hygroscopic, and instantly decomp. by  $\text{H}_2\text{O}$  or alcohol. Very sol. in  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ ; less sol. in  $\text{PCl}_3$ ,  $\text{AsCl}_3$ , and a great many organic liquids. (Moissan, C. R. 112. 717.)

**Boron iodide ammonia,  $\text{BI}_3, 5\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 114. 542.)

**Boron iodophosphide,  $\text{BI}_2\text{P}$ .**

Very hygroscopic; decomp. by  $\text{H}_2\text{O}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , even if fuming, but on heating decomposition takes place. Very sl. sol. in  $\text{CS}_2$ . Insol. in benzene,  $\text{PCl}_3$ , or  $\text{CCl}_4$ . (Moissan, C. R. 113. 624.)

$\text{BIP}$ . Less hygroscopic than  $\text{BI}_2\text{P}$ , but otherwise the properties are similar. (Moissan.)

**Boron nitride, BN.**

Insol. in  $H_2O$ , conc.  $HNO_3$ , conc.  $HCl$  + Aq. or conc. solutions of alkalis.

Decomp. by hot conc.  $H_2SO_4$  or  $HF$ . (Wöhler, A. 74. 70.)

**Boron trioxide,  $B_2O_3$ .**

Deliquescent. Sol. in  $H_2O$  with a large increase in temp. (Ditte, C. R. 85. 1069.)

1 pt. dissolves—

at 18.75°	in 47.01 pts. $H_2O$ .
" 25°	" 27.75 " "
" 37.5°	" 18.73 " "
" 50°	" 15.13 " "
" 62.5°	" 9.29 " "
" 75°	" 7.28 " "
" 87.5°	" 5.58 " "
" 100°	" 4.74 " "

Or 100 pts.  $H_2O$  dissolve—

at 18.75°	2.13 pts. $B_2O_3$ .
" 25°	3.60 " "
" 37.5°	4.24 " "
" 50°	6.61 " "
" 62.5°	10.76 " "
" 75°	13.73 " "
" 87.5°	17.92 " "
" 100°	21.09 " "

(Brandes and Firnhaber, Arch. Pharm. 7. 50.)

1 litre  $H_2O$  dissolves—

at 0°	11.00 g. $B_2O_3$ .
" 12°	16.50 " "
" 20°	22.49 " "
" 40°	39.50 " "
" 62°	64.50 " "
" 80°	95.00 " "
" 102°	164.50 " "

(Ditte, C. R. 85. 1069.)

Sat.  $H_2O$  solution boils at 100°. (Brandes and Firnhaber.)

Sat.  $H_2O$  solution boils at 103.3°. (Griffiths, Quar. J. Sci. 18. 90.)

Sol. in acetic acid, hot conc.  $HCl$  + Aq,  $HNO_3$ , and  $H_2SO_4$ . From the three latter it separates on cooling or dilution with  $H_2O$ .

Solubility in  $Na_2O$  + Aq at 30°.

See **Borates, sodium.**

Solubility in  $K_2O$  + Aq at 30°.

See **Borates, potassium.**

Insol. in hot glacial acetic acid. (Holt, Chem. Soc. 1911, 100. (2) 720.)

Insol. in alcohol. (Graham.)

Sol. in alcohol. (Berzelius, Ebelmen.)

Sol. in oils.

See also **Boric acid.**

**Boron trioxide potassium fluoride,  $B_2O_3 \cdot 2KF$ .**

Gradually sol. in  $H_2O$ . Decomp. by much  $H_2O$ . Insol. in alcohol. (Schiff and Sestini, A. 228. 82.)

**Boron oxychloride,  $BOCl$ .**

(Gustavson, Zeit. Chem. 1870. 521.)

$BOCl_2$ . Slowly decomp. by  $H_2O$ . (Coulcler, J. pr. (2) 18. 399.)

Oxychlorides of either the above formulæ do not exist; the true formula for boron oxychloride is  $B_2O_{11}Cl_2$ . (Lorenz, A. 247. 226.)

**Boron phosphide, BP.**

Insol. in  $H_2O$ . Sol. in conc. boiling alkalis + Aq with decomp. Decomp. by  $HNO_3$  + Aq. (Besson, C. R. 113. 78.)

Insol. in  $PCl_3$ ,  $AsCl_3$ ,  $SbCl_3$ ,  $CCl_4$ , and in fact in all known solvents.

Not attacked by boiling  $H_2O$ , conc.  $HCl$ , or  $HI$  + Aq. Sol. in conc.  $HNO_3$  with decomp. on heating. Not attacked by cold  $H_2SO_4$ . (Moissan, C. R. 113. 726.)

$B_2P_3$ . Not attacked by boiling conc.  $HNO_3$  + Aq. Insol. in all solvents. (Moissan.)

**Boron phosphiodide.**

See **Boron iodophosphide.**

**Boron selenide,  $B_2Se_3$ .**

Violently decomp. by  $H_2O$ . (Sabatier, C. R. 112. 1000.)

**Boron trisulphide,  $B_2S_3$ .**

Decomp. with violence with  $H_2O$ . Combines with alcohol and ether. (Fremy, A. ch. (3) 38. 312.)

Insol. in most solvents, but sl. sol. in  $PCl_3$ , without decomp.; more sol. in  $SCl_2$ , but does not crystallize from the solution. (Moissan, C. R. 115. 203.)

**Boron trisulphide ammonia,  $B_2S_3 \cdot 6NH_3$ .**

Ppt. (Stock, B. 1901, 34. 3042.)

**Boron pentasulphide,  $B_2S_5$ .**

Decomp. by  $H_2O$  and alcohol. (Moissan, C. R. 115. 271.)

**Borosulphuric acid,  $BOHSO_4 + SO_3$ .**

Decomp. by  $H_2O$ . (Schultz-Sellac, B. 4. 12.)

$B(HSO_4)_3$ . Very deliquescent. Easily sol. in fuming  $H_2SO_4$ . (D'Arcy, Chem. Soc. 55. 155.)

$SO_3(O \cdot BO)_3$ . Hygroscopic. Deliquescent. Sol. in  $H_2O$  with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc. 1908, (4) 3. 1121.)

$(SO_3)_2B_2O_3$ . Hygroscopic. Deliquescent. Sol. in  $H_2O$  with decomp. Decomp. by cold alcohols. (Pictet, Bull. Soc. 1908, (4) 3. 1121.)

**Borononotungstic acid,  $H_4B_3W_9O_{31} + 22H_2O = 9WO_3, B_2O_3, 2H_2O + 22H_2O$ .**

Sol. in less than  $\frac{1}{4}$  pt.  $H_2O$ , and as easily sol. in alcohol and ether. Sp. gr. of aqueous solution is somewhat under 3. (Klein, A. ch. (5) 28. 370.)

**Aluminum borononotungstate,  $Al_4(B_3W_9O_{31})_2 + 65H_2O$ .**

Extremely sol. in  $H_2O$ . (Klein.)

**Ammonium —,  $(NH_4)_4B_3W_9O_{31} + 18H_2O$ .**

Quickly effloresces. (Klein.)



**Barium boronotungstate**,  $\text{Ba}_2\text{B}_2\text{W}_6\text{O}_{32} + 19\text{H}_2\text{O}$ .

Sol. in 4 pts. cold, and less than  $\frac{1}{2}$  pt. hot  $\text{H}_2\text{O}$ . (Klein.)

**Cadmium** —,  $\text{Cd}_2\text{B}_2\text{W}_6\text{O}_{32} + 18\text{H}_2\text{O}$ .

Deliquescent.

100 pts. of salt dissolve in less than 8 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ . Sp. gr. of solution is 3.28. (Klein.)

Sp. gr. of sat. solution at  $15.6^\circ/4^\circ = 3.2887$ ; at  $16.2^\circ/4^\circ = 3.2868$ . (Kahlbaum, Z. anorg. 1902, 29. 229.)

**Calcium** —,  $\text{Ca}_2\text{B}_2\text{W}_6\text{O}_{32} + 15\text{H}_2\text{O}$ .

Sol. in  $\frac{1}{10}$  pt.  $\text{H}_2\text{O}$ . Solution has sp. gr. = 3.10. (Klein.)

**Cerium** —,  $\text{Ce}_2(\text{B}_2\text{W}_6\text{O}_{32})_2 + 57\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sp. gr. of solution is over 3.

**Chromium** —,  $\text{Cr}_2(\text{B}_2\text{W}_6\text{O}_{32})_2 + 74\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sp. gr. of solution is 2.80. (Klein.)

**Cobalt** —,  $\text{Co}_2\text{B}_2\text{W}_6\text{O}_{32} + 18\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sp. gr. of solution sat. at  $19^\circ = 3.36$ . (Klein.)

100 pts.  $\text{H}_2\text{O}$  dissolve 306.8 pts. anhydrous salt at  $16.2^\circ$ ; 288 pts. at  $18.5^\circ$ ; 299.7 pts. at  $19.6^\circ$ ; 286 pts. at  $21.8^\circ$ .

Sp. gr. of solution sat. at  $19.2^\circ/4^\circ = 3.1369$ . (Kahlbaum, Z. anorg. 1902, 29. 218.)

**Copper** —,  $\text{Cu}_2\text{B}_2\text{W}_6\text{O}_{32} + 19\text{H}_2\text{O}$ .

25 pts.  $\text{H}_2\text{O}$  dissolve 100 pts. salt. Sp. gr. of solution = 2.6. (Klein.)

**Lead** —,  $\text{Pb}_2\text{B}_2\text{W}_6\text{O}_{32} + 11\text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Klein.)

**Lithium** —, (?).

Very sol. in  $\text{H}_2\text{O}$ . Sp. gr. of solution is about 3.

**Magnesium** —,  $\text{Mg}_2\text{B}_2\text{W}_6\text{O}_{32} + 22\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Manganous** —,  $\text{Mn}_2\text{B}_2\text{W}_6\text{O}_{32} + 17\text{H}_2\text{O}$ .

100 pts. dissolve in 13 pts.  $\text{H}_2\text{O}$ . Sp. gr. of solution at  $19^\circ = 3.15$ . (Klein.)

**Mercurous** —,  $3\text{Hg}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $9\text{WO}_3 + 14\text{H}_2\text{O}$  (?).

Precipitate.

Insol. in  $\text{H}_2\text{O}$ . (Klein.)

Sol. in 20,000 pts. dil. cold, and 1000 pts. boiling  $\text{HNO}_3$  + Aq of 1.42 sp. gr.

**Nickel** —,  $\text{Ni}_2\text{B}_2\text{W}_6\text{O}_{32} + 18\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sp. gr. of sat. solution at  $19^\circ = 3.32$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 261.6 pts. at  $21.2^\circ$ .

Sp. gr.  $15.75^\circ/4^\circ$  of solution = 2.2950. (Kahlbaum, Z. anorg. 1902, 29. 218.)

**Potassium boronotungstate**,  $\text{K}_2\text{B}_2\text{W}_6\text{O}_{32} + 13\text{H}_2\text{O}$ .

5 pts. salt dissolve in 8 pts.  $\text{H}_2\text{O}$  at  $19^\circ$  to form a solution of 1.38 sp. gr. The solution sat. at  $100^\circ$  has sp. gr. of over 2. (Klein.)

**Silver** —,  $\text{Ag}_2\text{B}_2\text{W}_6\text{O}_{32} + 14\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ .

**Sodium** —,  $\text{Na}_2\text{H}_2\text{B}_2\text{W}_6\text{O}_{32} + 23\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $19^\circ$  contains 84 pts. salt to 16 pts.  $\text{H}_2\text{O}$ . (Klein.)  $\text{Na}_2\text{B}_2\text{W}_6\text{O}_{32} + 12\text{H}_2\text{O}$ . Sol. in less than  $\frac{1}{3}$  pt.  $\text{H}_2\text{O}$ .

**Thallium** —,  $\text{Tl}_2\text{B}_2\text{W}_6\text{O}_{32} + 5\text{H}_2\text{O}$ .

Sl. sol. in hot  $\text{H}_2\text{O}$  and nearly insol. in cold  $\text{H}_2\text{O}$ . (Klein.)

**Uranyl** —,  $(\text{UO}_2)_2(\text{B}_2\text{W}_6\text{O}_{32})_2 + 30\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Klein.)

Sp. gr. of solution = 3.1.

**Zinc** —,  $\text{Zn}_2\text{B}_2\text{W}_6\text{O}_{32} + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Sp. gr. of solution = 3.15. (Klein.)

### Borodecitungstic acid.

**Barium borodecitungstate**,  $\text{Ba}_2\text{B}_2\text{W}_{10}\text{O}_{42} + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klein, C. R. 99. 35.)

**Boroduodecitungstic acid**,  $\text{H}_2\text{B}_2\text{W}_{12}\text{O}_{42} = 4\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $12\text{WO}_3$ .

Known only in solution, which decomposes into boronotungstic acid and tungstic acid, when evaporated to a certain concentration. (Klein, C. R. 99. 35.)

**Barium potassium boroduodecitungstate**,  $3\text{BaO}$ ,  $\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $12\text{WO}_3 + 28\text{H}_2\text{O}$ .

**Potassium** —,  $\text{K}_2\text{B}_2\text{W}_{12}\text{O}_{42} + 21\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klein.)

$2\text{K}_2\text{O}$ ,  $12\text{WO}_3$ ,  $\text{B}_2\text{O}_3 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Boroquatuordecitungstic acid**,  $\text{H}_{12}\text{B}_2\text{W}_{14}\text{O}_{51} = 6\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3$ .

Has not been obtained in the free state. (Klein, A. ch. (5) 28. 353.)

**Barium boroquatuordecitungstate**,

$\text{Ba}_2\text{B}_2\text{W}_{14}\text{O}_{51} = 3\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 5\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Barium sodium** —,  $3\frac{1}{2}\text{BaO}$ ,  $1\frac{1}{2}\text{Na}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 29\text{H}_2\text{O}$ .

**Potassium** —,  $3\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 22\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klein.)

**Silver** —,  $\text{Ag}_2\text{H}_2\text{B}_2\text{W}_{14}\text{O}_{51} + 7\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Klein.)

**Sodium** —,  $\text{Na}_4\text{H}_2\text{B}_2\text{W}_{14}\text{O}_{51} + 29\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  (Klein.)

**Sodium strontium boroquatuordecitungstate**,  $3\frac{1}{2}\text{SrO}$ ,  $1\frac{1}{2}\text{Na}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $14\text{WO}_3 + 29\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Klein.)

**Boroundevigintitungstic acid.**

**Barium boroundevigintitungstate**,  $4\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $19\text{WO}_3 + 30\text{H}_2\text{O}$ .

Can be cryst. from  $\text{H}_2\text{O}$ . (Ebenhusen, Dissert. 1905.)

**Boroquatuorevigintitungstic acid**,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 66\text{H}_2\text{O}$ .

Deliquescent. Somewhat more sol. in  $\text{H}_2\text{O}$  than  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3 + 62\text{H}_2\text{O}$ . Also more stable. (Copaux, C. R. 1908, 147. 975.)

**Barium boroquatuorevigintitungstate**,  $5\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 54\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 50 pts. salt. (Copaux, A. ch. 1909, (8) 17. 217.)

$6\text{BaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 58\text{H}_2\text{O}$ . (Copaux, l. c.)

**Cadmium** —,  $5\text{CdO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 51\text{H}_2\text{O}$ .

Extremely sol. in  $\text{H}_2\text{O}$ . (Copaux, l. c.)

**Calcium** —,  $5\text{CaO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 44\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Copaux, l. c.)

**Lithium** —,  $15\text{Li}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 38\text{H}_2\text{O}$ . (Copaux, l. c.)

**Magnesium** —,  $5\text{MgO}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 42\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Copaux, l. c.)

**Mercurous** —,  $9\text{Hg}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 25\text{H}_2\text{O}$ .

(Copaux, l. c.)

**Potassium** —,  $5\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 36\text{H}_2\text{O}$ .

(Copaux, l. c.)

**Sodium** —,  $5\text{Na}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $24\text{WO}_3 + 5\text{H}_2\text{O}$ .

As  $\text{NH}_4$  salt. (Copaux, l. c.)

**Boroquinquavigintitungstic acid.**

**Potassium boroquinquavigintitungstate**,

$5\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $25\text{WO}_3 + 34\text{H}_2\text{O}$ . (Ebenhusen, Dissert. 1905.)

**Boroduodetrigintatungstic acid**,  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3 + 62\text{H}_2\text{O}$ .

Decomp. in boiling aqueous solution. (Copaux, C. R. 1908, 147. 975.)

**Potassium boroduodetrigintatungstate**,  $6\text{K}_2\text{O}$ ,  $\text{B}_2\text{O}_3$ ,  $28\text{WO}_3 + 42\text{H}_2\text{O}$ .

Decomp. by boiling alkalis. (Copaux, A. ch. 1909 (8) 17. 217.)

**Borovanadic acid.**

Sol. in  $\text{H}_2\text{O}$ . Easily decomp. (Guyard, Bull. Soc. (2) 25. 354.)

**Metabromantimonic acid**,  $\text{HSbBr}_3 + 3\text{H}_2\text{O}$ .

Very hygroscopic. Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$  with separation of antimonic acid. (Weinland, B. 1903, 36. 256.)

**Ammonium metabromantimonate**,

$\text{NH}_4\text{SbBr}_6 + \text{H}_2\text{O}$ .

Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Iron (ferric) metabromantimonate**,

$\text{Fe}(\text{SbBr}_6)_3 + 14\text{H}_2\text{O}$ .

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Lithium metabromantimonate**,  $\text{LiSbBr}_6 + 4\text{H}_2\text{O}$ .

Very hygroscopic. Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Nickel metabromantimonate**,  $\text{Ni}(\text{SbBr}_6)_2 + 12\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Potassium metabromantimonate**,  $\text{KSbBr}_6 + \text{H}_2\text{O}$ .

Loses  $\text{Br}_2$  in the air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Bromarsenious acid.**

See Arsenyl bromide.

**Bromauric acid**,  $\text{HAuBr}_4 + 3\text{H}_2\text{O}$ .

(Lengfeld, Am. Ch. J. 1901, 26. 329.)

$+5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Thomsen, J. pr. (2) 13. 337.)

$+6\text{H}_2\text{O}$ . Sol. in ether and  $\text{CHCl}_3$  without decomp. (Lengfeld, Am. Ch. J. 1901, 26. 329.)

**Ammonium bromaurate**,  $\text{NH}_4\text{AuBr}_6$ .

Ppt. (Gutbier, Z. anorg. 1914, 85. 358.)

**Barium bromaurate.**

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff, Pogg. 17. 261.)

**Cæsium bromaurate**,  $\text{CsAuBr}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (Wells and Wheeler, Sill. Am. J. 144. 157.)

Ppt. (Gutbier, Z. anorg. 1914, 85. 360.)

**Cerium bromaurate**,  $\text{CeAuBr}_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Jolin, Bull. Soc. (2) 21. 533.)

**Didymium bromaurate**,  $\text{DiAuBr}_6 + 9\text{H}_2\text{O}$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Lanthanum bromaurate**,  $\text{LaAuBr}_6 + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Magnesium bromaurate.**

Deliquescent in moist air. (v. Bonsdorff.)

**Manganese bromaurate.**

Deliquescent. (v. Bonsdorff.)

**Potassium bromaurate,  $\text{KAuBr}_4$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . More sol. in cold alcohol than in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

+ $2\text{H}_2\text{O}$ . Sol. in 5.12 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , 1.56 pts. at  $40^\circ$ , and 0.48 pt. at  $67^\circ$ . Decomp. by ether. Sl. sol. in  $\text{KBr} + \text{Aq}$ . (Schottländer, A. 217. 314.)

+ $5\text{H}_2\text{O}$ . Efflorescent. (v. Bonsdorff.)

**Rubidium bromaurate,  $\text{RbAuBr}_4$ .**

As caesium bromaurate.

Ppt. (Gutbier, Z. anorg. 1914, 85. 359.)

**Samarium bromaurate,  $\text{SmAuBr}_4 + 10\text{H}_2\text{O}$ .**

Very deliquescent. (Cleve, Bull. Soc. (2) 43. 165.)

**Sodium bromaurate,  $\text{NaAuBr}_4$ .**

Slowly sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

**Zinc bromaurate,  $\text{Zn}(\text{AuBr}_4)_2$ .**

Very deliquescent. (v. Bonsdorff.)

**Bromauricyanhydric acid.**

Not known in free state.

**Barium bromauricyanide,  $\text{Ba}[\text{Au}(\text{CN})_2\text{Br}_2]_2 + 10\text{H}_2\text{O}$ .**

Very sol. in hot or cold  $\text{H}_2\text{O}$ , also in alcohol. (Lindbom, Lund. Univ. Arsk. 12. No. 6.)

**Cadmium bromauricyanide,  $\text{Cd}[\text{Au}(\text{CN})_2\text{Br}_2]_2 + 6\text{H}_2\text{O}$ .**

Very sol. in hot or cold  $\text{H}_2\text{O}$ , but solution is unstable. (Lindbom.)

**Calcium bromauricyanide,  $\text{Ca}[\text{Au}(\text{CN})_2\text{Br}_2]_2 + 10\text{H}_2\text{C}$ .**

Extremely sol. in  $\text{H}_2\text{O}$  and alcohol. (Lindbom.)

**Cobalt bromauricyanide,  $\text{Co}[\text{Au}(\text{CN})_2\text{Br}_2]_2 + 9\text{H}_2\text{O}$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . Less sol. than other bromauricyanides. (Lindbom.)

**Potassium bromauricyanide,  $\text{KAu}(\text{CN})_2\text{Br}_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Sodium bromauricyanide,  $\text{NaAu}(\text{CN})_2\text{Br}_2 + 2\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  or alcohol.

**Strontium bromauricyanide,  $\text{Sr}[\text{Au}(\text{CN})_2\text{Br}_2]_2 + x\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  or alcohol.

**Zinc bromauricyanide,  $\text{Zn}[\text{Au}(\text{CN})_2\text{Br}_2]_2 + 8\text{H}_2\text{O}$ .**

Easily sol. in cold or hot  $\text{H}_2\text{O}$ .

**Bromhydric acid,  $\text{HBr}$ .**

Very sol. in  $\text{H}_2\text{O}$ .

The most concentrated  $\text{HBr} + \text{Aq}$  has a sp. gr. of 1.78, and contains 82.02%  $\text{HBr}$ . (Champion and Pellat, C. R. 70. 620.) This, or a weak acid on heating leaves a residue, which

distills unchanged at  $125$ – $125.5^\circ$  under 785 mm. pressure, and contains 48.17%  $\text{HBr}$  (Topsoë); at  $126^\circ$  under 758 mm. pressure, and contains 46.83%  $\text{HBr}$  (Bineau); and has sp. gr. = 1.486 at  $20^\circ$  (Bineau); sp. gr. = 1.48 at  $20^\circ$  (Champion and Pellat); sp. gr. = 1.49 at  $20^\circ$  (Topsoë).

According to Roscoe (A. 116. 214) an acid of constant composition, obtained by boiling a stronger or a weaker acid, if distilled under 752–762 mm. pressure, contains 47.38–47.86%  $\text{HBr}$ , and boils at  $126^\circ$  at 760 mm. pressure; but the composition is dependent on the pressure, as, for example, under 1952 mm. pressure, the residue boils at  $153^\circ$ , and contains 46.3%  $\text{HBr}$ . (Roscoe.)

By conducting dry air through  $\text{HBr} + \text{Aq}$  an acid is obtained containing 51.65%  $\text{HBr}$  if at  $16^\circ$ , and 49.35%  $\text{HBr}$  if at  $100^\circ$  (Roscoe).

1 vol.  $\text{H}_2\text{O}$  dissolves 600 vols.  $\text{HBr}$  at  $10^\circ$ . (Berthelot, C. R. 76. 679.)

1 pt.  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm. pressure dissolves pts.  $\text{HBr}$ .

$t^\circ$	Pts. $\text{HBr}$	$t^\circ$	Pts. $\text{HBr}$	$t^\circ$	Pts. $\text{HBr}$
-25	2.550	-5	2.280	+50	1.715
-20	2.473	0	2.212	+75	1.505
-15	2.390	+10	2.103	+100	1.300
-10	2.335	+25	1.930	...	...

(Roozeboom, R. t. c. 4. 107.)

Absorption by 1 pt.  $\text{H}_2\text{O}$  at  $t^\circ$  and p pressure in mm.

$t^\circ = -25^\circ$ .

p	Pts. $\text{HBr}$	p	Pts. $\text{HBr}$
760	2.550	100	2.056
300	2.263	1	1.755
140	2.120	0.5	1.10

$t^\circ = -20^\circ$ .

p	Pts. $\text{HBr}$	p	Pts. $\text{HBr}$
760	2.473	130	2.056
375	2.267	20	1.850
180	2.119	...	...

$t^\circ = -15^\circ$ .

p	Pts. $\text{HBr}$	p	Pts. $\text{HBr}$
760	2.390	175	2.056
470	2.266	102	1.980
250	2.119	...	...

$t^\circ = -11.3^\circ$ .

p	Pts. $\text{HBr}$	p	Pts. $\text{HBr}$
760	2.350	310	2.118
570	2.265	216	2.055

$t^{\circ} = -5^{\circ}$ .

p	Pts. HBr	p	Pts. HBr
760	2.280	430	2.117
730	2.264	298	2.055

 $t^{\circ} = 0^{\circ}$ .

p	Pts. HBr	p	Pts. HBr
760	2.212	380	2.054
540	2.116	5	1.085

(Rooseboom; R. t. c. 4, 107.)

Sp. gr. of HBr + Aq.

Sp. gr.	% HBr	Temp.	Sp. gr.	% HBr	Temp.
1.055	7.67	14°	1.335	36.67	13°
1.075	10.19	14°	1.349	37.86	13°
1.089	11.94	14°	1.368	39.13	13°
1.097	12.96	14°	1.419	43.12	13°
1.118	15.37	14°	1.431	43.99	13°
1.131	16.92	14°	1.438	44.62	13°
1.164	20.65	14°	1.451	45.45	14°
1.200	24.35	13°	1.460	46.09	13°
1.232	27.62	13°	1.485	47.87	14°
1.253	29.68	13°	1.490	48.17	14°
1.302	33.84	13°	...	...	...

(Topsoë, B. 3. 404.)

Sp. gr. of HBr + Aq at 14°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.007	18	1.140	35	1.314
2	1.014	19	1.149	36	1.326
3	1.021	20	1.158	37	1.338
4	1.028	21	1.167	38	1.351
5	1.035	22	1.176	39	1.363
6	1.043	23	1.186	40	1.376
7	1.050	24	1.196	41	1.389
8	1.058	25	1.206	42	1.403
9	1.065	26	1.215	43	1.417
10	1.073	27	1.225	44	1.431
11	1.081	28	1.235	45	1.445
12	1.089	29	1.246	46	1.459
13	1.097	30	1.257	47	1.473
14	1.106	31	1.268	48	1.487
15	1.114	32	1.279	49	1.502
16	1.122	33	1.290	..	...
17	1.131	34	1.302	..	...

(Topsoë, calculated by Gerlach, Z. anal. 27. 316.)

Sp. gr. of HBr + Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
5	1.038	25	1.204	45	1.435
10	1.077	30	1.252	50	1.515
15	1.177	35	1.305	..	...
20	1.159	40	1.365	..	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. 23. 242.)

Sp. gr. of HBr + Aq at 15°.

% HBr	Sp. gr.	% HBr	Sp. gr.	% HBr	Sp. gr.
1	1.0082	18	1.145	35	1.314
2	1.0155	19	1.154	36	1.326
3	1.0230	20	1.163	37	1.338
4	1.0305	21	1.172	38	1.350
5	1.038	22	1.181	39	1.362
6	1.046	23	1.190	40	1.375
7	1.053	24	1.200	41	1.388
8	1.061	25	1.209	42	1.401
9	1.069	26	1.219	43	1.415
10	1.077	27	1.229	44	1.429
11	1.085	28	1.239	45	1.444
12	1.093	29	1.249	46	1.459
13	1.102	30	1.260	47	1.474
14	1.110	31	1.270	48	1.490
15	1.119	32	1.281	49	1.496
16	1.127	33	1.292	50	1.513
17	1.136	34	1.303	..	...

(Biel, C. C. 1882. 148.)

Absorbed by alcohol with formation of  $C_2H_5Br$ .

The composition of the hydrates formed by HBr at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by HBr and of the conductivity and sp. gr. of HBr + Aq. (Jones, Am. Ch. J. 1905, 34. 326.)

+  $H_2O$ . (Rooseboom, R. t. c. 5. 363.)+  $2H_2O$ . (Berthelot, A. ch. (5) 14. 369.)

(Pickering Chem. Soc. 1894, 64 (2) 232.)

Mpt.  $-11.2^{\circ}$ . (Pickering, l. c.)+  $3H_2O$ . Mpt.  $-48.0^{\circ}$ . (Pickering.)+  $4H_2O$ . Mpt.  $-55.8^{\circ}$ . (Pickering.)+  $5H_2O$ . (Pickering.)

**Bromhydric cyanhydric acid, .  $3HBr$ ,  $2HCN$ .**

Decomp. by  $H_2O$  and alcohol.

Insol. in ether. (Gautier, A. ch. (4) 17. 141.)

**Bromic acid,  $HBRO_3$ .**

Known only in aqueous solution.

Solution evaporated on water bath decomposes when it contains 4.26%  $HBRO_3$ . In vacuo, an acid containing 50.59%  $HBRO_3$ , corresponding to formula  $HBRO_3 + 7H_2O$  can be obtained.

Not decomp. by dil.  $HNO_3$ , or  $H_2SO_4$  + Aq. Conc.  $H_2SO_4$  decomposes.

Alcohol and ether are quickly oxidized by  $HBRO_3$ .

**Bromates.**

Most of the bromates are very sol. in  $H_2O$ , a few are sl. sol., but none are insol., the least sol. being  $AgBrO_3$  and  $Hg_2(BrO_3)_2$ .

**Aluminum bromate,  $Al(BrO_3)_3$ .**

Deliquescent. (Rammelsberg, Pogg. 55. 63.)

+  $9H_2O$ . Mpt.  $62.3^{\circ}$ . Less hygroscopic

than  $\text{Al}(\text{ClO}_3)_3$ . (Dobrosserdow, C. C. 1907. I, 1723.)

### Ammonium bromate, $\text{NH}_4\text{BrO}_3$ .

Decomposes spontaneously; sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 85.)

### Barium bromate, $\text{Ba}(\text{BrO}_3)_2$ .

Solubility of  $\text{Ba}(\text{BrO}_3)_2$  in  $\text{H}_2\text{O}$ . 100 g. sat.  $\text{Ba}(\text{BrO}_3)_2 + \text{Aq}$  at  $t^\circ$  contain g. anhydrous  $\text{Ba}(\text{BrO}_3)_2$ .

$t^\circ$	grams $\text{Ba}(\text{BrO}_3)_2$	$t^\circ$	Grams $\text{Ba}(\text{BrO}_3)_2$
Eutectic point $-0.034^\circ \pm 0.002^\circ$	0.280	$50^\circ$	1.72
$0^\circ$	0.286	$60^\circ$	2.271
$+10^\circ$	0.439	$70^\circ$	2.922
$20^\circ$	0.652	$80^\circ$	3.521
$25^\circ$	0.788	$90^\circ$	4.26
$30^\circ$	0.95	$98.7^\circ$	5.256
$40^\circ$	1.31	$*99.65^\circ$	5.39

\*  $99.65^\circ$  is bpt. at 740 mm. =  $100.39^\circ$  at 760 mm.

(Anschütz, Z. phys. Ch. 1906, 56. 240.)

100 g. sat.  $\text{Ba}(\text{BrO}_3)_2 + \text{Aq}$  contain 0.793 g.  $\text{Ba}(\text{BrO}_3)_2$  at  $25^\circ$ . Sp. gr. of the solution at  $25^\circ/4^\circ = 1.0038$ . (Harkins J. Am. Chem. Soc. 1911, 33. 1815.)

Solubility of  $\text{Ba}(\text{BrO}_3)_2$  in salts + Aq at  $25^\circ$ . C = concentration of salt in salt + Aq in milliequivalents per l.

$d_1$  = Sp. gr. at  $25^\circ/4^\circ$  of salt + Aq.

S = solubility of  $\text{Ba}(\text{BrO}_3)_2$  in salt + Aq expressed in milliequivalents per l.

$d_2$  = sp. gr. at  $25^\circ/4^\circ$  of  $\text{Ba}(\text{BrO}_3)_2 + \text{salt} + \text{Aq}$ .

Salt	C	$d_1$	S	$d_2$
None			40.18	1.0038
$\text{KNO}_3$	25.018	0.9985	43.86	1.0059
	50.032	1.0030	47.03	1.0081
	99.970	1.0033	52.13	1.0120
$\text{Ba}(\text{NO}_3)_2$	25.018	1.0003	36.77	1.0059
	50.039	1.0025	34.74	1.0083
	99.97	1.0073	32.63	1.0132
	199.95	1.0183	30.95	1.0233
$\text{KBrO}_3$	24.988	1.0001	26.53	1.0046
	49.971	1.0031	17.37	1.0062
	99.85	1.0093	8.76	1.0109
$\text{Mg}(\text{NO}_3)_2$	100.0		52.57	1.0114

(Harkins, J. Am. Chem. Soc. 1911, 33. 1815.)

+  $\text{H}_2\text{O}$ . Sol. in 130 pts. cold, and 24 pts. boiling  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 81.)

Decomp. by  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$ .

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

### Bismuth bromate.

Known only in solution, which decomp. on evaporation. (Rammelsberg, Pogg. 55. 76.)

### Cadmium bromate, $\text{Cd}(\text{BrO}_3)_2 + \text{H}_2\text{O}$ .

Sol. in 0.8 pt. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 74.)

+  $2\text{H}_2\text{O}$ . (Topsoë, J. B. 1872, 164.)

### Cadmium bromate ammonia, $\text{Cd}(\text{BrO}_3)_2 \cdot 3\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 74.)

$\text{Cd}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 43. 51.)

### Calcium bromate, $\text{Ca}(\text{BrO}_3)_2 + \text{H}_2\text{O}$ .

Sol. in 1.1 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 98.)

### Cerous bromate, $\text{Ce}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 63.)

Mpt.  $49^\circ$ ; very sol. in  $\text{H}_2\text{O}$  with decomp. (James, J. Am. Chem. Soc. 1909, 31. 914.)

### Cobaltous bromate, $\text{Co}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .

Sol. in 2.2 pts. cold  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 55. 71.)

### Cupric bromate, basic, $6\text{CuO} \cdot \text{Br}_2\text{O}_3 + 10\text{H}_2\text{O}$ .

Ppt. (Rammelsberg, Pogg. 55. 78.)

### Cupric bromate, $\text{Cu}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 92.)

### Cupric bromate ammonia, $\text{Cu}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$ .

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by dilution.

Insol. in alcohol. (Rammelsberg, Pogg. 52. 92.)

### Didymium bromate, $\text{Di}(\text{BrO}_3)_2 + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

### Dysprosium bromate, $\text{Dy}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .

Mpt.  $78^\circ$ . Easily sol. in  $\text{H}_2\text{O}$ . Difficultly sol. in alcohol. (Jantsch, B. 1911, 44. 1275.)

### Erbium bromate, $\text{Er}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .

Very sol. in alcohol and  $\text{H}_2\text{O}$ .

### Glucinum bromate.

Deliquescent.

### Iron (ferrous) bromate, $\text{Fe}(\text{BrO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ , but solution decomp. very easily.

### Iron (ferric) bromate, $5\text{Fe}_2\text{O}_3 \cdot \text{Br}_2\text{O}_3 + 30\text{H}_2\text{O}$ .

Partially sol. in  $\text{H}_2\text{O}$ , with separation of a more basic salt. Sol. in  $\text{HBO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 55. 68.)

### Lanthanum bromate, $\text{La}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .

Sol. in  $3\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Marignac, Ann. Min. (5) 15. 274.)

Mpt.  $37.5^\circ$  in its water of crystallization. 416 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . (James, J. Am. Chem. Soc. 1909, 31. 913.)

**Lead bromate, basic**,  $3\text{PbO}$ ,  $\text{Pb}(\text{BrO}_3)_2 + 2\text{H}_2\text{O}$ .

Ppt. (Strömholm, Z. anorg. 1904, 38. 441.)

**Lead bromate**,  $\text{Pb}(\text{BrO}_3)_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ .  $13.37 \times 10^{-10}$  g. are contained in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

+ $\text{H}_2\text{O}$ . Sol. in 75 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 52. 96.)

**Lithium bromate**,  $\text{LiBrO}_3$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. A. 55. 63.)

Not deliquescent. (Potilitzin, B. 23. 545 R.)

Sp. gr. of solution sat. at  $18^\circ = 1.833$ , and contains 60.4%  $\text{LiBrO}_3$ . (Mylus, B. 1897, 30. 1718.)

+ $\text{H}_2\text{O}$ . Not deliquescent. (Potilitzin.)

**Magnesium bromate**,  $\text{Mg}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .

Efflorescent. Sol. in 1.4 pts. cold  $\text{H}_2\text{O}$  at  $15^\circ$ . Melts in its water of crystallization when heated. (Rammelsberg, Pogg. 52. 89.)

**Mercurous bromate, basic**,  $2\text{Hg}_2\text{O}$ ,  $\text{Br}_2\text{O}_3$ .

Insol. in warm  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 55. 79.)

**Mercurous bromate**,  $\text{Hg}_2(\text{BrO}_3)_2$ .

Decomp. by  $\text{H}_2\text{O}$  into basic salt. Difficultly sol. in  $\text{HNO}_3 + \text{Aq}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . (Rammelsberg.)

**Mercuric bromate, basic**,  $2\text{HgO}$ ,  $\text{Br}_2\text{O}_3 + \text{H}_2\text{O}$ .

Slowly decomp. by cold, quickly by hot  $\text{H}_2\text{O}$  into oxide and an acid salt.

Easily sol. in dil. acids. (Topsoë, W. A. B. 66. 2. 2.)

**Mercuric bromate**,  $\text{HgBrO}_3 + 2\text{H}_2\text{O}$ .

Sol. in 650 pts. cold, and 64 pts. boiling  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Rammelsberg, Pogg. 55. 79.)

**Mercuric bromate ammonia**.

Sol. with decomp. in  $\text{HCl} + \text{Aq}$ . (Storer's Dict.)

**Neodymium bromate**,  $\text{Nd}(\text{BrO}_3)_3 + 9\text{H}_2\text{O}$ .

Mpt.  $66.7^\circ$ . 146 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . (James, J. Am. Chem. Soc. 1909, 31. 915.)

**Nickel bromate**,  $\text{Ni}(\text{BrO}_3)_2 + 6\text{H}_2\text{O}$ .

Sol. in 3.58 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 69.)

**Nickel bromate ammonia**,  $\text{Ni}(\text{BrO}_3)_2, 2\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$ , with decomposition of the major portion. Insol. in alcohol. (Rammelsberg, l. c.)

$\text{Ni}(\text{BrO}_3)_2, 6\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48. 50.)

**Potassium bromate**,  $\text{KBrO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 6.58 pts.  $\text{KBrO}_3$  at  $15^\circ$  (Rammelsberg). 100 pts.  $\text{H}_2\text{O}$  dissolve 5.83 pts.  $\text{KBrO}_3$  at  $17.1^\circ$  (Pohl, W. A. B. 6.

595); at  $0^\circ$ , 3.11 pts.; at  $20^\circ$ , 6.92 pts.; at  $40^\circ$ , 13.24 pts.; at  $60^\circ$ , 22.76 pts.; at  $80^\circ$ , 33.90 pts.; at  $100^\circ$  49.75 pts.  $\text{KBrO}_3$ . Sat. solution boils at  $104^\circ$ . (Kremers, Pogg. 97. 5.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.4715 moles  $\text{KBrO}_3$ . (Geffcken, Z. phys. Ch. 1904, 49. 296.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.478 mol.  $\text{KBrO}_3$  at  $25^\circ$ . (Rothmund, Z. phys. Ch. 1909, 69. 539.)

Sp. gr. of  $\text{KBrO}_3 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{KBrO}_3$	1	2	3	4	5
Sp. gr. .	1.009	1.016	1.024	1.031	1.039

% $\text{KBrO}_3$	6	7	8	9	10
Sp. gr. .	1.046	1.054	1.062	1.070	1.079

(Gerlach, Z. anal. 8. 290.)

Solubility of  $\text{KBrO}_3$  in salts +  $\text{Aq}$  at  $25^\circ$ .

Salt	Moles of $\text{KBrO}_3$ sol. in 1 liter of				
	.5-N solution	N solution	2-N solution	3-N solution	4-N solution
$\text{NaNO}_3$	0.5745	0.6497	0.7680	0.9026	1.031
$\text{NaCl}$	0.5220	0.5616	0.6042	0.6244	0.640

(Geffcken, Z. phys. Ch. 1904, 49. 296.)

Easily sol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46. 2.)

Sl. sol. in alcohol. (Rammelsberg.)

Insol. in absolute alcohol.

Solubility in organic compds. +  $\text{Aq}$  at  $25^\circ$ .

Solvent	Mol. $\text{KBrO}_3$ sol. in 1 litre
Water	0.478
0.5-N Methyl alcohol	0.444
" Ethyl alcohol	0.421
" Propyl alcohol	0.409
" Tert. amyl alcohol	0.383
" Acetone	0.425
" Ether	0.395
" Formaldehyde	0.397
" Glycol	0.448
" Glycerine	0.451
" Mannitol	0.451
" Glucose	0.463
" Sucrose	0.431
" Urea	0.477
" Dimethyl pyrone	0.478
" Ammonia	0.445
" Diethylamine	0.384
" Pyridine	0.415
" Piperidine	0.396
" Urethane	0.433
" Formamide	0.473
" Acetamide	0.445
" Glyccoll	0.501
" Acetic acid	0.456
" Phenol	0.426
" Methylal	0.405
" Methyl acetate	0.420

(Rothmund, Z. phys. Ch. 1909, 69. 539.)

**Insol.** in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Insol.** in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Insol.** in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Praseodymium bromate**,  $\text{Pr}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ .

Mpt.  $56.5^\circ$ . 190 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . (James, J. Am. Chem. Soc. 1909, 31. 914.)

**Samarium bromate**,  $\text{Sm}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ .

Mpt.  $75^\circ$ . 114 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . Very sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, 31. 915.)

**Scandium bromate**.

(Crookes, Roy. Soc. Proc. 1908, 80, A, 518.)

**Silver bromate**,  $\text{AgBrO}_3$ .

1 pt.  $\text{H}_2\text{O}$  dissolves 0.00810-pt.  $\text{AgBrO}_3$  at  $24.5^\circ$ . (Noyes, Z. phys. Ch. 6. 246.)

Sol. in 595.3 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ .

Sol. in 320.4 pts.  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.21) at  $25^\circ$ .

Sol. in 2.2 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.96) at  $25^\circ$ . (Longi, Gazz. ch. it. 13. 87.)

1 l.  $\text{H}_2\text{O}$  dissolves 1.71 g.  $\text{AgBrO}_3$  at  $27^\circ$ . (Whitby, Z. anorg. 1910, 67. 108.)

Sl. sol. in  $\text{H}_2\text{O}$ .  $1.59 \times 10^{-4}$  g. are contained in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

**Insol.** in  $\text{HNO}_3$ . (Löwig.) Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Silver bromate ammonia**,  $\text{AgBrO}_3 \cdot 2\text{NH}_3$ .

Decomp. in air or by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 62. 94.)

**Sodium bromate**,  $\text{NaBrO}_3$ .

Sol. in 2.7 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Rammelsberg.)

100 pts.  $\text{H}_2\text{O}$  dissolve at—

$0^\circ$   $20^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$

27.54 34.48 50.25 62.5 75.75 90.9 pts.  $\text{NaBrO}_3$ . (Kremers, Pogg. 94. 271.)

Easily forms supersaturated solutions.

Sat. solution boils at  $109^\circ$ . (Kremers.)

$\text{NaBrO}_3 + \text{Aq}$  containing 10.10%  $\text{NaBrO}_3$  has sp. gr.  $20^\circ/20^\circ = 1.0818$ .

$\text{NaBrO}_3 + \text{Aq}$  containing 11.09%  $\text{NaBrO}_3$  has sp. gr.  $20^\circ/20^\circ = 1.0900$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896 19. 278.)

Sp. gr. of  $\text{NaBrO}_3 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{NaBrO}_3$ . . .	5	10	15
Sp. gr. . . . .	1.041	1.083	1.129
% $\text{NaBrO}_3$ . . .	20	25	30
Sp. gr. . . . .	1.178	1.231	1.289

(Kremers, Pogg. 97. 5, calculated by Gerlach, Z. anal. 8. 290.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

**Insol.** in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Insol.** in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Sodium bromate bromide**,  $3\text{NaBrO}_3, 2\text{NaBr} + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Fritzsche.)

**Strontium bromate**,  $\text{Sr}(\text{BrO}_3)_2 + \text{H}_2\text{O}$ .

Sol. in 3 pts.  $\text{H}_2\text{O}$  (Rammelsberg, Pogg. 62. 84); less sol. in  $\text{H}_2\text{O}$  than  $\text{SrBr}_2 \cdot 6\text{H}_2\text{O}$ . (Löwig.)

**Thallous bromate**,  $\text{TlBrO}_3$ .

Sl. sol. in hot  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Oettinger.)

Easily sol. in  $\text{H}_2\text{O}$  and dil. acids. (Ditte, A. ch. (6) 21. 145.)

**Terbium bromate**,  $\text{Tb}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ .

Not deliquescent. (Potratz, C. N. 1905, 92, 3.)

**Thallous bromate**,  $\text{TlBrO}_3$ .

1 l.  $\text{H}_2\text{O}$  at  $39.75^\circ$  dissolves  $2.216 \times 10^{-2}$  g. mol. (Noyes and Abbott, Z. phys. Ch. 1895, 16. 130.)

Sl. sol. in  $\text{H}_2\text{O}$ .  $3.46 \times 10^{-1}$  gram are contained in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

**Thallic bromate**,  $\text{Tl}(\text{BrO}_3)_3 \cdot 3\text{H}_2\text{O}$ .

Very hygroscopic. Easily decomp. by  $\text{H}_2\text{O}$ . (Gewecke, Z. anorg. 1912, 76. 275.)

**Thulium bromate**,  $\text{Tm}_2(\text{BrO}_3)_6 \cdot 18\text{H}_2\text{O}$ .

Pptd. from sat. aqueous solution by 95% alcohol.

$\text{NH}_4\text{OH}$  is the best precipitant. (James, J. Am. Chem. Soc. 1911, 33. 1342.)

**Tin (stannous) bromate (?)**.

**Insol.** in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ .

**Uranyl bromate**,  $4\text{UO}_3, 3\text{Br}_2\text{O}_3 + 16\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Yttrium bromate**,  $\text{Y}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$ .

More easily sol. in  $\text{H}_2\text{O}$  than  $\text{Y}(\text{IO}_3)_3$ . Sl. sol. in alcohol. Insol. in ether. (Cleve.)

Mpt.  $74^\circ$ . 168 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ .

Sl. sol. in alcohol. (James, J. Am. Chem. Soc. 1909, 31. 916.)

**Zinc bromate**,  $\text{Zn}(\text{BrO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

Sol. in 1 pt. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 62. 90.)

**Zinc bromate ammonia**,  $\text{Zn}(\text{BrO}_3)_2 \cdot 2\text{NH}_3 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 62. 90.)

$\text{Zn}(\text{BrO}_3)_2 \cdot 4\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48. 51.)

**Perbromic acid**.

See Perbromic acid.

**Bromides.**

Most bromides are sol. in  $H_2O$ , many in alcohol, and some in ether.

$AgBr$  and  $Hg_2Br_2$  are insol. in  $H_2O$  or acids;  $PbBr_2$  and  $TlBr$  are sl. sol. therein.  $Cu_2Br_2$  is insol. in  $H_2O$ , sol. in acids.

See under each element.

**Bromine,  $Br_2$ .**

1 pt.  $Br$  dissolves at  $15^\circ$  in 33 pts.  $H_2O$ . (Löwig, Pogg. 14. 485.)

1 pt.  $Br$  dissolves at  $15^\circ$  in 31 pts.  $H_2O$ . (Dancer, Chem. Soc. 15. 477.)

**Solubility of  $Br$  in 100 pts.  $H_2O$  at  $t^\circ$ .**

$t^\circ$	Pts. $Br$	$t^\circ$	Pts. $Br$	$t^\circ$	Pts. $Br$
5	3.600	15	3.226	25	3.167
10	3.327	20	3.208	30	3.126

(Dancer, l. c.)

A sat. aqueous solution of  $Br$  contains 4.05%  $Br$  at  $0^\circ$ ; 3.80%  $Br$  at  $3^\circ$ ; 3.33%  $Br$  at  $10^\circ$ . (Rooseboom, R. t. o. 3. 29, 59, 73, 84.)

1 l.  $H_2O$  dissolves 34 g.  $Br$  at  $25^\circ$ . (Jakowkin, Z. phys. Ch. 1896, 20. 25.)

1 pt. is sol. in 30 pts.  $H_2O$ . (Dietze, Chem. Soc. 1899, 76 (2) 150.)

100 pts.  $H_2O$  dissolve at:

$0^\circ$  10.34° 19.96° 30.17° 40.03° 49.85°  
4.167 3.740 3.578 3.437 3.446 3.522  
pts. bromine.

Liquid bromine as such is insol. in  $H_2O$ ; only the vapor dissolves. (Winkler, Ch. Z. 1899, 23. 688.)

1 l.  $H_2O$  dissolves 33.95 g.  $Br_2$  at  $25^\circ$ . (McLauchlan, Z. phys. Ch. 1903, 44. 617.)

**Solubility of bromine vapor in  $H_2O$  at  $t^\circ$ .**

$a$  = coefficient of absorption.

$t^\circ$	$a$	$t^\circ$	$a$
0	60.5	42	8.6
2	54.1	44	7.9
4	48.3	46	7.4
6	43.3	48	6.9
8	38.9	50	6.5
10	35.1	52	6.1
12	31.5	54	5.8
14	28.4	56	5.4
16	25.7	58	5.1
18	23.4	60	4.9
20	21.3	62	4.6
22	19.4	64	4.4
24	17.7	66	4.2
26	16.3	68	4.0
28	15.0	70	3.8
30	13.8	72	3.6
32	12.7	74	3.4
34	11.7	76	3.3
36	10.9	78	3.1
38	10.1	80	3.0
40	9.4	..	...

(Winkler, Ch. Z. 1899, 23. 688.)

**Solubility of bromine vapor.  
(Mean of many determinations)**

Temp.	Pressure	Absorption coefficient
0.0	56-13mm.	60.53
9.94°	89-16	35.22
20.46	138-9	20.87
30.38	179-12	13.65
40.31	229-26	9.22
50.25	274-53	6.50
60.04	314-46	4.84
69.98	154-54	3.82
80.22	396-74	2.94

**Solubility of liquid bromine.**

(The mean of many determinations)

Temp.	$0^\circ$	$10.34^\circ$	$19.96^\circ$	$30.17^\circ$	$40.03^\circ$	$49.85^\circ$
Pts. $H_2O$ that dissolve 1 pt. $Br_2$	24.0	26.74	27.94	29.10	29.02	28.38

Much less  $Br_2$  is sol. in ice cold  $H_2O$  in the presence of bromine hydrate.

**Solubility in presence of bromine hydrate.  
(The mean of many determinations)**

Temp.	$0^\circ$	$5.12^\circ$
Pts. $H_2O$ that dissolve 1 pt. $Br_2$	42.39	26.26

(Winkler, Ch. Z. 1899, 23. 688-689.)

Solubility of  $Br_2$  in  $H_2O$  at  $25^\circ = 0.21$  mols. in 1 l. (Bray, J. Am. Chem. Soc. 1910, 32. 398.)

Sp. gr. of  $Br_2 + Aq$  containing pts.  $Br$  in 1000 pts. solution.

Pts. $Br$	Sp. gr.	Pts. $Br$	Sp. gr.
10.72	1.00901	18.74-19.06	1.01491
10.68	1.00931	19.52-20.09	1.01585
12.05	1.00995	20.89-21.55	1.01807
12.21	1.01223	31.02-31.69	1.02367

(Slessor, N. Edin. Phil. J. 7. 287.)

Sp. gr. of  $Br_2 + Aq$  at  $32.5^\circ$ .

% $Br_2$ by weight	Sp. gr.
0.7214	0.999814
1.1172	1.002520
1.6448	1.006100
1.9956	1.008870
2.5960	1.013200

(Joseph, Chem. Soc. 1915, 107. 3.)

Sol. in conc.  $HCl$ ,  $HBr$ , conc. solutions of bromides, and in liquid  $SO_2$ . (Sestini, Zeit. Chem. 1868. 718.)

Much more sol. in  $HCl + Aq$  than in  $H_2O$ . 100 ccm.  $HCl + Aq$  of 1.153 sp. gr. dissolve 36.4 g.  $Br$  at  $12^\circ$ .

More sol. in  $SrCl_2$ , and  $BaCl_2 + Aq$  than in  $H_2O$ . (Berthelot, C. R. 100. 761.)



Bromine is not more sol. in  $\text{KBr} + \text{Aq}$  than in  $\text{H}_2\text{O}$  (?). (Balard.)

$\text{KBr} + \text{Aq}$  containing 1 pt.  $\text{KBr}$  to 6 pts.  $\text{H}_2\text{O}$  takes up as much  $\text{Br}$  as it already contains; when this solution is heated the dissolved  $\text{Br}$  is separated. 1 pt.  $\text{KBr} + 1$  pt.  $\text{H}_2\text{O}$  takes up twice as much  $\text{Br}$  as it already contains, much heat being evolved. This solution loses  $\text{Br}$  on exposure to the air or when heated. (Löwig.)

#### Solubility of $\text{Br}_2$ in $\text{KBr} + \text{Aq}$ .

g. Mols. $\text{KBr}$ per l.	g. at. $\text{Br}$ dissolved per l. at $18.5^\circ$	g. at. $\text{Br}$ dissolved per l. at $26.5^\circ$
0.00	0.4448	0.4282
0.01	0.4634	0.4490
0.02	0.4823	0.4671
0.03	0.5049	0.4925
0.04	0.5243	0.5101
0.05	0.5431	0.5301
0.06	0.5668	0.5530
0.07	0.5895	0.5636
0.08	0.6059	0.5920
0.09	0.6301	0.5981
0.1	0.6533	0.6488
0.2	0.8718	0.8591
0.3	1.0549	1.0787
0.4	1.3124	1.2704
0.5	1.5436	1.4731
0.6	1.7712	1.6717
0.7	2.0006	1.9197
0.8	2.2354	2.1029
0.9	2.4851	2.3349

The above figures indicate that below a concentration of 0.1 g. mol.  $\text{KBr}$  per l. just enough  $\text{Br}$  is dissolved to form  $\text{KBr}_2$ , while above that concentration somewhat larger amounts of  $\text{Br}$  are dissolved, which is greater at the lower temp.

(Worley, Chem. Soc. 1905, 87, 1109.)

#### Solubility of $\text{Br}_2$ in $\text{NaBr} + \text{Aq}$ at $25^\circ$ .

g. $\text{NaBr}$ per l.	g.-atoms $\text{Br}_2$ per l.	Sp. gr.
92.6	2.479	1.213
160.5	4.345	1.372
205.8	6.195	1.515
255.8	8.575	1.678
319.7	13.65	1.997
359.0	16.04	2.137
....	19.23	2.327
406.3	20.85	2.420

(Bell, J. Am. Chem. Soc. 1912, 34, 14.)

#### Solubility in salts + $\text{Aq}$ . Solubility in 1 liter $\text{K}_2\text{SO}_4 + \text{Aq}$ at $25^\circ$ .

$\text{K}_2\text{SO}_4 + \text{Aq}$	g. Bromine
1-N	25.14
$\frac{1}{2}$ -N	29.44
$\frac{1}{3}$ -N	31.46
$\frac{1}{4}$ -N	32.70
$\frac{1}{16}$ -N	33.10

(Jakowkin, Z. phys. Ch. 1896, 20, 26.)

#### Solubility in 1 liter $\text{Na}_2\text{SO}_4 + \text{Aq}$ at $25^\circ$ .

$\text{Na}_2\text{SO}_4 + \text{Aq}$	g. Bromine
1-N	25.07
$\frac{1}{2}$ -N	29.20
$\frac{1}{3}$ -N	31.33
$\frac{1}{4}$ -N	32.94
$\frac{1}{16}$ -N	33.26

(Jakowkin, l. c.)

#### Solubility in 1 liter $\text{NaNO}_3 + \text{Aq}$ at $25^\circ$ .

$\text{NaNO}_3 + \text{Aq}$	g. Bromine
1-N	28.80
$\frac{1}{2}$ -N	31.35
$\frac{1}{3}$ -N	32.62
$\frac{1}{4}$ -N	33.33
$\frac{1}{16}$ -N	33.74

(Jakowkin, l. c.)

#### Solubility in salts + $\text{Aq}$ at $25^\circ$ .

Salt + $\text{Aq}$ .	g. $\text{Br}_2$ sol. in 1 liter
$\frac{1}{2}$ -N. $\text{Na}_2\text{SO}_4$	23.90
$\frac{1}{2}$ -N. $\text{K}_2\text{SO}_4$	24.80
$\frac{1}{2}$ -N. $(\text{NH}_4)_2\text{SO}_4$	77.7
N. $\text{NaNO}_3$	28.00
N. $\text{KNO}_3$	28.95
N. $\text{NH}_4\text{NO}_3$	55.15
N. $\text{NaCl}$	55.90
N. $\text{KCl}$	57.40
N. $\text{NH}_4\text{Cl}$	82.2

(McLauchlan, Z. phys. Ch. 1903, 44, 617.)

#### Solubility in $\text{HgBr}_2 + \text{Aq}$ at $25^\circ$ . 10 ccm. of the solution contain:—

Millimols. $\text{Br}_2$	Millimols. $\text{Hg}$
2.125	0.
2.204	0.0560
2.216	0.0793
2.226	0.1284
2.231	0.2120

(Herz and Paul, Z. anorg. 1914, 85, 215.)

1 l. N.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves 340.5 g.  $\text{Br}_2$  at  $25^\circ$ . (McLauchlan, Z. phys. Ch. 1903, 44, 617.)

Miscible in all proportions with liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79, 1361.)

More sol. in alcohol than in  $\text{H}_2\text{O}$ ; miscible with ether,  $\text{CS}_2$ ,  $\text{CHCl}_3$ . (Sestini, Zeit. Chem. 1868, 718.)

Somewhat soluble in glycerine. (Pelouze.) Sol. in benzene (Mansfield); insol. in benzene (Moride, A. ch. (3) 39, 452). Sol. in warm chloral, bromal, and iodal. (Löwig, Pogg. 14, 485.) Sol. in  $\text{SCl}_3$  (Solly), and  $\text{SBr}_2$ . Sol. in conc.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Balard.) Sol. in aqueous solution of potassium, sodium, or calcium acetates. (Cahours.)

Solubility in  $\text{CS}_2$ .

100 g. of the sat. solution contain at:

—95°	—110.5°	—116°
45.4	39.0	36.9 g. $\text{Br}_2$ .

(Arctowski, Z. anorg. 1896, 11. 274.)

Cryst. from  $\text{CS}_2$  at —90° in fine needles.  
(Arctowski, Z. anorg. 1895, 10. 25.)Sp. gr. of  $\text{Br}_2 + \text{CCl}_4$  at 32.5°.

% $\text{Br}_2$ by weight	Sp. gr.
1.5449	1.58014
1.6454	1.58060
1.7990	1.58168
2.6676	1.58812
3.5833	1.59526

(Joseph, Chem. Soc. 1915, 107. 3.)

Sp. gr. of  $\text{Br}_2$  + nitrobenzene at 32.5°.

% $\text{Br}_2$ by weight	Sp. gr.
1.5643	1.20225
3.2323	1.21449
4.6462	1.22518
6.1826	1.23603

(Joseph, Chem. Soc. 1915, 107. 3.)

Very sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37. 4328.)

Partition of  $\text{Br}_2$  between water and other solvents.

W = millimols Bromine in 10 ccm. of the aqueous layer.

G = millimols Bromine in 10 ccm. of the other layer.

Other solvent	G	W	G/W
$\text{CCl}_4$	1.949	0.0853	22.73
	7.008	0.3085	22.71
	12.171	0.5300	23.13
	39.880	1.3132	30.32
	54.574	1.5560	35.01

75% by vol. $\text{CCl}_4$ +25% by vol. $\text{CS}_2$	3.567	0.0985	37.06
	7.304	0.1910	38.15
	10.833	0.2900	37.36
	13.922	0.3720	37.42
	17.230	0.4580	37.62
	25.637	0.6580	38.96
	40.625	0.9940	40.88
	54.035	1.2080	44.73

50% by vol. $\text{CCl}_4$ + 50% by vol. $\text{CS}_2$	3.592	0.0784	45.82
	6.820	0.1487	46.85
	10.148	0.2206	46.01
	13.866	0.3065	45.24
	16.616	0.3688	45.05
	42.975	0.8086	53.15
	55.965	0.9960	56.19

25% by vol. $\text{CCl}_4$ +75% by vol. $\text{CS}_2$	5.753	0.0884	65.05
	10.902	0.1682	64.82
	26.724	0.4970	65.65
	41.314	0.6331	65.26
	55.526	0.8520	65.17

Partition of  $\text{Br}_2$ , etc.—Continued

Other solvent	G	W	G/W
$\text{CS}_2$	7.750	0.1015	76.35
	10.600	0.1387	76.44
	14.696	0.1910	76.98
	17.999	0.2352	76.54
	26.345	0.3467	75.99
	40.625	0.5194	78.21
	57.038	0.7160	79.66

(Herz, Z. Elektrochem, 1910, 16. 871.)

Partition coefficient for bromine between  $\text{CS}_2$  and  $\text{H}_2\text{O}$  at 25°C.

A = concentration of the water layer.

C = concentration of the  $\text{CS}_2$  layer.

A	C	N = C/A
7.545	691.9	91.71
4.109	338.6	82.41
2.660	217.4	81.72
2.544	207.7	81.66
1.740	140.38	80.67
1.2878	103.7	80.51
0.8073	64.44	79.83
0.5046	39.64	78.38

Partition coefficient for bromine between  $\text{CHBr}_3$  and  $\text{H}_2\text{O}$  at 25°C.

A = concentration of the water layer.

C = concentration of the  $\text{CHBr}_3$  layer.

A	C	N = C/A
5.424	373.6	68.88
3.838	264.7	68.80
2.368	161.5	68.19
1.348	90.17	66.90
0.766	50.49	65.84
0.366	23.62	64.85

Partition coefficient for bromine between  $\text{CCl}_4$  and  $\text{H}_2\text{O}$  at 25°C.

A = concentration of the water layer.

C = concentration of the  $\text{CCl}_4$  layer.

A	C	N = C/A
14.42	545.2	37.82
10.80	372.2	34.44
7.901	252.8	32.01
7.163	225.8	31.52
6.803	218.5	32.12
5.651	172.6	30.54
3.216	94.84	29.48
2.054	58.36	28.41
1.266	35.92	28.37
0.7711	21.53	27.92
0.5761	15.72	27.26
0.4476	12.09	27.02
0.3803	10.27	27.00
0.2478	6.691	27.00

(Jakowkin, Z. phys. Ch. 1895, 18. 588.)

Partition of bromine between  $\text{CCl}_4$  and salts + Aq.

A = concentration of Br in  $\text{H}_2\text{O}$  layer.

C = concentration of Br in  $\text{CCl}_4$  layer.

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{NaNO}_3$  + Aq at  $25^\circ$ .

$\text{NaNO}_3$ + Aq	A	C
1-N	7.905	316.7
$\frac{1}{2}$ -N	8.763	319.5
$\frac{1}{4}$ -N	9.033	315.7
$\frac{1}{8}$ -N	9.200	316.7
$\frac{1}{16}$ -N	9.399	319.3

(Jakowkin, Z. phys. Ch. 1896, 20, 25.)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{K}_2\text{SO}_4$  + Aq at  $25^\circ$ .

$\text{K}_2\text{SO}_4$ + Aq	A	C
1-N	5.982	255.4
$\frac{1}{2}$ -N	6.843	253.4
$\frac{1}{4}$ -N	7.354	252.8
$\frac{1}{8}$ -N	7.585	250.3
$\frac{1}{16}$ -N	7.498	242.3

(Jakowkin, l. c.)

Partition of  $\text{Br}_2$  between  $\text{CCl}_4$  and  $\text{Na}_2\text{SO}_4$  + Aq at  $25^\circ$ .

$\text{Na}_2\text{SO}_4$ + Aq	A	C
1-N	5.934	254.6
$\frac{1}{2}$ -N	6.838	253.4
$\frac{1}{4}$ -N	7.402	254.4
$\frac{1}{8}$ -N	7.609	252.8
$\frac{1}{16}$ -N	7.713	251.2

(Jakowkin, l. c.)

Crystallizes at  $4^\circ$  with  $10\text{H}_2\text{O}$ .

**Bromine chloride,  $\text{BrCl}$ .**

Sol. in  $\text{H}_2\text{O}$ ,  $\text{CS}_2$ , ether, etc.

**Bromine fluoride,  $\text{BrF}_2$ .**

Fumes in the air. Decomp. by  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1905, 141, 1019.)

**Bromine oxides.**

No oxides of bromine are known in the free state. See hypobromous, bromic, and perbromic acids.

**Bromiridic acid.**

**Ammonium bromiridate,  $(\text{NH}_4)_2\text{IrBr}_4$ .**

Less sol. in cold  $\text{H}_2\text{O}$  than the K salt. (Birnbbaum, Zeit. Chem. 1865, 22.)

Very sol. in cold  $\text{H}_2\text{O}$ . (Gutbier, B. 1909, 42, 3910.)

**Cesium bromiridate,  $\text{Cs}_2\text{IrBr}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1909, 42, 3911.)

**Potassium bromiridate,  $\text{K}_2\text{IrBr}_4$ .**

Moderately sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

Insol. in alcohol or ether.

Sol. in cold  $\text{H}_2\text{O}$  and in  $\text{HBr}$  + Aq. (Gutbier, B. 1909, 42, 3910.)

**Rubidium bromiridate,  $\text{Rb}_2\text{IrBr}_4$ .**

Very sol. in cold  $\text{H}_2\text{O}$ . Sol. in hot dil.  $\text{HBr}$  + Aq. (Gutbier, B. 1909, 42, 3911.)

**Sodium bromiridate.**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.

**Bromiridous acid,  $\text{H}_2\text{Ir}_2\text{Br}_{12} + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Birnbbaum, 1864.)

**Ammonium bromiridite,  $(\text{NH}_4)_2\text{Ir}_2\text{Br}_{12} + \text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Birnbbaum.)

**Potassium bromiridite,  $\text{K}_2\text{Ir}_2\text{Br}_{12} + 6\text{H}_2\text{O}$ .**

Efflorescent. Sol. in  $\text{H}_2\text{O}$ .

**Silver bromiridite,  $\text{Ag}_2\text{Ir}_2\text{Br}_{12}$ .**

Ppt. Insol. in  $\text{H}_2\text{O}$  or acids.

**Sodium bromiridite,  $\text{Na}_2\text{Ir}_2\text{Br}_{12} + 24\text{H}_2\text{O}$ .**

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ .

**Bromocarbonatoplatindiamine carbonate,  $\text{CO}_2[\text{Pt}(\text{N}_2\text{H}_4)_2]_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .**

Ppt.

**Bromocarbonatoplatindiamine carbonate**

**bromoplatindiamine nitrate,**

$\text{CO}_2[\text{Pt}(\text{N}_2\text{H}_4)_2]_2(\text{CO}_3)_2, 2\text{Br}_2\text{Pt}(\text{N}_2\text{H}_4)_2(\text{NO}_3)_2$ .

**Bromochloroplatindiamine chloride,**

$\text{BrCl Pt}(\text{N}_2\text{H}_4)_2\text{Cl}_2$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **chlorobromide,  $\text{Br Cl Pt N}_2\text{H}_4\text{Cl N}_2\text{H}_4\text{Br} (?)$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ .

**Bromochloroplatinic acid.**

**Potassium bromochloroplatinate,  $\text{K}_2\text{PtCl}_2\text{Br}_2$**

(Pitkin, J. Am. Chem. Soc. 2, 408.)

Mixture. (Herty, J. Am. Chem. Soc. 1896, 18, 136.)

$\text{K}_2\text{PtCl}_2\text{Br}_2$ . Sl. sol. in cold  $\text{H}_2\text{O}$ ; much more sol. in hot  $\text{H}_2\text{O}$ . (Pitkin.)

Mixture. (Herty.)

$\text{K}_2\text{PtCl}_2\text{Br}_2$ . As above.

$\text{K}_2\text{PtCl}_2\text{Br}_4$ . (Pigeon, A. ch. 1894, (7) 2, 488.)

$\text{K}_2\text{PtClBr}_2$ . (Pitkin.)

**Bromochromic acid.**

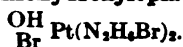
**Potassium bromochromate,  $\text{KCrO}_2\text{Br}_2 = \text{CrO}_2(\text{Br})\text{OK}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Heintze, J. pr. (2) 4, 225.)

**Dibromochromium chloride,**  
 $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]\text{Cl} + 2\text{H}_2\text{O}.$

Ppt. Nearly insol. in fuming HCl. (Bjerrum, B. 1907, 40. 2918.)

**Bromohydroxyloplatindiamine bromide,**



Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **chloride,**  $\begin{array}{c} \text{OH} \\ | \\ \text{Br Pt}(\text{N}_2\text{H}_4\text{Cl})_2. \end{array}$

Sol. in  $\text{H}_2\text{O}$  (Cleve.)

— **nitrate,**  $\begin{array}{c} \text{OH} \\ | \\ \text{Br Pt}(\text{N}_2\text{H}_4\text{NO}_2)_2. \end{array}$

Very sl. sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Bromohydroxyloplatinmonodiamine**



Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Bromomercurosulphurous acid.**

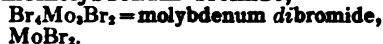
**Ammonium bromomercurosulphite,**  
 $\text{NH}_4\text{SO}_3\text{HgBr}.$

Sol. in  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 9. 215.)

**Potassium bromomercurosulphite,**  
 $\text{KSO}_3\text{HgBr}.$

As above. (B.)

**Bromomolybdenum bromide,**



Insol. in  $\text{H}_2\text{O}$  or acids, or even in boiling aqua regia. Easily sol. in dilute, decomp. by conc. alkalis + Aq. (Blomstrand, J. pr. 82. 436.)

**Bromomolybdenum chloride,**  $\text{Br}_4\text{Mo}_3\text{Cl}_2 + 3\text{H}_2\text{O}.$

Insol. in acids. (Blomstrand.)

**Bromomolybdenum chromate,**  $\text{Br}_4\text{Mo}_3\text{CrO}_4 + 2\text{H}_2\text{O}.$

Insol. in dil. acids. Sol. in hot conc. HCl + Aq. Insol. in alkali chromates + Aq. (Atterberg.)

**Bromomolybdenum fluoride,**  $\text{Br}_4\text{Mo}_3\text{F}_2 + 3\text{H}_2\text{O}.$

Insol. in  $\text{H}_2\text{O}$ . (Atterberg.)

**Bromomolybdenum hydroxide,**  $\text{Br}_4\text{Mo}_3(\text{OH})_2.$

Completely sol. in alkalis if not heated over  $90^\circ$ . (Atterberg.)



**Bromomolybdenum iodide hydroxide,**  
 $2\text{Br}_4\text{Mo}_3\text{I}_2, \text{Br}_4\text{Mo}_3(\text{OH})_2 + 8\text{H}_2\text{O}.$

Precipitate. (Blomstrand, J. pr. 77. 92.)

**Bromomolybdenum molybdate,**  $\text{Br}_4\text{Mo}_3\text{MoO}_4.$

Precipitate. (Atterberg.)

**Bromomolybdenum phosphate,**  
 $\text{Br}_4\text{Mo}_3\text{H}_4(\text{PO}_4)_2.$

Precipitate. Insol. in  $\text{H}_2\text{O}$ . (Atterberg.)

**Bromomolybdenum sulphate,**  $\text{Br}_4\text{Mo}_3\text{SO}_4 + 3\text{H}_2\text{O}.$

Precipitate. Sl. sol. in boiling  $\text{H}_2\text{SO}_4$ . (Atterberg.)

**Dibromomolybdous acid,**  $\text{MoOBr}_2(\text{OH}) + 1\frac{1}{2}\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . Very hygroscopic. (Weinland, Z. anorg. 1905, 44. 86.)

**Tetrabromomolybdous acid,**  $\text{MoBr}_4(\text{OH}) + 2\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . Hygroscopic. (Weinland, l. c.)

**Diammonium pentabromomolybdite,**  
 $\text{MoBr}_5\text{O}(\text{NH}_4)_2.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Dicæsium pentabromomolybdite,**  
 $\text{MoBr}_5\text{OCs}_2.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Calcium tetrabromomolybdite,**  $(\text{MoBr}_4\text{O})_2\text{Ca} + 7\text{H}_2\text{O}.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Monolithium tetrabromomolybdite,**  
 $\text{MoBr}_4(\text{OLi}) + 4\text{H}_2\text{O}.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Magnesium pentabromomolybdite,**  
 $\text{MoBr}_5(\text{OMg}) + 7\text{H}_2\text{O}.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Monopotassium tetrabromomolybdite,**  
 $\text{MoBr}_4(\text{OK}) + 2\text{H}_2\text{O}.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Dipotassium pentabromomolybdite,**  
 $\text{MoBr}_5\text{OK}_2.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Dirubidium pentabromomolybdite,**  
 $\text{MoBr}_5\text{ORb}_2.$

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Weinland, l. c.)

**Bromonitratoplatindiamine nitrate,**



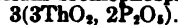
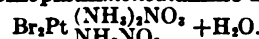
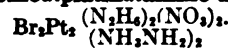
Decomp. by  $\text{H}_2\text{O}$ . (Cleve.)

— **sulphate,**  $\begin{array}{c} \text{Br} \\ | \\ \text{NO}_2 \text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}. \end{array}$

Sl. sol. in  $\text{H}_2\text{O}$ . Digitized by Google

**Bromonitritoplatinsemidiamine nitrite,**  
 $\text{NO}_2\text{Br}_2\text{Pt}(\text{NH}_3)_2\text{NO}_2$ Sl. sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)**Bromonitrous acid.****Platinum silver bromonitrite,**  $\text{PtAg}_3\text{Br}_2(\text{NO}_2)_4$ 

Ppt. (Miolati, Gazz. ch. it. 1900, 30. 588.)

**Bromopalladic acid.****Ammonium bromopalladate,**  $(\text{NH}_4)_2\text{PdBr}_4$ Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  and by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, B. 1905, 33. 1907.)**Cesium bromopalladate,**  $\text{Cs}_2\text{PdBr}_4$ Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, l. c.)**Potassium bromopalladate,**  $\text{K}_2\text{PdBr}_4$ Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, l. c.)**Rubidium bromopalladate,**  $\text{Rb}_2\text{PdBr}_4$ Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, l. c.)**Bromopalladious acid.****Ammonium bromopalladite,**  $(\text{NH}_4)_2\text{PdBr}_4$ Very stable. Sol. in  $\text{H}_2\text{O}$ . (Smith, Z. anorg. 1894, 6. 381.)Very sol. in cold  $\text{H}_2\text{O}$ .Can be cryst. from a very small amount of hot  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 33. 2387.)**Barium bromopalladite.**Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)**Cesium bromopalladite,**  $\text{Cs}_2\text{PdBr}_4$ Very sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 33. 2388.)**Manganese bromopalladite,**  $\text{MnPdBr}_4$ Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)  
+  $7\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Smith, Z. anorg. 1894, 6. 382.)**Potassium bromopalladite,**  $\text{K}_2\text{PdBr}_4$ Easily sol. in  $\text{H}_2\text{O}$ . (Joannis, C. R. 95. 295.)Very stable. Sol. in  $\text{H}_2\text{O}$ . (Smith, Z. anorg. 1894, 6. 381.)+  $2\text{H}_2\text{O}$ . Unstable in the air. (Smith, l. c.)**Rubidium bromopalladite,**  $\text{Rb}_2\text{PdBr}_4$ Can be cryst. from a very small amount of hot  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 33. 2388.)**Sodium bromopalladite,**  $\text{Na}_2\text{PdBr}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Smith, l. c.)**Strontium bromopalladite,**  $\text{SrPdBr}_4 + 6\text{H}_2\text{O}$ Stable in the air. Very sol. in  $\text{H}_2\text{O}$ . (Smith, l. c.)**Zinc bromopalladite.**Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)**Bromophosphatoplatindiamine phosphate,**  $\text{BrPt}(\text{N}_3\text{H}_4)_2 + 2\text{H}_2\text{O}$ Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromophosphoric acid.****Thorium bromophosphate,**  $\text{ThBr}_4$ Insol. in most acids and in fused alkali carbonates. Decomp. by long boiling with conc.  $\text{H}_2\text{SO}_4$ . (Colani, C. R. 1900, 149. 208.)**Bromoplatinamine bromide,**Sl. sol. in  $\text{H}_2\text{C}$ . (Cleve, Sv. V. A. H. 10, 9. 31.)— nitrite,  $\text{Br}_2\text{Pt}(\text{NH}_2\text{NO}_2)_2$ Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromoplatindiamine bromide,**Only sl. sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)— chloride,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_4)_2\text{Cl}_2$ Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)— dichromate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_4)_2\text{Cr}_2\text{O}_7$ Sl. sol. in  $\text{H}_2\text{C}$ .— nitrate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_4\text{NO}_2)_2$ Sl. sol. in cold, rather easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)— phosphate,  $\text{Br}_2\text{Pt}[\text{N}_2\text{H}_4\text{PO}_3(\text{OH})_2]_2 + 2\text{H}_2\text{O}$ Rather easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)— sulphate,  $\text{Br}_2\text{Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4$ Very sl. sol. in  $\text{H}_2\text{O}$ .**Bromoplatinmonodiamine nitrate,**Easily sol. in  $\text{H}_2\text{O}$ .— sulphate,  $\text{Br}_2\text{Pt}(\text{NH}_2)_2\text{SO}_4 + \text{H}_2\text{O}$ Moderately sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromoplatinsemidiamine bromide,**Sl. sol. in cold  $\text{H}_2\text{O}$ . (Cleve.)**Bromodiplatindiamine anhydronitrate,**Sol. in  $\text{HNO}_3 + \text{Aq}$

**Bromodiplatindiamine chloride,**

Ppt. (Cleve.)

— **nitrate**,  $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_4)_4(\text{NO}_3)_4 \cdot 2\text{H}_2\text{O}$ .Moderately sol. in hot  $\text{H}_2\text{O}$ .— **sulphate**,  $\text{Br}_2\text{Pt}_2(\text{N}_2\text{H}_4)_4(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$ .

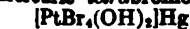
Ppt. (Cleve.)

**Bromoplatinic acid**,  $\text{H}_2\text{PtBr}_6 \cdot 9\text{H}_2\text{O}$ .Very deliquescent, and sol. in  $\text{H}_2\text{O}$ , alcohol, ether, chloroform, or acetic acid. (Topsoë, J. B. 1868. 273.)**Ammonium bromoplatinate**,  $(\text{NH}_4)_2\text{PtBr}_6$ .Sol. in 200 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Topsoë.)100 pts.  $(\text{NH}_4)_2\text{PtBr}_6 + \text{Aq}$  sat. at  $20^\circ$  contain 0.59 pt. dry salt. (Halberstadt, B. 17. 2965.)**Barium bromoplatinate**,  $\text{BaPtBr}_6 \cdot 10\text{H}_2\text{O}$ .Sl. deliquescent. Very sol. in  $\text{H}_2\text{O}$ .**Cesium bromoplatinate**,  $\text{Cs}_2\text{PtBr}_6$ .Sl. sol. in dil.  $\text{HBr} + \text{Aq}$ . (Obermaier, Dissert.)**Calcium bromoplatinate**,  $\text{CaPtBr}_6 \cdot 12\text{H}_2\text{O}$ .Sl. deliquescent. Very sol. in  $\text{H}_2\text{O}$ .**Cobalt bromoplatinate**,  $\text{CoPtBr}_6 \cdot 12\text{H}_2\text{O}$ .

Deliquescent.

**Copper bromoplatinate**,  $\text{CuPtBr}_6 \cdot 8\text{H}_2\text{O}$ .Very deliquescent; sol. in  $\text{H}_2\text{O}$ .**Lead bromoplatinate**,  $\text{PbPtBr}_6$ .Easily sol. in  $\text{H}_2\text{O}$ , but decomp. by large amount.**Lead tetrabromoplatinate**,  $[\text{PtBr}_4(\text{OH})_2]\text{Pb} \cdot \text{PbOH}$ .Insol. in  $\text{H}_2\text{O}$ . (Miolati, C. C. 1900, II. 810.)**Magnesium bromoplatinate**,  $\text{MgPtBr}_6 \cdot 12\text{H}_2\text{O}$ .

Not deliquescent.

**Manganese bromoplatinate**,  $\text{MnPtBr}_6 \cdot 6\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . $+12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .**Mercuric tetrabromoplatinate**,Insol. in  $\text{H}_2\text{O}$ . (Miolati, C. C. 1900, II. 810.)**Nickel bromoplatinate**,  $\text{NiPtBr}_6 \cdot 12\text{H}_2\text{O}$ .

Deliquescent.

**Potassium bromoplatinate**,  $\text{K}_2\text{PtBr}_6$ .Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (v. Bonardoff, Pogg. 19. 344.)Sol. in 10 pts. boiling  $\text{H}_2\text{O}$ . (Pitkin, C. N. 41. 218.)100 pts.  $\text{K}_2\text{PtBr}_6 + \text{Aq}$  sat. at  $20^\circ$  contain 2.02 pts. dry salt. (Halberstadt, B. 17. 2962.)**Praseodymium bromoplatinate**,  $\text{PrBr}_3 \cdot \text{PtBr}_6 \cdot 10\text{H}_2\text{O}$ .Deliquescent; very sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HBr}$ . (Von Schule, Z. anorg. 1898, 18. 353.)**Rubidium bromoplatinate**,  $\text{Rb}_2\text{PtBr}_6$ .Sl. sol. in dil.  $\text{HBr} + \text{Aq}$ . (Obermaier, Dissert.)**Silver bromoplatinate**,  $\text{Ag}_2\text{PtBr}_6$ .Insol. in  $\text{H}_2\text{O}$ . (Miolati, C. C. 1900, II. 810.)**Silver tetrabromoplatinate**,  $[\text{PtBr}_4(\text{OH})_2]\text{Ag}_2$ .Ppt.; insol. in  $\text{H}_2\text{O}$ . (Miolati, l. c.)**Sodium bromoplatinate**,  $\text{Na}_2\text{PtBr}_6 \cdot 6\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$  and alcohol.**Strontium bromoplatinate**,  $\text{SrPtBr}_6 \cdot 10\text{H}_2\text{O}$ .Sl. deliquescent. Very sol. in  $\text{H}_2\text{O}$ .**Thallium tetrabromoplatinate**,Insol. in  $\text{H}_2\text{O}$ . (Miolati, C. C. 1900, II. 810.)**Ytterbium bromoplatinate**,  $\text{YbBr}_3 \cdot 3\text{H}_2\text{PtBr}_6 \cdot 30\text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 138.)

**Zinc bromoplatinate**,  $\text{ZnPtBr}_6 \cdot 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Bromoplatinocyanhydric acid**,

See Perbromoplatinocyanhydric acid.

**Potassium bromoplatinocyanide**,  $5\text{K}_2\text{Pt}(\text{CN})_4$ .Sol. in  $\text{H}_2\text{O}$ .**Bromoplatinous acid**.**Potassium bromoplatinite**,  $\text{K}_2\text{PtBr}_4 \cdot 2\text{H}_2\text{O}$ .Extremely sol. in  $\text{H}_2\text{O}$ . (Billmann and Andersen, B. 1903, 36. 1566.)**Bromopurpureochromium bromide**,Less sol. in  $\text{H}_2\text{O}$  than chloropurpureochromium chloride. (Jørgensen, J. pr. (2) 26. 83.)— **bromoplatinate**,  $\text{BrCr}(\text{NH}_3)_4\text{PtBr}_6$ .

(Jørgensen, l. c.)

— **chloride**,  $\text{BrCr}(\text{NH}_3)_4\text{Cl}_2$ .More sol. in  $\text{H}_2\text{O}$  than the bromide. (Jørgensen, l. c.)

**Bromopurpleochromium chromate,**  
 $\text{BrCr}(\text{NH}_3)_4\text{CrO}_4$ .Precipitate. (Jørgensen, *l. c.*)— **nitrate**,  $\text{BrCr}(\text{NH}_3)_4(\text{NO}_3)_2$ .More sol. than bromide and less than chloride. (Jørgensen, *l. c.*)**Bromopurplecobaltic bromide,**  
 $\text{CoBr}(\text{NH}_3)_4\text{Br}_2$ .Sol. in 530 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . Insol. in alcohol,  $\text{NH}_4\text{Br}$ ,  $\text{KBr}$ , or  $\text{HBr} + \text{Aq}$ . More sol. in hot  $\text{H}_2\text{O}$  containing a little  $\text{HBr}$ . (Jørgensen, *J. pr.* (2) 19. 49.)**Bromopurplecobaltic mercuric bromide,**  
 $\text{CoBr}(\text{NH}_3)_4\text{Br}_2, 3\text{HgBr}_2$ .More sol. in  $\text{H}_2\text{O}$  than the corresponding  $\text{HgCl}_2$  salt. (J.)— **bromoplatinate**.Very sl. sol. in cold  $\text{H}_2\text{O}$ . (J.)— **chloride**,  $\text{CoBr}(\text{NH}_3)_4\text{Cl}_2$ .Difficultly sol. in cold  $\text{H}_2\text{O}$ , but much more easily than the bromide. Insol. in dil.  $\text{HCl} + \text{Aq}$ , and in alcohol.— **mercuric chloride**,  $\text{CoBr}(\text{NH}_3)_4\text{Cl}_2, 3\text{HgCl}_2$ .Sl. sol. in  $\text{H}_2\text{O}$ .— **chloroplatinate**.Nearly or quite insol. in  $\text{H}_2\text{O}$ . (J.)— **chromate**,  $\text{CoBr}(\text{NH}_3)_4\text{CrO}_4$ .Nearly insol. in  $\text{H}_2\text{O}$ .— **dithionate**,  $\text{CoBr}(\text{NH}_3)_4\text{S}_2\text{O}_8$ .Nearly insol. in  $\text{H}_2\text{O}$ .— **fluosilicate**,  $\text{CoBr}(\text{NH}_3)_4\text{SiF}_6$ .Very sl. sol. in cold  $\text{H}_2\text{O}$ ; insol. in alcohol.— **nitrate**,  $\text{CoBr}(\text{NH}_3)_4(\text{NO}_3)_2$ .More sol. in  $\text{H}_2\text{O}$  than the bromide, but less than the chloride. Wholly insol. in dil.  $\text{HNO}_3 + \text{Aq}$  or alcohol.— **oxalate**,  $\text{CoBr}(\text{NH}_3)_4\text{C}_2\text{O}_4$ .Nearly insol. in  $\text{H}_2\text{O}$ .— **sulphate**,  $\text{CoBr}(\text{NH}_3)_4\text{SO}_4$ .Can be crystallized from very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in alcohol.  
 $+ 6\text{H}_2\text{O}$ . Efflorescent.**Bromopurpleorhodium bromide,**  
 $\text{BrRh}(\text{NH}_3)_4\text{Br}_2$ .Much less easily sol. in  $\text{H}_2\text{O}$  than the chloro-chloride. Insol. in dil.  $\text{HBr} + \text{Aq}$  and alcohol. (Jørgensen, *J. pr.* (2) 27. 433.)— **bromoplatinate**,  $\text{BrRh}(\text{NH}_3)_4\text{PtBr}_4$ .Almost insol. in  $\text{H}_2\text{O}$ .— **fluosilicate**,  $\text{BrRh}(\text{NH}_3)_4\text{SiF}_6$ .Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in boiling  $\text{NaOH} + \text{Aq}$  as roseo salt.**Bromopurpleorhodium nitrate,**  
 $\text{BrRh}(\text{NH}_3)_4(\text{NO}_3)_2$ .Sl. sol. in  $\text{H}_2\text{O}$ , but much more sol. than the bromide.**Bromorhodos acid.****Ammonium bromorhodite**,  $(\text{NH}_4)_3\text{RhBr}_4$ .Sol. in  $\text{H}_2\text{O}$ . (Goloubkine, *Chem. Soc.* 1911, 100 (2) 45.)Sol. in  $\text{H}_2\text{O}$ . (Gutbier, *B.* 1908, 41. 215.)**Barium bromorhodite**,  $\text{BaRhBr}_4$ .Sol. in  $\text{H}_2\text{O}$ . (Goloubkine, *l. c.*)**Cæsium bromorhodite**,  $\text{Cs}_2\text{RhBr}_4$ .Difficultly sol. in  $\text{H}_2\text{O}$ . (Gutbier, *l. c.*)**Potassium bromorhodite**,  $\text{K}_2\text{RhBr}_4$ .Very sol. in  $\text{H}_2\text{O}$ . (Goloubkine, *l. c.*)Sol. in  $\text{H}_2\text{O}$ . (Gutbier, *l. c.*)**Rubidium bromorhodite**,  $\text{Rb}_2\text{RhBr}_4$ .Sol. in  $\text{H}_2\text{O}$ . (Goloubkine, *l. c.*)Difficultly sol. in  $\text{H}_2\text{O}$ . (Gutbier, *l. c.*)**Sodium bromorhodite**,  $\text{Na}_2\text{RhBr}_4$ .Very sol. in  $\text{H}_2\text{O}$ . (Goloubkine, *l. c.*)**Bromoruthenic acid.****Potassium bromoruthenate**,  $\text{K}_2\text{RuBr}_4$ .Very sol. in  $\text{H}_2\text{O}$ . (Howe, *J. Am. Chem. Soc.* 1904, 26. 946.)**Potassium aquobromoruthenate**,  
 $\text{K}_2\text{Ru}(\text{H}_2\text{O})\text{Br}_4$ .Ppt. (Howe, *l. c.*)**Rubidium bromoruthenate**,  $\text{Rb}_2\text{RuBr}_4$ .Sol. in  $\text{H}_2\text{O}$ . (Howe, *l. c.*)**Rubidium aquobromoruthenate**,  
 $\text{Rb}_2\text{Ru}(\text{H}_2\text{O})\text{Br}_4$ .Ppt. (Howe, *l. c.*)**Bromoruthenious acid.****Cæsium bromoruthenite**,  $\text{CsRuBr}_4 + \text{H}_2\text{O}$ .Ppt. (Howe, *J. Am. Chem. Soc.* 1904, 26. 945.)**Potassium bromoruthenite**,  $\text{K}_2\text{RuBr}_4$ .Very sol. in  $\text{H}_2\text{O}$  with decomp. Very sol. in dil.  $\text{HBr}$ . (Howe, *l. c.*)**Rubidium bromoruthenite**,  $\text{Rb}_2\text{RuBr}_4 + \text{H}_2\text{O}$ .Sol. in dil.  $\text{HBr}$ . (Howe, *l. c.*)**Bromoselenic acid.****Ammonium bromoselenate**,  $(\text{NH}_4)_2\text{SeBr}_4$ .Sol. in  $\text{H}_2\text{O}$  with decomp. (Muthmann and Schäfer, *B.* 26. 1008.)**Cæsium bromoselenate**,  $\text{Cs}_2\text{SeBr}_4$ .Sl. sol. in  $\text{H}_2\text{O}$ . (Lenher, *J. Am. Chem. Soc.* 1898, 20. 571.)**Potassium bromoselenate**,  $\text{K}_2\text{SeBr}_4$ .As  $\text{NH}_4$  salt. (M. and S.)

**Rubidium bromoselenate,  $\text{Rb}_2\text{SeBr}_4$ .**

Less sol. in  $\text{H}_2\text{O}$  than K salt. (Lenher, *l. c.*)

**Bromopyroselenious acid.****Ammonium bromopyroselenite,  $\text{NH}_4\text{Br} \cdot 2\text{SeO}_3 + 2\text{H}_2\text{O}$ .**

More easily sol. in  $\text{H}_2\text{O}$  than corresponding Cl compound. (Muthmann and Schäfer, B. 1893, 26. 1014.)

**Potassium bromopyroselenite,  $\text{KBr} \cdot 2\text{SeO}_3 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Muthmann and Schäfer, B. 26. 1008.)

**Bromosmic acid.****Ammonium bromosmate,  $(\text{NH}_4)_2\text{OsBr}_4$ .**

Only sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1899, 21. 135.)

**Cesium bromosmate,  $\text{Cs}_2\text{OsBr}_4$ .**

Nearly insol. in  $\text{H}_2\text{O}$  and dil. HBr. (Gutbier, B. 1913, 46. 2103.)

**Potassium bromosmate,  $\text{K}_2\text{OsBr}_4$ .**

Only sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim, *l. c.*)

**Rubidium bromosmate,  $\text{Rb}_2\text{OsBr}_4$ .**

Difficultly sol. in  $\text{H}_2\text{O}$  and in dil. HBr. (Gutbier, *l. c.*)

**Silver bromosmate,  $\text{Ag}_2\text{OsBr}_4$ .**

Ppt.; insol. in  $\text{H}_2\text{O}$ . (Rosenheim, *l. c.*)

**Sodium bromosmate,  $\text{Na}_2\text{OsBr}_4 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, *l. c.*)

**Bromostannic acid,  $\text{H}_2\text{SnBr}_6 + 8\text{H}_2\text{O}$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Seubert, B. 20. 794.)

**Ammonium bromostannate,  $(\text{NH}_4)_2\text{SnBr}_6$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis, A. 223. 323.)

**Cesium bromostannate.**

Sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis.)

**Calcium bromostannate,  $\text{CaSnBr}_6 + 6\text{H}_2\text{O}$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis.)

**Cobalt bromostannate,  $\text{CoSnBr}_6 + 10\text{H}_2\text{O}$ .**

Deliquescent. (Raymann and Preis.)

**Ferrous bromostannate,  $\text{FeSnBr}_6 + 6\text{H}_2\text{O}$ .**

Deliquescent. (Raymann and Preis.)

**Lithium bromostannate,  $\text{Li}_2\text{SnBr}_6 + 6\text{H}_2\text{O}$ .**

Extremely deliquescent. (Leteur, C. R. 113. 541.)

**Magnesium bromostannate,  $\text{MgSnBr}_6 + 10\text{H}_2\text{O}$ .**

Deliquescent. (Raymann and Preis.)

**Manganous bromostannate,  $\text{MnSnBr}_6 + 6\text{H}_2\text{O}$ .**

Deliquescent. (Raymann and Preis.)

**Nickel bromostannate,  $\text{NiSnBr}_6 + 8\text{H}_2\text{O}$ .**

Deliquescent. (Raymann and Preis.)

**Potassium bromostannate,  $\text{K}_2\text{SnBr}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsöe.)

**Rubidium bromostannate.**

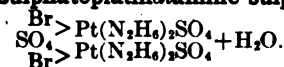
Sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis.)

**Sodium bromostannate,  $\text{Na}_2\text{SnBr}_6 + 6\text{H}_2\text{O}$ .**

Not deliquescent, but extremely sol. in  $\text{H}_2\text{O}$ . (Seubert, B. 20. 796.)

**Strontium bromostannate,  $\text{SrSnBr}_6 + 6\text{H}_2\text{O}$ .**

Very hygroscopic, and sol. in  $\text{H}_2\text{O}$ . (Raymann and Preis.)

**Bromosulphatoplatindiamine sulphate,**

Rather easily sol. in hot  $\text{H}_2\text{O}$ .

**Bromosulphobismuthous acid.****Cuprous bromosulphobismuthite,  $2\text{Cu}_3\text{S}, \text{Bi}_2\text{S}_3, 2\text{BiSBr}$ .**

Stable in the air and insol. in  $\text{H}_2\text{O}$  at ord. temp. Partially decomp. by boiling  $\text{H}_2\text{O}$ . Decomp. by mineral acids with the evolution of  $\text{H}_2\text{S}$ . (Ducatte, C. R. 1902, 134. 1212.)

**Lead bromosulphobismuthite,  $\text{PbS}, \text{Bi}_2\text{S}_3, 2\text{BiSBr}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . Decomp. by dil. mineral acids with evolution of  $\text{H}_2\text{S}$ . (Ducatte, *l. c.*)

**Bromotantalum bromide,  $(\text{Ta}_6\text{Br}_{12})\text{Br}_2 + 7\text{H}_2\text{O}$ .**

Stable in the air when in the solid state. Sol. in  $\text{H}_2\text{O}$  without decomp. Sol. in propyl alcohol. (Chapin, J. Am. Chem. Soc. 1910, 32. 328.)

**Bromotantalum chloride,  $(\text{Ta}_6\text{Br}_{12})\text{Cl}_2 + 7\text{H}_2\text{O}$ .**

(Chapin, *l. c.*)

**Bromotantalum hydroxide,  $(\text{Ta}_6\text{Br}_{12})(\text{OH})_2 + 10\text{H}_2\text{O}$ .**

Sl. sol. in HCl. Stable in the air below  $100^\circ$ .

Sol. in alcohol. Insol. in ether. (Chapin, *l. c.*)

**Bromotantalum iodide,  $(\text{Ta}_6\text{Br}_{12})\text{I}_2 + 7\text{H}_2\text{O}$ .**

(Chapin, *l. c.*)

**Bromotelluric acid.****Ammonium bromotellurate,  $(\text{NH}_4)_2\text{TeBr}_6$ .**

Less sol. in  $\text{H}_2\text{O}$  than K salt. (Muthmann and Schmidt, B. 1893, 26. 1011.)

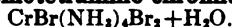


**Cæsium bromotellurate,  $\text{Cs}_2\text{TeBr}_6$ .**Decomp. by  $\text{H}_2\text{O}$ .100 pts.  $\text{HBr} + \text{Aq}$  (sp. gr. 1.49) dissolve 0.02 pt. at  $22^\circ$ .100 pts.  $\text{HBr} + \text{Aq}$  (sp. gr. 1.08) dissolve 0.13 pt. at  $22^\circ$ .

Insol. in alcohol. (Wheeler, Sill. Am. J. 145. 267.)

**Potassium bromotellurate,  $\text{K}_2\text{TeBr}_6 + 3\text{H}_2\text{O}$ .**Sol. in little, decomp. by much  $\text{H}_2\text{O}$ . (v. Hauer.)Contains  $2\text{H}_2\text{O}$ . (Wheeler, Sill. Am. J. 145. 267.)

Efflorescent.

100 pts.  $\text{HBr} + \text{Aq}$  (sp. gr. 1.49) dissolve 6.57 pts. at  $22^\circ$ .100 pts.  $\text{HBr} + \text{Aq}$  (sp. gr. 1.08) dissolve 62.90 pts. at  $22^\circ$ .*Anhydrous*. Stable on air. (Wheeler.)**Rubidium bromotellurate,  $\text{Rb}_2\text{TeBr}_6$ .**Sol. in a little hot  $\text{H}_2\text{O}$ , but  $\text{H}_2\text{TeO}_3$  separates on cooling.100 pts.  $\text{HBr} + \text{Aq}$  (sp. gr. 1.49) dissolve 0.25 pt. at  $22^\circ$ .100 pts.  $\text{HBr} + \text{Aq}$  (sp. gr. 1.08) dissolve 3.88 pts. at  $22^\circ$ . (Wheeler.)**Bromotetramine chromium bromide,**Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)**— chloride,  $\text{CrBr}(\text{NH}_3)_4\text{Cl}_2 + \text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Cleve.)**— sulphate,  $\text{CrBr}(\text{NH}_3)_4\text{SO}_4 + \text{H}_2\text{O}$ .**Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Bromotetramine cobaltic sulphate,**Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Blasberg, B. 22. 2652.)**Cadmium, Cd.**Not attacked by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but more easily in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .Chemically pure Cd like Zn is almost insol. in dil. acids, with the exception of  $\text{HNO}_3$ . (Weeren, B. 1891, 24. 1798.)Sol. in  $\text{HClO}_3 + \text{Aq}$  without evolution of H. (Hendrixson, J. Am. Chem. Soc. 1904, 26. 756.)Cadmium is sol. in molten  $\text{CdCl}_2$  and can be recryst. therefrom. (Auerbach, Z. anorg. 1901, 28. 42.)From 4 g. Cd in 32 g. molten  $\text{CdCl}_2$  at  $650^\circ$ , 2.197 g. were dissolved in  $\frac{1}{2}$  hr. (Helfenstein, Z. anorg. 1900, 23. 295.)Moderately quickly sol. in  $\text{K}_2\text{S}_2\text{O}_8 + \text{Aq}$ . More slowly sol. in  $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{Aq}$ . (Levi, Gazz. ch. it. 1908, 38 (1) 583.)Sol. in  $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{Aq}$  without evolution of gas. (Turrentine, J. phys. Chem. 1907, 11. 627.)Sol. in sulphostannates +  $\text{Aq}$ . (Storch, B. 1883, 16. 2015.) $\frac{1}{2}$  ccm. oleic acid dissolves 0.0293 g. Cd in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

Not attacked by sugar solution. (Klein and Berg, C. R. 102. 1170.)

**Cadmium amalgam,  $\text{Cd}, \text{Hg}$ .**Stable from  $0^\circ$ – $44^\circ$ . Can be cryst. from Hg without decomp. if temp. does not exceed  $44^\circ$ . (Kerp. Z. anorg. 1900, 28. 68.)**Cadmium amide,  $\text{Cd}(\text{NH}_2)_2$ .**Decomp. by  $\text{H}_2\text{O}$ . (Bohart, J. phys. Chem. 1915, 19. 543.)**Cadmium arsenide,  $\text{Cd}_3\text{As}_2$ .**

(Descamps, C. R. 86. 1022.)

 $\text{Cd}_3\text{As}_2$ . Sol. in dil. cold  $\text{HNO}_3$ . Attacked by aqua regia. (Granger, C. R. 1904, 138. 575.)**Cadmium azoimide,  $\text{Cd}(\text{N}_3)_2$ .**

Ppt. (Curtius, J. pr. 1898, (2) 58. 294.)

**Cadmium subbromide,  $\text{Cd}_2\text{Br}_3$ .**Decomp. by  $\text{H}_2\text{O}$ . (Morse and Jones, Am. Ch. J. 1890, 12. 490.)**Cadmium bromide,  $\text{CdBr}_2$ .**Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$** 

$t^\circ$	% $\text{CdBr}_2$	$t^\circ$	% $\text{CdBr}_2$
—4	32.0	48	60.0
—1	34.7	71	61.2
+1	36.3	104	61.8
2	36.0	155	63.7
9	41.9	170	65.2
14	46.0	215	69.9
25	52.6	232	70.1
35	59.6	245	71.5

Solid phase above  $100^\circ$  is  $\text{CdBr}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

(Étard, A. ch. 1894, (7) 2. 541.)

See also under  $\text{CdBr}_2 + \text{H}_2\text{O}$  and  $\text{CdBr}_2 + 4\text{H}_2\text{O}$ .Sp. gr. of  $\text{CdBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5	10	15	20	25 % $\text{CdBr}_2$ ,
1.043	1.090	1.141	1.199	1.260
30	35	40	45	50 % $\text{CdBr}_2$ .
1.326	1.400	1.481	1.578	1.680

(Kremers, calculated by Gerlach, Z. anal. 8. 280.)

 $\text{CdBr}_2 + \text{Aq}$  containing 18.06%  $\text{CdBr}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1378$ . $\text{CdBr}_2 + \text{Aq}$  containing 21.39%  $\text{CdBr}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1666$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sp. gr. of  $\text{CdBr}_2 + \text{Aq}$  containing 35.84%  $\text{CdBr}_2 = 1.4231$  at  $19.4^\circ/4^\circ$ . (Hallwachs, W. Ann. 1899, 68. 27.)

Sp. gr. of CdBr<sub>2</sub>+Aq at 18°/4°.

$\frac{1}{4}$ CdBr <sub>2</sub>	33.289	23.973	20.552	11.983
Sp. gr.	1.384	1.252	1.209	1.112
$\frac{1}{2}$ CdBr <sub>2</sub>	6.543	3.734	1.927	
Sp. gr.	1.106	1.030	1.017	

(de Muijnck, W. Ann. 1894, **53**, 561.)

Sp. gr. of CdBr<sub>2</sub>+Aq at 18°.

$\frac{1}{4}$ CdBr <sub>2</sub>	1	5	10	15	20
Sp. gr.	1.0072	1.0431	1.0907	1.1432	1.1991
$\frac{1}{2}$ CdBr <sub>2</sub>	25	30	35	40	43
Sp. gr.	1.2605	1.3296	1.4052	1.4915	1.5467

(Grottrian, W. Ann. 1883, **18**, 193.)

Sp. gr. of CdBr<sub>2</sub>+Aq.

$\frac{1}{4}$ CdBr <sub>2</sub>	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0324	17.90	0.99901	0.99900
	22.75	0.99702	
0.0748	17.23	0.99949	0.99935
	21.50	0.99863	
0.154	17.67	1.00008	1.00002
	23.10	0.99896	
0.253	17.23	1.00119	0.00100
	22.95	0.99986	
0.506	18.07	0.00308	1.00310
	22.65	1.00212	
1.013	18.00		1.00750

(Wershofen, Z. phys. Ch. 1890, **5**, 493.)

Sp. gr. of CdBr<sub>2</sub>+Aq at 20°.

Normality of CdBr <sub>2</sub> +Aq	%CdBr <sub>2</sub>	Sp. gr.
2.774	46.574	1.6198
1.997	37.53	1.4469
0.973	22.53	1.2293
0.5138	12.46	1.1211

(Forchheimer, Z. phys. Ch. 1900, **34**, 29.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, **20**, 827.)

Sol. in AlBr<sub>3</sub>. (Isbekow, Z. anorg. 1913, **84**, 27.)

Sol. in HCl+Aq, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, alcohol, or ether. (Berthelot, A. ch. **44**, 387.)

Sol. in 0.94 pt. H<sub>2</sub>O, 3.4 pts. abs. alcohol, 250 pts. ether, and 16 pts. alcohol-ether (1 : 1) (Eder, Dingl. **221**, 89.)

Anhydrous CdBr<sub>2</sub> is sol. in acetone. (Krug and M'Elroy.)

1 g. CdBr<sub>2</sub> is sol. in 64.5 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.8073. (Naumann, B. 1904, **37**, 4337.)

Sol. in acetone. (Eidmann, C. C. **1899**, II, 1014.)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, **9**, 647.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**, 314.)

Sol. in chinoline. (Beckmann and Gabel, Z. anorg. 1906, **51**, 236.)

100 g. benzonitrile dissolve 0.857 g. CdBr<sub>2</sub> at 18°. (Naumann, B. 1914, **47**, 1370.)

Mol. weight determined in piperidine. (Ferochland, Z. anorg. 1897, **15**, 17.)

+H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

100 g. of the sat. solution contain at:

35° 40° 45° 60° 80° 100°  
60.29 60.65 60.75 61.10 61.29 61.63 g. CdBr<sub>2</sub>.  
(Dietz, Z. anorg. 1899, **20**, 261.)

+1½H<sub>2</sub>O. (Étard, A. ch. 1894, (7) **2**, 541.)

+4H<sub>2</sub>O. Efflorescent. (Rammelsberg, Pogg. **55**, 241.)

Solubility in H<sub>2</sub>O.

100 g. of the sat. solution contain at:

0° 18° 30° 38°  
37.92 48.90 56.90 61.84 g. CdBr<sub>2</sub>.

Sp. gr. of sat. solution at 18° = 1.683.

(Dietz, Z. anorg. 1899, **20**, 261.)

100 g. sat. solution of CdBr<sub>2</sub>+4H<sub>2</sub>O in absolute alcohol contain 20.93 g. CdBr<sub>2</sub> at 15°.

100 g. sat. solution of CdBr<sub>2</sub>+4H<sub>2</sub>O in absolute ether contain 0.4 g. CdBr<sub>2</sub> at 15°. (Eder, Dingl. **221**, 89.)

**Cadmium hydrogen bromide.**

Decomp. by H<sub>2</sub>O. (Berthelot, C. R. **91**, 1024.)

**Cadmium caesium bromide, CdBr<sub>2</sub>, CsBr.**

Easily sol. in H<sub>2</sub>O. (Wells and Walden, Z. anorg. **6**, 270.)

CdBr<sub>2</sub>, 2CsBr. Decomp. by H<sub>2</sub>O into above comp. (W. and W.)

CdBr<sub>2</sub>, 3CsBr. Decomp. by H<sub>2</sub>O into CdBr<sub>2</sub>, CsBr. (W. and W.)

**Cadmium potassium bromide, CdBr<sub>2</sub>, KBr + ½H<sub>2</sub>O.**

Sol. in 0.79 pt. H<sub>2</sub>O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221**, 89.)

+H<sub>2</sub>O. Sol. in H<sub>2</sub>O without decomp. from 0.4°-112.5°. (Rimbach, B. 1905, **38**, 1554.)

100 pts. of the solution contain at:

0.4° 15.8° 50° 112.5°  
53.75 58.68 68.25 78.10 pts. of the salt.

CdBr<sub>2</sub>, 4KBr. Sol. in 1.40 pts. H<sub>2</sub>O at 15°; pptd. by alcohol and ether. (Eder, Dingl. **221**, 89.)

Cannot be prepared in a pure state as it is decomp. by H<sub>2</sub>O below 160°. (Rimbach, B. 1905, **38**, 1560.)

**Cadmium rubidium bromide, CdBr<sub>2</sub>, RbBr.**

Sol. in H<sub>2</sub>O without decomp. from 0.4° to 107.5°.

100 pts. of the solution contain at:

0.4° 14.5° 49.2° 107.5°  
32.65 41.87 58.54 75.77 pts. of the salt.

(Rimbach, B. 1905, **38**, 1556.)

CdBr<sub>2</sub>, 4RbBr. Sol. in H<sub>2</sub>O without decomp. from 0.5° to 114.5°.

100 pts. of the solution contain at:

0.5° 13.5° 51.5° 114.5°  
47.95 55.17 68.82 79.04 pts. of the salt.

(Rimbach, B. 1905, **38**, 1561.)

**Cadmium sodium bromide**,  $\text{CdBr}_2$ ,  $\text{NaBr} + 2\frac{1}{2}\text{H}_2\text{O}$ .

Sol. at 15° in 1.04 pts.  $\text{H}_2\text{O}$ , 3.7 pts. abs. alcohol, and 190 pts. ether (sp. gr. 0.729). (Eder, Dingl. **221**, 389.)

$3\text{CdBr}_2$ ,  $2\text{NaBr} + 6\text{H}_2\text{O}$ . Stable in conc. solutions and decomp. only by great dilution. (Jones and Knight, Am. Ch. J. 1899, **22**, 134.)

**Cadmium bromide ammonia**,  $\text{CdBr}_2$ ,  $2\text{NH}_3$ .

Can be crystallized out of warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Croft, Phil. Mag. **21**, 356.)

$\text{CdBr}_2$ ,  $3\text{NH}_3$ . (Tassily, C. R. 1897, **124**, 1022.)

$\text{CdBr}_2$ ,  $4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Croft.)

**Cadmium bromide cupric oxide**,  $\text{CdBr}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) **27**, 383.)

**Cadmium bromide hydrazine**,  $\text{CdBr}_2$ ,  $2\text{N}_2\text{H}_4$ .

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Franzen, Z. anorg. 1908, **60**, 280.)

**Cadmium bromide hydroxylamine**,  $\text{CdBr}_2$ ,  $2\text{NH}_2\text{OH}$ .

Sol. in hot  $\text{H}_2\text{O}$  with formation of a basic salt. Sol. in dil. acids. Insol. in alcohol and ether. (Adams, Am. Ch. J. 1902, **28**, 218.)

**Cadmium subchloride**,  $\text{Cd}_2\text{Cl}_3$ .

Decomp. by  $\text{H}_2\text{O}$  and by acids. (Morse and Jones, Am. Ch. J. 1890, **12**, 490.)

**Cadmium chloride**,  $\text{CdCl}_2$ .

Sol. at 20° 40° 60° 80° 100°  
in 0.71 0.72 0.72 0.70 0.67 pts.  $\text{H}_2\text{O}$ .  
(Kremers, Pogg. **103**, 57.)

Sat.  $\text{CdCl}_2 + \text{Aq}$  contains %  $\text{CdCl}_2$  at t°.

t°	% $\text{CdCl}_2$	t°	% $\text{CdCl}_2$
-7	43.5	120	63.0
+1	47.6	150	64.8
6	49.7	165	68.2
7	51.3	170	68.4
10	51.6	180	70.1
19	52.7	190	71.9
25	52.9	200	72.0
61	57.9	235	76.0
82	58.8	270	77.7

(Étard, A. ch. 1894, (7) **2**, 536.)

100 mol.  $\text{H}_2\text{O}$  dissolve at:

19.3° 29.7° 40.1° 54.5°

10.94 12.74 13.15 13.16 mol.  $\text{CdCl}_2$ .

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37**, 19.)

See also under  $\text{CdCl}_2 + \text{H}_2\text{O}$ ,  $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ , and  $\text{CdCl}_2 + 4\text{H}_2\text{O}$ .

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  containing pts.  $\text{CdCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ .

13	26.9	41	pts. $\text{CdCl}_2$ ,
1.1068	1.2106	1.3100	
55.8	72.5	114.2	pts. $\text{CdCl}_2$ .
1.4060	1.5060	1.7266	

(Kremers, Pogg. **103**, 57.)

$\text{CdCl}_2 + \text{Aq}$  containing 8.91%  $\text{CdCl}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0715$ . (Le Blanc and Rohland, Z. phys. Ch. 1896, **19**, 282.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at room temp. containing:

% $\text{CdCl}_2$	11.09	16.30	24.786
Sp. gr.	1.1093	1.1813	1.3199

(Wagner, W. Ann. 1883, **18**, 266.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $18^\circ/4^\circ$ .

% $\text{CdCl}_2$	57.524	41.547	29.977
Sp. gr.	1.852	1.515	1.330

% $\text{CdCl}_2$	21.431	14.761
Sp. gr.	1.210	1.142

(de Muijnck, W. Ann. 1894, **53**, 561.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{CdCl}_2$	1	5	10	15
Sp. gr.	1.0063	1.0436	1.0919	1.1443
% $\text{CdCl}_2$	20	25	30	35
Sp. gr.	1.2007	1.2620	1.3305	1.4075
% $\text{CdCl}_2$	40	45	50	
Sp. gr.	1.4878	1.5775	1.6799	

(Grotrian, W. Ann. 1883, **18**, 193.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CdCl}_2 + \text{Aq}$	Sp. gr.
1-normal	1.0779
$\frac{1}{2}$ -normal	1.0394
$\frac{1}{3}$ -normal	1.0197
$\frac{1}{6}$ -normal	1.0098

(Wagner, Z. phys. Ch. 1890, **5**, 36.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$ .

% $\text{CdCl}_2$	t°	Sp. gr. at t°	Sp. gr. at 18°
0.0503	17.59	0.99920	0.99910
	24.27	0.99781	
0.0999	17.70	0.99964	0.99958
	22.06	0.99833	
0.200	18.31	1.00038	1.00044
	24.00	0.99920	
0.399	16.86	1.00239	1.0022
	24.21	1.00083	
0.599	17.49	1.00406	1.0039
	25.12	1.00238	
0.769	17.58	1.00580	1.0057
	21.76	1.00496	
0.997	17.55	1.00754	1.0075
	19.65	1.00713	

(Wershofen, Z. phys. Ch. 1890, **5**, 462.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at t°.

t°	Normality of $\text{CdCl}_2 + \text{Aq}$	g. $\text{CdCl}_2$ in 100 g. of solution	Sp. gr. t°/4°
20.5	3.80	44.42	1.5645
"	2.61	34.22	1.3941
"	1.76	25.90	1.2435
"	1.29	19.91	1.1977
"	0.93	14.88	1.1404
"	0.52	8.84	1.0801

(Oppenheimer, Z. phys. Ch. 1898, **27**, 454.)

Sp. gr. of  $\text{CdCl}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Concentration of $\text{CdCl}_2 + \text{Aq}$	Sp. gr.
22	1 pt. $\text{CdCl}_2$ in 1.3458 pts. $\text{H}_2\text{O}$	1.6128
18.7	1 " " " 2.7005 " "	1.2896
17.2	1 " " " 53.988 " "	1.0155
16	1 " " " 54.18 " "	1.0152
17	1 " " " 57.479 " "	1.0136
22	1 " " " 77.232 " "	1.0076

(Hittorf, Z. phys. Ch. 1902, 39. 628.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	100 g. $\text{H}_2\text{O}$ dissolve		Solid phase
	g. $\text{CdCl}_2$	g. $\text{KCl}$	
19.3	111.30	...	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	59.59	6.70	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ $\text{KCl} + \text{H}_2\text{O}$
	26.98	11.09	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	11.61	30.04	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ , 4KCl
	1.44	34.76	$\text{CdCl}_2$ , 4KCl + KCl KCl
29.7	...	33.94	
	129.65	...	$\text{CdCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$
	97.62	0.70	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	68.23	7.08	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	47.12	9.89	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	32.67	13.06	"
	24.26	16.10	"
	15.99	25.97	"
	15.47	33.58	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ , 4KCl
	2.42	37.66	$\text{CdCl}_2$ , 4KCl + KCl KCl
40.1	...	37.21	
	133.85	...	$\text{CdCl}_2 + \text{H}_2\text{O}$
	92.15	2.70	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	51.90	11.50	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	37.91	15.21	"
	24.45	21.73	"
	18.97	35.51	"
	19.92	37.63	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ , 4KCl
	2.98	40.45	$\text{CdCl}_2$ , 4KCl + KCl KCl
	...	40.36	
54.5	133.90	...	$\text{CdCl}_2 + \text{H}_2\text{O}$
	102.15	2.32	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	44.01	18.39	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O}$
	26.13	43.78	$\text{CdCl}_2$ , $\text{KCl} + \text{H}_2\text{O} + \text{CdCl}_2$ , 4KCl
	4.20	45.52	$\text{CdCl}_2$ , 4KCl + KCl KCl
	...	43.00	

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37. 34.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	100 g. $\text{H}_2\text{O}$ dissolve		Solid phase
	g. $\text{CdCl}_2$	g. $\text{NaCl}$	
19.3	111.30	...	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	116.64	7.52	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	85.15	12.19	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	40.01	25.67	"
	5.96	36.76	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O} +$ $\text{NaCl}$ $\text{NaCl}$
29.7	...	35.84	
	129.65	...	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$
	132.67	9.63	$\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} + \text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	123.54	10.10	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	106.16	12.92	"
40.1	91.10	15.41	"
	43.74	27.46	"
	9.43	37.54	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O} +$ $\text{NaCl}$ $\text{NaCl}$
	...	35.88	
	133.85	...	$\text{CdCl}_2 + \text{H}_2\text{O}$
54.5	137.03	15.14	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	48.17	29.50	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	13.31	38.16	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O} +$ $\text{NaCl}$ $\text{NaCl}$
	...	36.18	
	133.90	...	$\text{CdCl}_2 + \text{H}_2\text{O}$
54.5	140.42	19.10	$\text{CdCl}_2 + \text{H}_2\text{O} + \text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	52.76	32.97	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O}$
	22.53	39.07	$\text{CdCl}_2$ , $2\text{NaCl} + 3\text{H}_2\text{O} +$ $\text{NaCl}$ $\text{NaCl}$
	...	36.82	

At  $34.5^\circ$ ,  $\text{CdCl}_2 + 2\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CdCl}_2 + \text{H}_2\text{O}$  and water.  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37. 28.)

Insol. in  $\text{SbCl}_3$ . (Klemensiewicz, C. A. 1909, 269.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. or sl. sol. in ethyl alcohol, furfural, acetophenone, ethyl monochloracetate, ethyl cyanacetate, ethyl oxalate, ethyl nitrate, amyl nitrite, o-nitrotoluene, pyridine, piperidine, and quinoline. Sol. in salicylic aldehyde. (Lincoln, J. phys. Chem. 1899, 3. 461.)  
Insol. in anhydrous ether. (Hampe, Ch. Z. 1887, II, 847.)

Readily sol. in alcohol.  
100 pts. absolute methyl alcohol dissolve 1.71 pts.  $\text{CdCl}_2$  at  $15.5^\circ$ .

100 pts. absolute ethyl alcohol dissolve 1.52 pts.  $\text{CdCl}_2$  at  $15.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

100 g.  $\text{CdCl}_2 + \text{CH}_3\text{OH}$  contain 1.5 g.  $\text{CdCl}_2$ .

at the critical temp. (Centnerswer, Z. phys. Ch. 1910, **72**, 437.)

Somewhat sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone; insol. in methylal. (Eidmann, C. C. 1899, II, 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Sol. in ethyl acetate. (Naumann, B. 1904, **37**, 3601.)

Difficultly sol. in ethylacetate. (Naumann, B. 1910, **43**, 314.)

Sol. in urethane. (Castoro, Z. anorg. 1899, **20**, 61.)

At 18°, 100 g. benzonitrile dissolve 0.06332 g. CdCl<sub>2</sub>. (Naumann, B. 1914, **47**, 1370.)

Insol. in toluene. (Baxter and Hines, Am. Ch. J. 1904, **31**, 222.)

Sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, **51**, 236.)

+H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

100 g. of the sat. solution contain at:

10°      20°      40°      60°

57.47   57.35   57.51   57.77

80°      100°

58.41   59.52 g. CdCl<sub>2</sub>.

110° is bpt. of the sat. solution.

(Dietz, Z. anorg. 1899, **20**, 257.)

+2½H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

100 g. of the sat. solution contain at:

—10°   0°      18°   30°   36°

44.35   47.37   52.53   56.27   57.91 g. CdCl<sub>2</sub>.

Sp. gr. of sat. solution = 1.741.

(Dietz, Z. anorg. 1899, **20**, 257.)

+4H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

100 g. of the sat. solution contain at:

—9°   0°      +10°   +15°

43.58   49.39   55.58   59.12 g. CdCl<sub>2</sub>.

(Dietz, Z. anorg. 1899, **20**, 257.)

+5H<sub>2</sub>O. (Worobieff, Z. anorg. 1898, **18**, 386.)

**Cadmium hydrogen chloride**, CdCl<sub>2</sub>, 2HCl + 7H<sub>2</sub>O.

Decomp. in air. (Berthelot, C. R. **91**, 1024.)

**Cadmium cesium chloride**, CdCl<sub>2</sub>, 2CsCl.

Easily sol. in H<sub>2</sub>O and dil. HCl + Aq; insol. in conc. HCl + Aq. (Godeffroy, B. **8**, 9.)

Nearly insol. in CsCl + Aq. (Wells and Walden, Z. anorg. **5**, 266.)

CdCl<sub>2</sub>, CsCl. Sl. sol. in H<sub>2</sub>O; nearly insol. in CdCl<sub>2</sub> + Aq. (Wells and Walden.)

**Cadmium calcium chloride**, 2CdCl<sub>2</sub>, CaCl<sub>2</sub> + 7H<sub>2</sub>O.

Rather deliquescent, and very sol. in H<sub>2</sub>O. When ignited is only sl. sol. in H<sub>2</sub>O with evolution of heat. (v. Hauer, J. pr. **63**, 432.)

CdCl<sub>2</sub>, 2CaCl<sub>2</sub> + 12H<sub>2</sub>O. Very deliquescent. (v. Hauer.)

**Cadmium cobaltous chloride**, 2CdCl<sub>2</sub>, CoCl<sub>2</sub> + 12H<sub>2</sub>O.

Deliquescent. Sol. in H<sub>2</sub>O. (v. Hauer, W. A. B. **17**, 331.)

**Cadmium cupric chloride**, CdCl<sub>2</sub>, CuCl<sub>2</sub> + 4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (v. Hauer, W. A. B. **17**, 331.)

**Cadmium hydrazine chloride**, CdCl<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>.HCl.

Unstable in the air when moist. Very sol. in H<sub>2</sub>O; sl. sol. in alcohol; sol. in NH<sub>3</sub> + Aq. (Curtius, J. pr. 1894, (2) **50**, 334.)

CdCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.HCl + 4H<sub>2</sub>O. Very sol. in H<sub>2</sub>O; sl. sol. in alcohol. (Curtius, J. pr. 1894, (2) **50**, 335.)

**Cadmium iron (ferrous) chloride**, 2CdCl<sub>2</sub>, FeCl<sub>2</sub> + 12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (v. Hauer, W. A. B. **17**, 331.)

**Cadmium lithium chloride**, CdCl<sub>2</sub>, LiCl + 3½H<sub>2</sub>O.

Very deliquescent. Decomp. by solution in H<sub>2</sub>O, but not in alcohol. (Chassevant, A. ch. (6) **30**, 39.)

**Cadmium magnesium chloride**, 2CdCl<sub>2</sub>, MgCl<sub>2</sub> + 12H<sub>2</sub>O.

Deliquescent in moist, stable in dry air. Easily sol. in H<sub>2</sub>O with absorption of heat. Much more sol. in hot than in cold H<sub>2</sub>O. (v. Hauer.)

Solubility in H<sub>2</sub>O at t°.

t°	G. Cd <sub>2</sub> MgCl <sub>2</sub> in 100 g. solution	G. Cd <sub>2</sub> MgCl <sub>2</sub> in 100 g. H <sub>2</sub> O
2.4	45.61	83.86
20.8	49.69	98.77
45.5	53.51	115.10
67.2	58.14	138.90
121.8	65.48	189.69

(Rimbach, B. 1897, **30**, 3084.)

CdCl<sub>2</sub>, 2MgCl<sub>2</sub> + 12H<sub>2</sub>O. Very deliquescent. (v. Hauer.)

**Cadmium manganese chloride**, 2CdCl<sub>2</sub>, MnCl<sub>2</sub> + 12H<sub>2</sub>O.

Deliquescent in moist, efflorescent in dry air. Sol. in H<sub>2</sub>O. (v. Hauer.)

**Cadmium nickel chloride**, CdCl<sub>2</sub>, 2NiCl<sub>2</sub> + 12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (v. Hauer, W. A. B. **20**, 40.)

2CdCl<sub>2</sub>, NiCl<sub>2</sub> + 12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (v. Hauer.)

**Cadmium potassium chloride**, CdCl<sub>2</sub>, KCl + ½H<sub>2</sub>O.

Sol. in H<sub>2</sub>O without decomp. (v. Hauer.)

+H<sub>2</sub>O. 100 mol. H<sub>2</sub>O dissolve at:  
19.3° 29.7° 40.1° 54.5°  
2.65 3.21 3.72 4.33 mol. CdCl<sub>2</sub>, KCl+H<sub>2</sub>O.  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37**, 26.)

Solubility in H<sub>2</sub>O at t°.

t°	G. CdKCl <sub>2</sub> in 100 g. solution	G. CdKCl <sub>2</sub> in 100 g. H <sub>2</sub> O
2.6	21.87	27.99
15.9	26.60	36.4
41.5	35.66	55.34
60.6	40.67	68.55
106.1	51.67	106.91

(Rimbach, B. 1897, **30**, 3079.)

CdCl<sub>2</sub>, 2KCl. 100 pts. H<sub>2</sub>O at 15.5° dissolve 33.45 pts. Sl. sol. in alcohol. (Croft, Phil. Mag. (3) **21**, 356.)

Solubility in salts+Aq at 16°.  
CdCl<sub>2</sub>, 2KCl is sol. without decomp. in the following salt solutions at 16°.

Salt	Mols. salt in 100 mole H <sub>2</sub> O	In 1 litre of the solution mole			Sp. gr. of the solution
		CdCl <sub>2</sub>	KCl	RCl	
LiCl	9.3	0.166	0.663	4.483	1.1380
CaCl <sub>2</sub>	3.8	0.270	1.080	1.887	1.2333
KCl	2.378	0.507	3.195	...	1.214

(Rimbach, B. 1905, **38**, 1568.)

CdCl<sub>2</sub>, 4KCl. More sol. in H<sub>2</sub>O than CdCl<sub>2</sub>, KCl. (v. Hauer.)  
100 g. H<sub>2</sub>O dissolve at:

19.3° 29.7° 40.1° 54.5°  
41.65 49.05 57.55 69.91 g. CdCl<sub>2</sub>, 4KCl.  
(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37**, 24.)

Solubility in H<sub>2</sub>O at t°.

t°	100 pts. solution contain pts.		
	Cd	Cl	K
4.0	3.64	9.84	8.31
23.6	5.66	14.02	11.52
50.2	9.10	18.09	13.60
108.8	11.97	23.08	17.10
109.0	11.91	23.15	17.22

(Rimbach, B. 1897, **30**, 3080.)

Decomp. by H<sub>2</sub>O.

Can be recryst. without decomp. from LiCl, CaCl<sub>2</sub>, or MgCl<sub>2</sub>+Aq. (Rimbach, B. 1905, **38**, 1565.)

The salt is sol. without decomp. in HCl+Aq containing 19.8 mole HCl per 100 mole H<sub>2</sub>O at 16°.

1 l. of the solution contains 0.033 mole CdCl<sub>2</sub>, 0.132 mole KCl and 8.828 mole HCl; sp. gr. of the solution = 1.1403. (Rimbach, B. 1905, **38**, 1568.)

**Cadmium rubidium chloride**, CdCl<sub>2</sub>, 2RbCl.  
Sol. in H<sub>2</sub>O and HCl+Aq. (Godeffroy, B. **8**, 9.)  
CdCl<sub>2</sub>, RbCl. Solubility in H<sub>2</sub>O at t°.  
100 pts. by wt. of the solution contain pts. by wt. RbCl, CdCl<sub>2</sub>.

t°	Pts. RbCl, CdCl <sub>2</sub>
1.2	12.97
14.5	16.80
41.4	25.31
57.6	30.83
103.9	46.62

CdCl<sub>2</sub>, RbCl is sol. in H<sub>2</sub>O without decomp. from 0-104°. (Rimbach, B. 1902, **35**, 1303.)

CdCl<sub>2</sub>, 4RbCl.

Solubility of CdCl<sub>2</sub>, 4RbCl and CdCl<sub>2</sub>, RbCl in H<sub>2</sub>O at t°.

t°	In 100 pts. by wt. of the solution			Composition of the solid phase	
	Pts. by wt. Cd	Pts. by wt. Cl	Pts. by wt. Rb	Mol.-% mono-salt	Mol.-% tetra-salt
0.7	0.65	6.52	14.73	30	70
8.8	1.07	7.37	16.13	24	76
13.8	1.32	7.86	16.93	16	84
42.4	3.21	11.35	22.45	14	86
59.0	4.61	13.41	25.31	33	67
108.4	8.94	18.57	31.15	..	..

(Rimbach, B. 1902, **35**, 1305.)

Decomp. by H<sub>2</sub>O between 0° and 108°. (Rimbach, B. 1905, **38**, 1571.)

Sol. in conc. HCl without decomp. (Rimbach, B. 1905, **38**, 1571.)

Not sol. in CaCl<sub>2</sub>+Aq and LiCl+Aq without decomp. (Rimbach, B. 1905, **38**, 1571.)

**Cadmium sodium chloride**, CdCl<sub>2</sub>, 2NaCl+3H<sub>2</sub>O.

Sol. in 1.4 pts. H<sub>2</sub>O at 16°. (Croft.)

100 mol. H<sub>2</sub>O dissolve at:

19.3° 29.7° 40.1° 54.5°  
3.93 4.29 4.73 5.18 mol. CdCl<sub>2</sub>, 2NaCl+3H<sub>2</sub>O.

Stable between 19° and 55°.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, **37**, 25.)

Sl. sol. in alcohol or wood alcohol. (Croft.)

**Cadmium strontium chloride**, 2CdCl<sub>2</sub>, SrCl<sub>2</sub>+7H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (v. Hauer.)

**Cadmium chloride ammonia**, CdCl<sub>2</sub>, 2NH<sub>3</sub>.

Nearly insol. in H<sub>2</sub>O. (v. Hauer.)

CdCl<sub>2</sub>, 3NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.

CdCl<sub>2</sub>, 4NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.

CdCl<sub>2</sub>, 5NH<sub>3</sub>. (André, C. R. **104**, 908.)

CdCl<sub>2</sub>, 6NH<sub>3</sub>. Difficultly sol. in cold H<sub>2</sub>O. (Schüler, A. **87**, 34.)

**Cadmium chloride cupric oxide**,  $\text{CdCl}_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$ .

Not decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 378 and 174.)

**Cadmium chloride hydrazine**,  $\text{CdCl}_2 \cdot 2\text{N}_2\text{H}_4$ . Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Franzen, Z. anorg. 1908, 60. 279.)

+ $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Curtius, J. pr. 1894, (2) 50. 345.)

**Cadmium chloride hydroxylamine**,  $\text{CdCl}_2 \cdot 2\text{NH}_2\text{OH}$ .

Sl. sol. in cold, somewhat more in warm  $\text{H}_2\text{O}$ . Very sol. in hydroxylamine + Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) 3. 116.)

Aq solution sat. at  $20^\circ$  contains about 1%. (Antonoff, C. C. 1905, II. 810.)

**Cadmium fluoride**,  $\text{CdF}_2$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HF} + \text{Aq}$ . (Berselius, Pogg. 1. 26.)

Very sol. in  $\text{H}_2\text{O}$ ; insol. in 95% alcohol; sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$  with evolution of  $\text{HF}$ . (Poulenc, C. R. 116. 582.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.289 mol.  $\text{CdF}_2$  at  $25^\circ$ , or 100 cc. sat. aqueous solution contains 4.36 g.  $\text{CdF}_2$  at  $25^\circ$ . (Jaeger, Z. anorg. 1901, 27. 35.)

1 l. of 1.08-N  $\text{HF}$  dissolves 0.372 mol.  $\text{CdF}_2$  at  $25^\circ$ . (Jaeger, Z. anorg. 1901, 27. 35.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

**Cadmium ceric fluoride**,  $\text{CdF}_2 \cdot 2\text{CeF}_4 + 7\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, A. 1909, 368. 106.)

**Cadmium columbium fluoride**.

See Fluocolumbate, cadmium.

**Cadmium molybdenyl fluoride**.

See Fluoxymolybdate, cadmium.

**Cadmium silicon fluoride**.

See Fluosilicate, cadmium.

**Cadmium stannic fluoride**.

See Fluostannate, cadmium.

**Cadmium titanium fluoride**.

See Fluotitanate, cadmium.

**Cadmium zirconium fluoride**.

See Fluozirconate, cadmium.

**Cadmous hydroxide**,  $\text{CdOH}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids into cadmic salt. (Morse and Jones, Am. Ch. J. 12. 488.)

**Cadmium hydroxide**,  $\text{CdO}_2\text{H}_2$ .

Insol. in  $\text{H}_2\text{O}$ .

1 l.  $\text{CdO}_2\text{H}_2 + \text{Aq}$  contains 0.0026 g.  $\text{CdO}_2\text{H}_2$

at  $25^\circ$ . (Bodländer, Z. phys. Ch. 1898, 27. 66.)

Solubility in  $\text{H}_2\text{O} = 2.6 \times 10^{-4}$ . (Herz, Z. anorg. 1900, 24. 126.)

Sol. in acids; very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Easily sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4$  succinate + Aq. (Wittstein.)

Freshly pptd.  $\text{CdO}_2\text{H}_2$  is sol. in alkali haloids + Aq. (Bersch, Z. phys. Ch. 1891, 8. 392.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  increases with increase in concentration of  $\text{NH}_4\text{OH}$ . (Euler, B. 1903, 36. 3401.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

$\text{NH}_3$ norm.	g. $\text{CdO}$ per l.
0.5	0.24
1.0	0.62
1.8	1.33
4.6	4.92

(Bonsdorff, Z. anorg. 1904, 41. 187.)

Insol. in ethyl, and methyl amine + Aq. (Wurtz.)

Very sl. sol. in  $\text{HCN} + \text{Aq}$  even when freshly pptd. (Schüller, A. 87. 48.)

Not pptd. in presence of Na citrate (Spiller), and many non-volatile organic substances. (Rose.)

**Cadmium iodide**,  $\text{CdI}_2$ .

Sol. in 1.13 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Eder, Dingl. 221. 89.)

Sol. at  $20^\circ$   $40^\circ$   $60^\circ$   $80^\circ$   $100^\circ$   
in 1.08 1.00 0.93 0.86 0.75 pts.  $\text{H}_2\text{O}$ .

(Kremers, Pogg. 103. 57.)

Sat.  $\text{CdI}_2 + \text{Aq}$  contains at:

$-4^\circ$	$+2^\circ$	$+10^\circ$	$13^\circ$	$24^\circ$	$32^\circ$
42.4	43.7	45.2	44.8	46.5	47.4% $\text{CdI}_2$
54°	64°	76°	94°	95°	135°
49.5	50.1	52.4	55.1	54.7	62.9% $\text{CdI}_2$
140°	165°	185°	202°	202°	255°
63.1	68.1	70.7	73.4	73.2	84.5% $\text{CdI}_2$

(Étard, A. ch. 1894, (7) 2. 545.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$0^\circ$	$18^\circ$	$50^\circ$	$75^\circ$	$100^\circ$
44.39	46.02	49.35	52.65	56.08 g. $\text{CdI}_2$

(Diets, Z. anorg. 1899, 20. 262.)

Sp. gr. of  $\text{Cd I}_2 + \text{Aq}$  containing pts.  $\text{CdI}_2$  to 100 pts.  $\text{H}_2\text{O}$ .

21.4	43.7	88.5 pts. $\text{CdI}_2$
1.1681	1.328	1.6139

(Kremers, Pogg. 111. 60.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:  
 5 10 15 20 25 % $\text{CdI}_2$ ,  
 1.044 1.068 1.138 1.194 1.253  
 30 35 40 45 50 % $\text{CdI}_2$ .  
 1.319 1.395 1.476 1.575 1.680  
 (Kremers, calculated by Gerlach, Z. anal.  
 8. 285.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$  at  $18^\circ$ .  
 %  $\text{CdI}_2$  1 5 10 15 20  
 Sp. gr. 1.0071 1.0425 1.0883 1.1392 1.1943  
 %  $\text{CdI}_2$  25 30 35 40 45  
 Sp. gr. 1.2550 1.3228 1.4000 1.4816 1.5741  
 (Grottrian, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$ .

g. $\text{CdI}_2$ per l.	Sp. gr.	g. $\text{CdI}_2$ per l.	Sp. gr.
98.85	1.08	289.5	1.237
197.7	1.162	400	1.328

(Barbier and Roux, Bull. Soc. 1890, (3) 3. 425.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$ .

% $\text{CdI}_2$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0429	17.68	0.99915	0.99908
	22.88	0.99807	
0.100	17.55	0.99965	0.99956
	22.91	0.99363	
0.204	17.76	1.00052	1.0005
	22.79	0.99948	
0.399	17.40	0.00223	1.0021
	24.30	1.00082	
0.600	18.00		1.0038
0.800	17.44	1.00564	1.0056
	23.11	1.00442	
1.00	18.00		1.0072

(Wershofen, Z. phys. Ch. 1890, 5. 493.)

Sp. gr.  $\text{CdI}_2 + \text{Aq}$  at  $18^\circ/4^\circ$  containing:  
 31.123 13.677 9.559 %  $\text{CdI}_2$ .  
 1.338 1.125 1.066

(de Muijnck, W. Ann. 1894, 53. 561.)

$\text{CdI}_2 + \text{Aq}$  containing 10.97%  $\text{CdI}_2$  has sp. gr.  $20^\circ/20^\circ = 1.0982$ .

$\text{CdI}_2 + \text{Aq}$  containing 16.53%  $\text{CdI}_2$  has sp. gr.  $20^\circ/20^\circ = 1.1582$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sp. gr. of  $\text{CdI}_2 + \text{Aq}$  at  $20^\circ$ .

Normality of $\text{CdI}_2 + \text{Aq}$	% $\text{CdI}_2$	Sp. gr.
1.924	44.53	1.5807
0.951	27.07	1.2837
0.447	14.40	1.1355
0.211	7.26	1.0630

(Forchheimer, Z. phys. Ch. 1900, 34. 29.)

$\text{CdI}_2 + \text{Aq}$  containing 1 pt.  $\text{CdI}_2$  in 2.2691 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  has sp. gr. = 1.3341. (Hittorf, Z. phys. Ch. 1902, 39. 628.)

Sol. in sat.  $\text{HI} + \text{Aq}$ .

Sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Difficultly sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)

Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 215.)

Sol. in 15 pts. alcohol. (Vogel, N. Rep. Pharm. 12. 393.)

Sol. in 0.98 pt. abs. alcohol. (Eder, Dingl. 221. 89.)

Sp. gr. of  $\text{CdI}_2 + \text{alcohol}$ .

% $\text{CdI}_2$	Sp. gr. $20^\circ/20^\circ$
0	0.7949
7.28	0.8470

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 284.)

Sol. in 5.2 mols. methyl, 7 mols. ethyl, and 9.8 mols. propyl alcohol at  $20^\circ$ . (Timofejew, C. R. 112. 1224.)

Sol. in 3.6 pts. ether. (Eder, l. c.)

Sol. in 2.0 pts. alcohol-ether (1 : 1). (Eder, l. c.)

Very sl. sol. in anhydrous abs. ether. (Hampe, Ch. Z. 1887, 11. 847.)

100 g. of sat. solution in abs. ether contain 0.143 g.  $\text{CdI}_2$  at  $12^\circ$ . (Tyrer, Proc. Chem. Soc. 1911, 27. 142.)

Solubility in ether +  $\text{Aq}$  at  $12^\circ$ .

% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$	% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$	% $\text{H}_2\text{O}$ in ether	% $\text{CdI}_2$
0.0	0.143	0.50	3.36	1.00	7.30
0.10	0.78	0.70	4.77	1.10	8.27
0.30	2.07	0.90	6.46	1.14	8.68

(Tyrer, Proc. Chem. Soc. 27. 142.)

Solubility in benzene at  $16^\circ = 0.01\%$

" 35° = 0.02%

Solubility in ethyl ether at  $0^\circ = 0.03\%$

" 15.5° = 0.04%

" 20.3° = 0.05%

(Linebarger, Am. J. Sci. 1895, (3) 49. 52.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

1 g.  $\text{CdI}_2$  is sol. in 4 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.994$ . (Nau-mann, B. 1904, 37. 4338.)

Sp. gr. of  $\text{CdI}_2 + \text{acetone}$ .

% $\text{CdI}_2$	Sp. gr. $20^\circ/20^\circ$
0	0.7998
12.02	0.8929

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 284.)



Sol. in chinolin. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

100 g. benzonitrile dissolve 1.6295 g.  $\text{CdI}_2$  at  $18^\circ$ . (Naumann, B. 1914, 47. 1370.)

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)

Sl. sol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1849, 6. 257.)

Solubility in methyl acetate = 0.7–1.5%; 2.1% at bpt. (Schröder and Steiner, J. pr. 1909, (2) 79. 49.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

1 pt. is sol. in 54.3 pts. ethyl acetate at  $18^\circ$ .

The sat. solution has  $D_{18^\circ/4^\circ} = 0.9145$ . (Naumann, B. 1910, 43. 318.)

Insol. in mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

Mol. weight determined in piperidine, pyridine, methyl and ethyl sulphide. (Werner, Z. anorg. 1897, 15. 17.)

**Cadmium hydrogen iodide,  $\text{CdI}_2 \cdot \text{HI} + 3\text{H}_2\text{O}$ .**

Decomp. in air. (Dobroserdow, C. C. 1900, II. 527.)

**Cadmium caesium iodide,  $\text{CdI}_2 \cdot \text{CsI} + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  without decomp. (Wells and Walden, Z. anorg. 5. 271.)

$\text{CdI}_2 \cdot 2\text{CsI}$ . As above.

$\text{CdI}_2 \cdot 3\text{CsI}$ . Decomp. by  $\text{H}_2\text{O}$  into the above salt.

**Cadmium hydrazine iodide,  $\text{CdI}_2 \cdot 2\text{N}_2\text{H}_4\text{HI}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Ferratini, C. A. 1912. 1612.)

**Cadmium mercuric iodide.**

Very sol. in  $\text{H}_2\text{O}$ . (Berthémot, J. Pharm. 14. 613.)

$\text{CdI}_2 \cdot 3\text{HgI}_2$ . Sol. in  $\text{H}_2\text{O}$ . Can be recrystallized in alcohol. (Clarke and Kebler, Am. Ch. J. 5. 235.)

**Cadmium potassium iodide,  $\text{CdI}_2 \cdot \text{KI} + \text{H}_2\text{O}$ .**

Sol. in 0.94 pt.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Eder, Dingl. 221. 89.)

$\text{CdI}_2 \cdot 2\text{KI} + 2\text{H}_2\text{O}$ . Deliquescent. Extremely sol. in  $\text{H}_2\text{O}$ . Sol. at  $15^\circ$  in 0.73 pt.  $\text{H}_2\text{O}$ . Sl. sol. in alcohol and wood spirit, but less than  $\text{CdI}_2$ . (Croft.)

Sol. at  $15^\circ$  in 1.4 pts. absolute alcohol, 24.5 pts. ether (0.729 sp. gr.), and 4.5 pts. alcohol-ether (1:1). (Eder, l. c.)

Sp. gr. of  $\text{K}_2\text{CdI}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{K}_2\text{CdI}_4$	1	5	10	15	20
Sp. gr.	1.0065	1.0384	1.0808	1.1269	1.1770

% $\text{K}_2\text{CdI}_4$	25	30	35	40	45
Sp. gr.	1.2313	1.2890	1.3557	1.4282	1.5065

(Grottrian, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{K}_2\text{CdI}_4 + \text{Aq}$ .

% $\text{K}_2\text{CdI}_4$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0328	18		0.99895
0.0596	18		0.99921
0.0804	18		0.99938
0.100	17.12	0.99962	0.99945
	21.82	0.99872	
0.250	18		1.0007
0.500	18		1.0027
1.003	17.32	1.0068	1.0067
	20.63	1.0061	

(Wershofen, Z. phys. Ch. 1890, 5. 493.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Cadmium sodium iodide,  $\text{CdI}_2 \cdot 2\text{NaI} + 6\text{H}_2\text{O}$ .**

Deliquescent. (Croft.)

Sol. at  $15^\circ$  in 0.63 pt.  $\text{H}_2\text{O}$ , 0.86 pt. abs. alcohol, and 10.1 pts. ether (sp. gr. 0.729). (Eder, Dingl. 221. 89.)

**Cadmium strontium iodide,  $\text{CdI}_2 \cdot \text{SrI}_2 + 8\text{H}_2\text{O}$ .**

Deliquesces in moist, effloresces in dry air; sol. in  $\text{H}_2\text{O}$ . (Croft.)

**Cadmium iodide ammonia,  $\text{CdI}_2 \cdot 2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg.)

$\text{CdI}_2 \cdot 4\text{NH}_3$ . (Dawson and McCrae, Chem. Soc. 1900, 77. 1246.)

$\text{CdI}_2 \cdot 6\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ ; sol. in warm, less sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg.)

**Cadmium iodide hydrazine,  $\text{CdI}_2 \cdot 2\text{N}_2\text{H}_4$ .**

Easily sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Franzen, Z. anorg. 1908, 60. 281.)

**Cadmium iodide hydroxylamine,  $\text{CdI}_2 \cdot 3\text{NH}_2\text{OH}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in ether. (Adams, Am. Ch. J. 1902, 28. 218.)

**Cadmium iodide selenide,  $\text{CdI}_2 \cdot 3\text{CdSe}$ .**

Easily decomp. (Fonsses-Diacon, C. R. 1900, 131. 897.)

**Cadmium iodosulphide,  $\text{CdI}_2 \cdot 2\text{CdS}$ .**

Ppt. (Naumann, B. 1904, 37. 4338.)

**Cadmium suboxide,  $\text{Cd}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ , acids and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Tanatar, Z. anorg. 1901, 27. 433.)

$\text{Cd}_2\text{O}$ . Properties as cadmous hydroxide. (Morse and Jones.)

**Cadmium oxide,  $\text{CdO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Easily sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , less in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett, 1837.)

Insol. in KOH, NaOH,  $K_2CO_3$ , and  $Na_2CO_3$  + Aq.

See also Cadmium hydroxide.

Solubility in (calcium sucate + sugar) + Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.22 g. CdO.

1 l. solution containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.48 g. CdO.

(Bodenbender, J. B. 1865, 600.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37, 3601.)

**Cadmium peroxide,  $Cd_3O_2$  or  $Cd_2O_3$ (?).**

(Haas.)

$CdO_2$ ,  $Cd(OH)_2$ . (Kouriloff, A. ch. (6) 23, 431.)

Very stable towards  $H_2O$ . Insol. in  $NH_4OH$  + Aq. (Haas, B. 1884, 17, 2253.)

$4CdO_2$ ,  $Cd(OH)_2$ . Ppt. Insol. in NaOH + Aq. (Eykmann, C. C. 1906, I, 1629.)

$5CdO_2$ ,  $CdO + 3H_2O$ . Ppt. (Teletow, C. A. 1912, 43.)

**Cadmium oxybromide,  $CdO$ ,  $CdBr_2 + H_2O$ .**

Decomp. by  $H_2O$ . (Tassily, C. R. 1897, 124, 1023.)

+  $2H_2O$ . Stable in dry air; insol. in  $H_2O$ . (Tassily, C. R. 1897, 124, 1022.)

+  $3H_2O$ . Slowly decomp. by  $H_2O$ . (Tassily, C. R. 1897, 124, 1022.)

+  $7H_2O$ . (Mailhe, C. R. 1901, 132, 1561.)

**Cadmium oxychloride,  $CdCl_2$ ,  $CdO + H_2O$ .**

Sl. sol. in hot  $H_2O$ . (Habermann, M. Ch. 5, 432.)

+  $7H_2O$ . (Mailhe, Bull. Soc. 1901, (3) 25, 791.)

$2CdO$ ,  $CdCl_2$ . Insol. in  $H_2O$ , but slowly decomp. thereby. (Canzoneri, Gazz. ch. it. 1897, 27, (2) 486.)

**Cadmium oxyiodide,  $CdO$ ,  $CdI_2 + H_2O$ .**

Decomp. by  $H_2O$ . (Tassily, C. R. 1897, 124, 1023.)

+  $3H_2O$ . Stable in dry air; insol. in  $H_2O$ . (Tassily, C. R. 1897, 124, 1022.)

**Cadmium phosphide,  $Cd_3P_2$ .**

Sol. in HCl + Aq with evolution of  $PH_3$ . (Stromeyer.)

$Cd_3P_2$ . Sol. in conc. HCl + Aq. (Emmerling, B. 12, 152.)

Easily decomp. by acids. (Kulisch, A. 231, 327.)

$CdP_2$ . Decomp. by boiling conc. HCl + Aq. (Renault, C. R. 78, 283.)

**Cadmium selenide,  $CdSe$ .**

Sol. in HCl + Aq. (Uelsmann, A. 116, 122.)

Easily decomp. by acids. (Fonzes-Diacon, C. R. 1900, 131, 897.)

**Cadmium sulphide,  $CdS$ .**

Insol. in  $H_2O$ .

Solubility in  $H_2O$  at  $16-18^\circ = 6.6 \times 10^{-4}$  mols. per l. (Biltz, Z. phys. Ch. 1907, 58, 291.)

1 l.  $H_2O$  dissolves  $9.00 \times 10^{-4}$  mols.  $CdS$  (artificial greenockite) at  $18^\circ$ .

1 l.  $H_2O$  dissolves  $8.86 \times 10^{-4}$  mols. pptd.  $CdS$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 53, 294.)

Difficultly sol. in hot dil. HCl + Aq. Easily sol. in cold conc. HCl + Aq. (Stromeyer.) Sol. in  $HNO_3$  + Aq (Meissner), and boiling dil.  $H_2SO_4$  + Aq (1 : 6). (A. W. Hoffmann, A. 115, 286.) Very sl. sol. in  $NH_4OH$  + Aq. (Wackenroder, Repert. 46, 226.) Insol. in KOH, or  $(NH_4)_2S$  + Aq. Appreciably sol. in an acid solution of  $NH_4Cl$ . (Baxter and Hines, Z. anorg. 1905, 44, 160.)

Much more sol. in  $(NH_4)_2S$  + Aq than usually supposed. (Ditte, C. R. 85, 402.) Solubility increases by warming, and at  $68^\circ$  is twice that at ordinary temperatures. A sat. solution of  $(NH_4)_2S$  dissolves about 2 g.  $CdS$  to a litre. Alkali sulphides dissolve much less. (Ditte.)

Fresenius (Z. anal. 20, 236) could not confirm the above. According to Fresenius,  $CdS$  is not appreciably sol. in  $(NH_4)_2S$  + Aq.

Insol. in  $Na_2SO_3$  or KCN + Aq. (Fresenius.)

Insol. in  $NH_4Cl$  or  $NH_4NO_3$  + Aq. (Brett.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, -stannates + Aq. (Storch, B. 16, 2015.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

Min. *Greenockite*. Sol. in HCl + Aq.

**Colloidal.**—Solution of 4 g. colloidal C in a litre  $H_2O$  remains transparent several days. If it contains 11 g.  $CdS$  in a litre, it is completely coagulated in 24 hours. Solutions of salts of the following concentration cause an immediate coagulation in an aqueous solution of  $CdS$  containing 3.62 g. in a litre.

KCl	1 : 1615
KBr	1 : 727
KI	1 : 57
KCN	1 : 166
KClO <sub>4</sub>	1 : 1666
KNO <sub>3</sub>	1 : 1000
K <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	1 : 5000
K <sub>2</sub> SO <sub>4</sub>	1 : 833
K <sub>2</sub> Fe(CN) <sub>6</sub>	1 : 166
K <sub>4</sub> Fe(CN) <sub>6</sub>	< 1 : 100
K <sub>2</sub> CrO <sub>4</sub>	1 : 400
K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	1 : 3571
NaCl	1 : 2666
Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	1 : 98
NaHCO <sub>3</sub>	1 : 333
Na <sub>2</sub> CO <sub>3</sub>	1 : 166
Na <sub>2</sub> HPO <sub>4</sub>	1 : 202

NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> . . .	1 : 2451
Na benzoate . . .	1 : 10,000
(NH <sub>4</sub> ) <sub>2</sub> C <sub>2</sub> O <sub>4</sub> . . .	1 : 588
BaCl <sub>2</sub> . . .	1 : 11,764
Ba(NO <sub>3</sub> ) <sub>2</sub> . . .	1 : 8032
BaS <sub>2</sub> O <sub>4</sub> . . .	1 : 5617
MgSO <sub>4</sub> . . .	1 : 41,666
MnSO <sub>4</sub> . . .	1 : 22,222
CdSO <sub>4</sub> . . .	1 : 250,000
Cd(NO <sub>3</sub> ) <sub>2</sub> . . .	1 : 285,714
Pb(ClO <sub>4</sub> ) <sub>2</sub> . . .	1 : 209
Pb(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> . . .	1 : 147,058
Hg(CN) <sub>2</sub> . . .	< 1 : 20
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> . . .	1 : 232,558
Alum . . .	1 : 192,377
Chrom. alum . . .	1 : 42,555
HCl . . .	1 : 4807
H <sub>2</sub> SO <sub>4</sub> . . .	1 : 8000
HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> . . .	1 : 15
H <sub>2</sub> C <sub>2</sub> O <sub>4</sub> . . .	1 : 23,255
Succinic acid . . .	< 1 : 100
Tartaric acid . . .	1 : 333

(Prost, Belg. Acad. Bull. (3) 14. 312; J. B. 1887. 537.)

#### Cadmium pentasulphide, CdS<sub>5</sub>.

Insol. in H<sub>2</sub>O. (Schiff, A. 115. 74.)

Mixture of CdS and S. (Follenius, Z. anal. 13. 412.)

#### Cadmium potassium sulphide, K<sub>2</sub>Cd<sub>2</sub>S<sub>4</sub>.

(Milbauer, Z. anorg. 1904, 42. 439.)

#### Cadmium sodium sulphide, 3CdS, Na<sub>2</sub>S.

Decomp. by H<sub>2</sub>O. (Schneider, J. pr. (2) 8. 29.)

#### Cadmium sulphiodide.

See Cadmium iodosulphide.

#### Cadmium telluride, CdTe.

Not attacked by dil. acids. Attacked in the cold only by HNO<sub>3</sub>. (Tibbals, J. Am. Chem. Soc. 1909, 31. 908.)

#### Cadmic acid.

#### Potassium cadmate.

Insol. in H<sub>2</sub>O, but gradually decomp. when in contact therewith. (Meunier, C. R. 63. 330.)

#### Cæsium, Cs.

Decomp. H<sub>2</sub>O with great violence. (Setterberg, A. 211. 100.)

Very sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

#### Cæsium acetylide acetylene, Cs<sub>2</sub>C<sub>2</sub>, C<sub>2</sub>H<sub>2</sub>.

Insol. in C<sub>2</sub>H<sub>2</sub> and in CHCl<sub>3</sub>. (Moissan, C. R. 1903, 136. 1218.)

#### Cæsium amide, CsNH<sub>2</sub>.

Decomp. by H<sub>2</sub>O. Very sol. in liquid NH<sub>3</sub>. (Rengade, C. R. 1905, 140. 1185.)

#### Cæsium ammonia, Cs.NH<sub>3</sub>.

Sol. in liquid NH<sub>3</sub>. (Moissan, C. R. 1903, 136. 1177.)

#### Cæsium azoimide, CsN<sub>3</sub>.

Deliquescent. Stable in aq. solution.

224.2 pts. sol. in 100 pts. H<sub>2</sub>O at 0°  
307.4 " " " 100 " H<sub>2</sub>O " 16°  
1.0366 " " " 100 " abs. alcohol " 16°

Insol. in pure ether. (Curtius, J. pr. 1898, (2) 56. 283.)

#### Cæsium bromide, CsBr.

Ppt. (Chabrié, C. R. 1901, 132. 679.)

Sat. CsBr + Aq at 25° contains 55.23% CsBr. (Foote, Am. Ch. J. 1907, 37. 125.)

#### Cæsium tribromide, CsBr<sub>3</sub>.

Sol. in H<sub>2</sub>O; decomp. by alcohols. (Wells, Sill. Am. J. 143. 17.)

#### Cæsium pentabromide, CsBr<sub>5</sub>.

Very unstable. (Wells and Wheeler, Sill. Am. J. 144. 42.)

#### Cæsium cobalt bromide, Cs<sub>2</sub>CoBr<sub>4</sub>.

Decomp. by H<sub>2</sub>O. (Campbell, Z. anorg. 1894, 8. 126.)

Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) 48. 418.)

Cs<sub>2</sub>CoBr<sub>4</sub>. Decomp. by H<sub>2</sub>O. (Campbell, Z. anorg. 1894, 8. 126.)

Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) 48. 418.)

#### Cæsium copper bromide, CsBr, CuBr<sub>2</sub>.

Sol. in H<sub>2</sub>O without decomp. (Wells and Walden, Z. anorg. 5. 304.)

2 CsBr, CuBr<sub>2</sub>. (W. and W.)

#### Cæsium iridium bromide.

See Bromiridate, cæsium.

#### Cæsium iron (ferric) bromide, CsFeBr<sub>4</sub>.

Sol. in H<sub>2</sub>O. (Walden, Z. anorg. 1894, 7. 332.)

Cs<sub>2</sub>FeBr<sub>4</sub> + H<sub>2</sub>O. (Walden, Z. anorg. 1894, 7. 332.)

#### Cæsium lead bromide, CsBr, 2PbBr<sub>2</sub>.

Nearly stable in aqueous solution. (Walden, Sill. Am. J. 145. 127.)

CsBr, PbBr<sub>2</sub>. Decomp. by H<sub>2</sub>O. (Walden.)

4CsBr, PbBr<sub>2</sub>. As above.

Solubility determinations show that the double salts formed by cæsium and lead bromides at 25° are CsPb<sub>2</sub>Br<sub>3</sub>, CsPbBr<sub>2</sub> and Cs<sub>2</sub>PbBr<sub>4</sub>. (Foote, Am. Ch. J. 1907, 37. 125.)

#### Cæsium magnesium bromide, CsBr, MgBr<sub>2</sub> + 6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Wheeler and Campbell, Z. anorg. 5. 275.)

**Cæsium mercuric bromide, CsBr, 2HgBr<sub>2</sub>.**

Not decomp. by H<sub>2</sub>O. 100 pts. solution sat. at 16° contain 0.807 pt. CsBr, 2HgBr<sub>2</sub>. Sl. sol. in hot strong alcohol, from which CsBr, HgBr<sub>2</sub> separates on cooling. (Wells, Sill. Am. J. 144. 221.)

CsBr, HgBr<sub>2</sub>. Decomp. by H<sub>2</sub>O into above salt. Sol. in alcohol without decomp. (Wells.)

2CsBr, HgBr<sub>2</sub>. Decomp. by H<sub>2</sub>O into CsBr, 2HgBr<sub>2</sub>.

3CsBr, HgBr<sub>2</sub>. As above.

**Cæsium molybdenyl bromide, 2CsBr, MoOBr<sub>2</sub>.**

(Weinland and Knöll, Z. anorg. 1905, 44. 107.)

**Cæsium nickel bromide, CsNiBr<sub>2</sub>.**

Decomp. by H<sub>2</sub>O. (Campbell, Z. anorg. 1894, 8. 126.)

Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Am. J. Sci. 1894, (3) 48. 418.)

**Cæsium osmium bromide.**

See Bromosmate, cæsium.

**Cæsium palladium bromide.**

See Bromopalladate, cæsium and bromopalladite, cæsium.

**Cæsium platinum bromide.**

See Bromoplatinate, cæsium.

**Cæsium ruthenium bromide.**

See Bromoruthenite, cæsium.

**Cæsium selenium bromide.**

See Bromoselenate, cæsium.

**Cæsium tellurium bromide.**

See Bromotellurate, cæsium.

**Cæsium thallic bromide, CsBr, TlBr<sub>3</sub>.**

Sol. in H<sub>2</sub>O with decomp. (Pratt, Z. anorg. 1895, 9. 19.)

By recryst. from H<sub>2</sub>O, forms 3CsBr, 2TlBr<sub>3</sub>. (Pratt, Am. J. Sci. 1895, (3) 49. 403.)

3CsBr, 2TlBr<sub>3</sub>. Can be recryst. unchanged from H<sub>2</sub>O. (Pratt, Am. J. Sci. 1895, (3) 49. 402.)

**Cæsium tin (stannic) bromide.**

See Bromostannate, cæsium.

**Cæsium zinc bromide, 3CsBr, ZnBr<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Wells and Campbell, Z. anorg. 5. 275.)

2CsBr, ZnBr<sub>2</sub>. As above.

**Cæsium bromide columbium oxybromide, 2CsBr, CbOBr<sub>2</sub>.**

Unstable in moist air. Decomp. by H<sub>2</sub>O. (Weinland, B. 1906, 39. 3059.)

**Cæsium bromochloride, CsBr<sub>2</sub>Cl.**

Properties as CsBr<sub>2</sub>. (Wells.)

CsBrCl<sub>2</sub>. As above. (Wells.)

**Cæsium mercuric bromochloride, Cs<sub>2</sub>HgCl<sub>2</sub>Br<sub>2</sub>.**

Decomp. by H<sub>2</sub>O finally to HgBr<sub>2</sub>. (Wells, Sill. Am. J. 144. 121.)

Cs<sub>2</sub>HgCl<sub>2</sub>Br. As above.

CsHgClBr<sub>2</sub>. As above.

CsHg<sub>2</sub>ClBr<sub>4</sub>. As above.

CsHg<sub>3</sub>ClBr<sub>10</sub>. As above.

**Cæsium bromochloriodide, CsBrClI.**

More sol. in H<sub>2</sub>O than in alcohol. Not decomp. at once by ether. (Wells.)

**Cæsium bromiodide, CsBrI<sub>2</sub>.**

Decomp. by H<sub>2</sub>O. Sol. in alcohol. Decomp. by ether with residue of CsBr. (Wells, Sill. Am. J. 143. 17.)

CsBr<sub>2</sub>I. More sol. in H<sub>2</sub>O than in alcohol. Not decomp. by ether.

CsBr<sub>2</sub>I + Aq sat. at 20° contains about 4.45% CsBr<sub>2</sub>I. (Wells.)

**Cæsium carbide, Cs<sub>2</sub>C<sub>2</sub>.**

Decomp. by cold H<sub>2</sub>O. (Moissan, C. R. 1903, 136. 1221.)

**Cæsium chloride, CsCl.**

Very deliquescent; sol. in H<sub>2</sub>O and alcohol.

Solubility of CsCl at t°.

t°.	Pts. by wt. of CsCl in 100 pts. solution
0.3	61.9
10	63.5
20	64.9
30	66.3
40	67.4

(Hinrichsen, Z. phys. Ch. 1904, 50. 99.)

Solubility of CsCl at t°.

t°	% CsCl	t°	% CsCl
0	61.7	60	69.7
10	63.6	70	70
20	65.1	80	71.4
30	66.4	90	72.2
40	67.5	100	73.0
50	68.0	119.4	74.4

(Berkeley, Trans. Roy. Soc. 1904, 203. A. 208.)

A normal solution of CsCl has sp. gr. at 25° = 1.1076. (Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp. gr. at 20°/4° of a normal solution of CsCl = 1.125815. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of CsCl + Aq.			
G. equiv. CsCl per l. at 18°	Sp. gr. at 6°/6°	Sp. gr. at 18°/18°	Sp. gr. at 30°/30°
0.504	1.06556	1.06483	1.06452
1.002	1.12962	1.12825	1.12750
2.007	1.25705	1.25452	1.25307
3.994	1.50514	1.50100	1.49859

(Clausen, W. Ann. 1914, (4) 44. 1071.)

Solubility of CsCl + FeCl<sub>3</sub> in H<sub>2</sub>O at 21°.

Substance added		Pts. by weight in 100 pts. of solution	
FeCl <sub>3</sub> grams	CsCl grams	FeCl <sub>3</sub>	CsCl
0	65	0	65.0
0.6	11.6	0.45	55.18
1.4	10.2	2.1	52.38
2.2	8.8	5.24	51.44
2.0	7.4	7.8	47.70
3.8	6.0	8.93	41.15
4.6	4.6	15.34	25.25
5.4	2.8	21.65	14.96
6.2	1.4	27.96	8.42
35	0.2	48.71	0.94
35	0	83.89	0

(Hinrichsen, Z. phys. Ch. 1904, 50. 96.)

Solubility of CsCl + HgCl<sub>2</sub> in H<sub>2</sub>O at 25°.

Solution contains		Solid phase
% CsCl	% HgCl <sub>2</sub>	
65.61	0.00	CsCl
65.78	0.215	CsCl + Cs <sub>2</sub> HgCl <sub>4</sub>
62.36	0.32	Cs <sub>2</sub> HgCl <sub>4</sub>
57.01	0.64	"
52.35	1.23	"
51.08	1.44	Cs <sub>2</sub> HgCl <sub>4</sub> + Cs <sub>2</sub> HgCl <sub>4</sub>
49.30	1.49	Cs <sub>2</sub> HgCl <sub>4</sub>
45.95	1.69	"
45.23	1.73	Cs <sub>2</sub> HgCl <sub>4</sub> + CsH <sub>2</sub> Cl <sub>2</sub>
38.63	1.32	CsH <sub>2</sub> Cl <sub>2</sub>
17.03	0.51	"
1.53	0.42	"
0.61	2.64	CsH <sub>2</sub> Cl <sub>2</sub> + CsH <sub>2</sub> Cl <sub>2</sub>
0.49	2.91	CsH <sub>2</sub> Cl <sub>2</sub>
0.40	3.78	CsH <sub>2</sub> Cl <sub>2</sub> + CsH <sub>2</sub> Cl <sub>11</sub>
0.44	4.63	"
0.41	4.68	CsH <sub>2</sub> Cl <sub>11</sub>
0.25	5.65	"
0.18	7.09	CsH <sub>2</sub> Cl <sub>11</sub> + HgCl <sub>2</sub>
0.00	6.90	HgCl <sub>2</sub>

(Foote, Am. Ch. J. 1903, 30. 340.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

100 g. solution in acetone sat. at 25° contain 0.032 g. CsCl. (Foote and Haigh, J. Am. Chem. Soc. 1911, 33. 461.)

Solubility of CsCl + HgCl<sub>2</sub> in acetone at 25°.

Solution contains		Solid phase
% HgCl <sub>2</sub>	% CsCl	
57.74	0.00	HgCl <sub>2</sub>
57.79	0.13	HgCl <sub>2</sub> + CsH <sub>2</sub> Cl <sub>11</sub>
57.74	0.20	CsH <sub>2</sub> Cl <sub>11</sub>
52.54	0.22	"
49.83	0.32	"
44.32	0.50	CsH <sub>2</sub> Cl <sub>11</sub> + CsH <sub>2</sub> Cl <sub>4</sub>
44.46	0.44	"
39.65	0.48	CsH <sub>2</sub> Cl <sub>4</sub>
28.48	0.48	"
26.96	0.52	CsH <sub>2</sub> Cl <sub>4</sub> + CsH <sub>2</sub> Cl <sub>2</sub>
27.32	0.61	"
21.50	0.46	CsH <sub>2</sub> Cl <sub>2</sub>
13.08	0.45	"
0.16	0.19	Mixtures of salts
0.17	0.25	"
0.02	0.11	"
0.00	0.032	CsCl

(Foote and Haigh, J. Am. Ch. Soc. 1911, 33. 461.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Solubility in glycol at ord. temp. = 10.6–10.8%. (de Coninck, Belg. Acad. Bull. 1905. 359.)

Insol. in anhydrous pyridine and in 97% pyridine + Aq. Sl. sol. in 95% pyridine + Aq. and in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

**Cæsium chromium chloride, 2CsCl, CrCl<sub>3</sub> + H<sub>2</sub>O.**

Stable in the air. Sol. in H<sub>2</sub>O. (Wells, Z. anorg. 1895, 10. 182.)

2CsCl, CrCl<sub>3</sub> + 4H<sub>2</sub>O; hygroscopic; very sol. in H<sub>2</sub>O. (Wells, l. c.)

**Cæsium tetra-aquochromium chloride, CrCl<sub>3</sub>(OH<sub>2</sub>)<sub>4</sub>.Cl, 2CsCl.**

Ppt. (Werner, B. 1901, 34. 1602.)

**Cæsium cobalt chloride, CsCoCl<sub>2</sub> + 2H<sub>2</sub>O.**

Decomp. by H<sub>2</sub>O and alcohol. (Campbell, Z. anorg. 1894, 8. 126.)

Cs<sub>2</sub>CoCl<sub>4</sub>. Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Z. anorg. 1894, 8. 126.)

Cs<sub>2</sub>CoCl<sub>4</sub>. Decomp. by H<sub>2</sub>O and by alcohol. (Campbell, Z. anorg. 1894, 8. 126.)

**Cæsium cuprous chloride, CsCl, Cu<sub>2</sub>Cl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O into CuCl<sub>2</sub>, CsCl. (Wells, Z. anorg. 5. 306.)

3CsCl, Cu<sub>2</sub>Cl<sub>2</sub>. (Wells.)

6CsCl, Cu<sub>2</sub>Cl<sub>2</sub>. (Wells.)

**Cæsium cupric chloride, 2CsCl, CuCl<sub>2</sub>.**

Easily sol. in H<sub>2</sub>O and dil. HCl + Aq; insol. in conc. HCl + Aq. (Godeffroy, B. 8. 9.)

Sol. in small amount  $H_2O$  without decomp. (Wells and Dupee, Z. anorg. 5. 300.)  
 $+2H_2O$ . Efflorescent. (W. and D.)

$3CsCl, 2CuCl_2 + 2H_2O$ .

$CsCl, CuCl_2$ . Sol. in  $H_2O$  without decomp. (W. and D.)

#### Cæsium gold chloride.

See Chloraurate, cæsium.

#### Cæsium iridium tetrachloride.

See Chloriridate, cæsium.

Cæsium iron (ferric) chloride,  $CsFeCl_4 + \frac{1}{2}H_2O$ .

Sol. in  $H_2O$ . Decomp. in the air. (Walden, Z. anorg. 1894, 7. 332.)

$Cs_2FeCl_6 + H_2O$ . Sol. in  $H_2O$ . (Walden.)

$Cs_2FeCl_6 + H_2O$ . Sol. in  $H_2O$ . (Walden.)

Cæsium lanthanum chloride,  $Cs_3LaCl_6 + 4H_2O$ .

Very hygroscopic. Easily sol. in  $H_2O$ . (R. J. Meyer, Z. anorg. 1914, 86. 273.)

#### Cæsium lead chloride, $CsCl, 2PbCl_2$ .

Nearly stable in aqueous solution. (Campbell, Sill. Am. J. 145. 126.)

$CsCl, PbCl_2$ . Decomp. by  $H_2O$ . (Campbell.)

$4CsCl, PbCl_2$ . As above. (Campbell.)

#### Cæsium lead tetrachloride.

See Chloroplumbate, cæsium.

Cæsium magnesium chloride,  $CsCl, MgCl_2 + 6H_2O$ .

Sol. in  $H_2O$ . (Wells and Campbell, Z. anorg. 5. 275.)

Cæsium manganous chloride,  $CsCl, MnCl_2 + 2H_2O$ .

Not deliquescent; sol. in  $H_2O$ . (Saunders, Am. Ch. J. 14. 143.)

$2CsCl, MnCl_2$ . (Godeffroy.)

$+2\frac{1}{2}H_2O$ . (Godeffroy.)

$+3H_2O$ . Sol. in  $H_2O$ . Conc.  $HCl + Aq$  precipitates anhydrous salt from aqueous solution. (Godeffroy, B. 8. 9.)

The only salt which exists contains  $2H_2O$ . (Saunders, Am. Ch. J. 14. 143.)

#### Cæsium manganic chloride, $2CsCl, MnCl_2$ .

Easily decomp. (Meyer and Best, Z. anorg. 1899, 22. 187.)

#### Cæsium mercuric chloride, $CsCl, HgCl_2$ .

100 pts. solution sat. at  $17^\circ$  contain 1.406 pts.  $CsHgCl_3$ . Not decomp. by  $H_2O$ . Insol. in absolute alcohol, but sol. on diluting with  $\frac{1}{2}$  vol.  $H_2O$ . (Wells, Sill. Am. J. 144. 221.)

$2CsCl, HgCl_2$ . Easily sol. in  $H_2O$  and dil.  $HCl + Aq$ ; insol. in conc.  $HCl + Aq$ . (Godeffroy.)

$3CsCl, HgCl_2$ . Decomp. by  $H_2O$ ; on recrystallizing from  $H_2O$ ,  $CsCl, HgCl_2$  is finally formed. (Wells, Sill. Am. J. 144. 221.)

$CsCl, 5HgCl_2$ . Decomp. by  $H_2O$ . (Wells.)

Solubility determinations show that the only double salts of  $CsCl$  and  $HgCl_2$  which exist at  $25^\circ$  are  $Cs_2HgCl_5$ ,  $Cs_3HgCl_6$ ,  $CsHg_2Cl_3$ ,  $CsHg_3Cl_4$ ,  $CsHg_4Cl_5$ . (Foote, Am. Ch. J. 1903, 30. 340.)

Cæsium molybdenum chloride,  $Cs_2MoCl_6 + H_2O$ .

Sol. in  $H_2O$ . Nearly insol. in alcohol and ether. (Chilesotti, C. C. 1903, II. 652.)

Cæsium molybdenyl chloride,  $CsCl, MoO_2Cl_2 + H_2O$ .

Hygroscopic. Decomp. by  $H_2O$ . (Weinland and Knöll, Z. anorg. 1905, 44. 93.)

$2CsCl, MoO_2Cl_2$ . Hygroscopic. Decomp. by  $H_2O$ . (Weinland and Knöll, Z. anorg. 1905, 44. 92.)

$2CsCl, 6MoO_2Cl_2 + 22H_2O$ . Very hygroscopic. Decomp. by  $H_2O$ . (Weinland and Knöll, Z. anorg. 1905, 44. 94.)

$2CsCl, MoOCl_3$ . Only sl. sol. in  $H_2O$ . (Nordenskjöld, B. 1901, 34. 1573.)

Cæsium neodymium chloride,  $Cs_3NdCl_6 + 5H_2O$ .

Very hygroscopic. Easily sol. in  $H_2O$ . (R. J. Meyer, Z. anorg. 1914, 86. 273.)

#### Cæsium nickel chloride, $2CsCl, NiCl_2$ .

As the corresponding  $Cu$  salt.

$CsNiCl_3$ . Decomp. by  $H_2O$  and by alcohol. (Campbell, Am. J. Sci. 1894, (3) 48. 418.)

#### Cæsium palladium dichloride.

See Chloropalladate, cæsium.

#### Cæsium palladium tetrachloride.

See Chloropalladate, cæsium.

Cæsium praseodymium chloride,  $Cs_3PrCl_6 + 5H_2O$ .

Very hygroscopic. Easily sol. in  $H_2O$ . (R. J. Meyer, Z. anorg. 1914, 86. 273.)

#### Cæsium rhodium chloride.

See Chlororhodite, cæsium.

#### Cæsium ruthenium chloride.

See Chlororuthenite, cæsium and chlororuthenate, cæsium.

Cæsium oxyruthenium chloride,  $Cs_2RuO_4Cl_2$ .

Ppt.; decomp. by  $H_2O$ ; sol. in cold  $HCl$ . (Howe, J. Am. Chem. Soc. 1901, 23. 779.)

Cæsium samarium chloride,  $Cs_3SmCl_6 + 5H_2O$ .

Very hygroscopic. Easily sol. in  $H_2O$ . (R. J. Meyer, Z. anorg. 1914, 86. 273.)

**Cæsium silver chloride,  $2\text{CsCl}$ ,  $\text{AgCl}$ .**

Easily decomp. by  $\text{H}_2\text{O}$ . (Wells and Wheeler, *Sill. Am. J.* 144. 155.)

**Cæsium tellurium chloride.**

See Chlorotellurate, cæsium.

**Cæsium thallic chloride,  $2\text{CsCl}$ ,  $\text{TiCl}_3$ .**

By recryst. from  $\text{H}_2\text{O}$  forms  $3\text{CsCl}$ ,  $2\text{TiCl}_3$ . (Pratt, *Am. J. Sci.* 1895, (3) 49. 398.)

+ $\text{H}_2\text{O}$ . Readily sol. in hot  $\text{H}_2\text{O}$  but  $3\text{CsCl}$ ,  $2\text{TiCl}_3$  cryst. from the solution. (Pratt, *Am. J. Sci.* 1895, (3) 49. 399.)

$3\text{CsCl}$ ,  $2\text{TiCl}_3$ . Can be recryst. from  $\text{H}_2\text{O}$  without change. (Pratt, *Am. J. Sci.* 1895, (3) 49. 401.)

$3\text{CsCl}$ ,  $\text{TiCl}_3$ + $2\text{H}_2\text{O}$ . Sol. in 36.4 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  and 3 pts. at  $100^\circ$ . (Godeffroy, *Zeitsch. d. allgem. österr. Apothekerv.* 1880. No. 9.)

**Cæsium tin (stannic) chloride.**

See Chlorostannate, cæsium.

**Cæsium titanium chloride,  $\text{TiCl}_3$ ,  $2\text{CsCl}$ + $\text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Stähler, *B.* 1904, 37. 4409.)

**Cæsium tungsten chloride,  $\text{Cs}_2\text{W}_2\text{Cl}_3$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ .

Sol. in a hot mixture of equal pts.  $\text{H}_2\text{O}$  and conc.  $\text{HCl}$ .

Nearly insol. in conc.  $\text{HCl}$ .

Sol. in very dil.  $\text{NaOH}$ + $\text{Aq}$ .

Nearly insol. in most organic solvents. (Olason, *B.* 1913, 46. 574.)

**Cæsium uranous chloride,  $\text{Cs}_2\text{UCl}_6$ .**

As K salt. (Aloy, *Bull. Soc.* 1899, (3) 21. 264.)

**Cæsium uranyl chloride,  $2\text{CsCl}$ ,  $(\text{UO}_2)_2\text{Cl}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Wells, *Z. anorg.* 1895, 10. 183.)

100 pts. of the solution contain at  $29.75^\circ$ , 56.07 pts.  $\text{UO}_2\text{Cl}_2$ ,  $2\text{CsCl}$ . (Rimbach, *B.* 1904, 37. 468.)

Pptd. from aq. solution by gaseous  $\text{HCl}$ . (Wells, *Am. J. Sci.* 1894, (3) 50. 251.)

**Cæsium vanadium chloride,  $\text{Cs}_2\text{VdCl}_5$ + $\text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$  and alcohol. (Stähler, *B.* 1904, 37. 4412.)

**Cæsium zinc chloride,  $3\text{CsCl}$ ,  $\text{ZnCl}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Wells and Campbell, *Z. anorg.* 5. 275.)

$2\text{CsCl}$ ,  $\text{ZnCl}_2$ . Easily sol. in  $\text{H}_2\text{O}$  and dil.  $\text{HCl}$ + $\text{Aq}$ . Insol. in conc.  $\text{HCl}$ + $\text{Aq}$ . (Godeffroy.)

**Cæsium chloride chromic oxychloride,  $2\text{CsCl}$ ,  $\text{CrOCl}_2$ .**

Decomp. in the air.

Sol. in conc.  $\text{HCl}$  without decomp. (Weinland, *B.* 1906, 39. 4045.)

**Cæsium chloride columbium oxychloride,  $2\text{CsCl}$ ,  $\text{CbOCl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, *B.* 1906, 39. 3057.)

**Cæsium chloriodide,  $\text{CsCl}_2\text{I}$ .**

Properties as  $\text{CsBrCl}_2$ . (Wells.)

$\text{CsCl}_2\text{I}$ . Sl. sol. in  $\text{H}_2\text{O}$ , from which it can be recrystallized without decomp. (Wells and Wheeler.)

**Cæsium mercuric chloriodide,  $\text{Cs}_2\text{HgCl}_2\text{I}_2$ .**

Decomp. instantly by  $\text{H}_2\text{O}$  to  $\text{HgI}_2$ . (Wells.)

**Cæsium fluoride,  $\text{CsF}$ .**

Ppt. (Chabrié, *C. R.* 1901, 132. 680.)

+ $1\frac{1}{2}\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve 366.5 g  $\text{CsF}$  at  $15^\circ$ . (de Forcrand, *C. R.* 1911, 152. 1210.)

**Cæsium hydrogen fluoride,  $\text{CsHF}_2$ .**

Ppt. (Chabrié, *C. R.* 1901, 132. 680.)

**Cæsium tantalum fluoride.**

See Fluotantalate, cæsium.

**Cæsium tellurium fluoride,  $\text{CsF}$ ,  $\text{TeF}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Wells, *Am. J. Sci.* 1901, (4) 12. 190.)

**Cæsium titanium fluoride.**

See Fluotitanate, cæsium.

**Cæsium zirconium fluoride.**

See Fluozirconate, cæsium.

**Cæsium hydride,  $\text{CaH}$ .**

Decomp. by  $\text{H}_2\text{O}$  with evolution of  $\text{H}_2$ . (Moissan, *C. R.* 1903, 136. 589.)

**Cæsium hydroxide,  $\text{CsOH}$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol.

79.41%  $\text{CsOH}$  is contained in a sat. aq. solution at  $15^\circ$ . (de Forcrand, *C. R.* 1909, 149. 1344.)

75.08%  $\text{CsOH}$  is contained in sat. aq. solution at  $30^\circ$ . (Schreinemakers, *C. C.* 1909, I. 11.)

**Cæsium iodide,  $\text{CsI}$ .**

Sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 44 pts.  $\text{CsI}$  at  $0^\circ$ ; 66.3 pts. at  $14.5^\circ$ ; 160 pts. at  $61^\circ$ .

Sp. gr. of  $\text{CsI}$ + $\text{Aq}$  sat. at  $14^\circ$ =1.393. (Betekoff, *Bull. Soc. Pétersb.* (4) 2. 197.)

**Cæsium periodide.**

Solubility determinations show that  $\text{CsI}_2$  and  $\text{CsI}_3$  are the only periodides of cæsium existing between  $-4^\circ$  and  $+73^\circ$ . (Foote, *Am. Ch. J.* 1903, **29**, 203.)

**Cæsium triiodide,  $\text{CsI}_3$ .**

1 ccm. sat.  $\text{CsI} + \text{Aq}$  dissolves 0.0097 g.  $\text{CsI}_3$ , and sp. gr. of solution is 1.154. Only al. decomp. by solution in  $\text{H}_2\text{O}$ . Much more sol. in alcohol than in  $\text{H}_2\text{O}$ . Not immediately decomp. by ether. (Wells, *Sill. Am. J.* **143**, 17.)

**Cæsium pentaoidide,  $\text{CsI}_5$ .****Cæsium cobalt iodide,  $\text{Cs}_2\text{CoI}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Campbell, *Z. anorg.* 1894, **8**, 12.)

Deliquescent; decomp. by  $\text{H}_2\text{O}$  and by alcohol. (Campbell, *Am. J. Sci.* 1894, (3) **48**, 418.)

**Cæsium lead iodide,  $\text{CsPbI}_3$ .**

Sl. sol. in hot  $\text{CsI} + \text{Aq}$ . (Wheeler, *Sill. Am. J.* **145**, 129.)

**Cæsium mercuric iodide,  $\text{CsI}$ ,  $2\text{HgI}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  finally into  $\text{HgI}_2$ . (Wells, *Sill. Am. J.* **144**, 221.)

$2\text{CsI}$ ,  $3\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$  finally into  $\text{HgI}_2$ .

$\text{CsI}$ ,  $\text{HgI}_2$ . As above.

$2\text{CsI}$ ,  $\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$ ; insol. in alcohol.

$3\text{CsI}$ ,  $\text{HgI}_2$ . As above.

**Cæsium silver iodide,  $\text{CsI}$ ,  $\text{AgI}$ .**

(Penfield, *Z. anorg.* **1**, 100.)

$\text{CsI}$ ,  $2\text{AgI}$ . More sol. in hot than in cold acetone. (Marsh, *Chem. Soc.* 1913, **103**, 782.)

**Cæsium tellurium iodide.**

See Iodotellurate, cæsium.

**Cæsium thallic iodide,  $\text{CsI}$ ,  $\text{TI}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Pratt, *Am. J. Sci.* 1895, (3) **49**, 403.)

**Cæsium zinc iodide,  $3\text{CsI}$ ,  $\text{ZnI}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Wells and Campbell, *Z. anorg.* **5**, 275.)

$2\text{CsI}$ ,  $\text{ZnI}_2$ . As above.

**Cæsium oxide,  $\text{Cs}_2\text{O}$ .**

Absorbs  $\text{H}_2\text{O}$  and  $\text{CO}_2$  from the air. Decomp. by  $\text{H}_2\text{O}$  and by liquid  $\text{NH}_3$ . (Rengade, *C. R.* 1906, **143**, 593.)

**Cæsium dioxide,  $\text{Cs}_2\text{O}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rengade, *C. R.* 1905, **140**, 1537.)

**Cæsium trioxide,  $\text{Cs}_2\text{O}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rengade, *C. R.* 1905, **140**, 1537.)

**Cæsium tetroxide,  $\text{Cs}_2\text{O}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rengade, *C. R.* 1905, **140**, 1538.)

**Cæsium sulphide,  $\text{Cs}_2\text{S} + 4\text{H}_2\text{O}$ .**

Deliquescent; very sol. in  $\text{H}_2\text{O}$ . (Biltz, *Z. anorg.* 1906, **48**, 300.)

**Cæsium disulphide,  $\text{Cs}_2\text{S}_2$ .**

Anhydrous. Sol. in  $\text{H}_2\text{O}$ . Hygroscopic. (Biltz, *Z. anorg.* 1906, **50**, 72.)

$+ \text{H}_2\text{O}$ . From  $\text{Cs}_2\text{S}_2 + \text{Aq}$ . Hygroscopic. (Biltz, *Z. anorg.* 1906, **50**, 72.)

**Cæsium trisulphide,  $\text{Cs}_2\text{S}_3$ .**

Anhydrous. Sol. in  $\text{H}_2\text{O}$ . Not hygroscopic. (Biltz, *Z. anorg.* 1906, **50**, 75.)

$+ \text{H}_2\text{O}$ . From  $\text{Cs}_2\text{S}_3 + \text{Aq}$ . (Biltz, *Z. anorg.* 1906, **50**, 76.)

**Cæsium tetrasulphide,  $\text{Cs}_2\text{S}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . Insol. in abs. alcohol. (Biltz, *Z. anorg.* 1906, **48**, 305.)

**Cæsium pentasulphide,  $\text{Cs}_2\text{S}_5$ .**

Mpt.  $2^\circ$ . Not hygroscopic. Very sol. in cold 70% alcohol. (Biltz, *B.* 1905, **38**, 129.)

**Cæsium hydrogen sulphide,  $\text{CsHS}$ .**

Deliquescent; very sol. in  $\text{H}_2\text{O}$ . (Biltz, *Z. anorg.* 1906, **48**, 300.)

**Cæsium copper tetrasulphide,  $\text{CsCuS}_4$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ .

Decomp. by conc. and dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$ .

Sl. sol. in alcohol. (Biltz, *B.* 1907, **40**, 978.)

**Calcium,  $\text{Ca}$ .**

Decomp.  $\text{H}_2\text{O}$  violently. Slowly attacked by cold  $\text{H}_2\text{SO}_4$ . Dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  or  $\text{HCl} + \text{Aq}$  attack violently and dissolve. Dil.  $\text{HNO}_3 + \text{Aq}$  oxidises, but fuming  $\text{HNO}_3$  scarcely attacks even on boiling. (Bunsen and Matthiessen.) Not attacked by anhydrous alcohol. (Lies-Bodart and Jobin, *A. ch.* (3) **54**, 364.)

Pure  $\text{Ca}$  is only very slowly decomp. by  $\text{H}_2\text{O}$  at ordinary temp.; sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . (Moissan, *C. R.* 1898, **129**, 589.)

Insol. in liquid  $\text{NH}_3$ . (Gore, *Am. Ch. J.* 1898, **20**, 827.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0334 g.  $\text{Ca}$  in 6 days. (Gates, *J. phys. Chem.* 1911, **15**, 143.)

**Calcium amalgam,  $\text{Ca}_2\text{Hg}_4$ .**

Decomp.  $\text{H}_2\text{O}$  readily. (Féré, *C. R.* 1898, **127**, 619.)

$\text{CaHg}_4$ . Rapidly decomp. in moist air. (Schürger, *Z. anorg.* 1900, **25**, 425.)



**Calcium amide,  $\text{Ca}(\text{NH}_2)_2$ .**

(Moissan, A. ch. 1899, (7) 18. 326.)

**Calcium ammonia,  $\text{Ca}, 4\text{NH}_3$ .**Decomp. at ordinary temp.; takes fire in contact with the air; sl. sol. in liquid  $\text{NH}_3$ . (Moissan, C. R. 1898, 127. 691.) $\text{Ca}, 6\text{NH}_3$ . (Kraus, J. Am. Chem. Soc. 1908, 30. 665.)**Calcium arsenide,  $\text{Ca}_3\text{As}_2$ .**Decomp. by cold  $\text{H}_2\text{O}$ ; insol. in cold fuming  $\text{HNO}_3$ ; very sol. in hot  $\text{HNO}_3$ . (Lebeau, C. R. 1899, 128. 98.)**Calcium azoimide,  $\text{Ca}(\text{N}_3)_2$ .**

Hydroscopic; explosive.

38.1 pts. sol. in 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$   
45.0 " " " 100 "  $\text{H}_2\text{O}$  " 15.2  
0.211 " " " 100 " abs. alcohol " 16.Sol. in  $\text{H}_2\text{O}$ ; decomp. when heated and on standing in the air. (Dennis, Z. anorg. 1898, 17. 21.)

Insol. in pure ether. (Curtius, J. pr. 1898, (2) 58. 286.)

**Calcium boride,  $\text{CaB}_2$ .**Not decomp. by  $\text{H}_2\text{O}$  at  $250^\circ$ ; sol. in fused oxidizing agents.Insol. in aq. acids; sl. sol. in conc.  $\text{H}_2\text{SO}_4$ ; sol. in dil. or conc.  $\text{HNO}_3$ . (Moissan, C. R. 1897, 125. 631-32.)**Calcium bromide,  $\text{CaBr}_2$ .**Very deliquescent. 100 pts.  $\text{H}_2\text{O}$  dissolve—  
at  $0^\circ$  20° 40° 60° 105°  
125 143 213 278 312 pts.  $\text{CaBr}_2$ .

(Kremers, Pogg. 103. 65.)

Sat.  $\text{CaBr}_2 + \text{Aq}$  contains at:

$-22^\circ$	$-22^\circ$	$-14^\circ$	$-7^\circ$	$-5^\circ$
50.5	50.2	52.5	52.6	52.6%

$+8^\circ$	$9^\circ$	$11^\circ$	$20^\circ$	$50^\circ$
53.1	55.1	55.7	57.1	62.6%

53.1	55.1	55.7	57.1	62.6%
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(Étard, A. ch. 1894, (7) 2. 540.)

Sp. gr. of  $\text{CaBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5	10	15	20	25 % $\text{CaBr}_2$
1.044	1.089	1.139	1.194	1.252

30	35	40	45	50 % $\text{CaBr}_2$
1.315	1.385	1.461	1.549	1.641

(Kremers, Pogg. 99. 444, calculated by Gerlach, Z. anal. 8. 285.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Very sol. in alcohol. (Henry.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

 $+4\text{H}_2\text{O}$ . (Kuznetsov, C. A. 1911. 842.) $+6\text{H}_2\text{O}$ .**Calcium manganous bromide,  $\text{CaMnBr}_4 + 4\text{H}_2\text{O}$ .**

Sl. hygroscopic. Unstable. (Ephraim, Z. anorg. 1910, 67. 377.)

**Calcium mercuric bromide.**Decomp. by  $\text{H}_2\text{O}$ . (v. Bonsdorff.)**Calcium molybdenyl bromide,  $\text{CaBr}_2, 2\text{MoOBr}_2 + 7\text{H}_2\text{O}$ .**

(Weinland and Knöll, Z. anorg. 1905, 44. 112.)

**Calcium stannic bromide.**

See Bromostannate, calcium.

**Calcium bromide ammonia,  $\text{CaBr}_2, 6\text{NH}_3$ .**Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 239.)**Calcium bromide hydrazine,  $\text{CaBr}_2, 3\text{N}_2\text{H}_4$ .**Easily sol. in  $\text{H}_2\text{O}$ . (Fransen, Z. anorg. 1908, 60. 288.)**Calcium bromofluoride,  $\text{CaBr}_2, \text{CaF}_2$ .**Decomp. by  $\text{H}_2\text{O}$ . (Defacqz, A. ch. 1904, (8) 1. 357.)**Calcium carbide,  $\text{CaC}_2$ .**Sp. gr. 2.22 at  $18^\circ$ . Insol. in fuming  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ , but readily decomp. by dil. acids and  $\text{H}_2\text{O}$ . (Moissan, Bull. Soc. 1894, (3) 11. 1005.)Insol. in  $\text{HCl}$  in the cold, but decomp. at red heat. Strong min. acids do not act in the cold; sol. in glacial acetic in the cold; sol. in fused alkali. (Venable, J. Am. Chem. Soc. 1895, 17. 307-310.)**Calcium chloride,  $\text{CaCl}_2$ .**Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  with evolution of heat.Anhydrous  $\text{CaCl}_2$  is sol. in 1.459 pts.  $\text{H}_2\text{O}$ . (Gerlach.) Anhydrous  $\text{CaCl}_2$  is sol. in 1.58 pts.  $\text{H}_2\text{O}$  at  $10.2^\circ$ . (Kremers, Pogg. 103. 65.)Anhydrous  $\text{CaCl}_2$  is sol. in 1.35 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ ; 0.83 pt.  $\text{H}_2\text{O}$  at  $40^\circ$ ; 0.72 pt.  $\text{H}_2\text{O}$  at  $60^\circ$ .  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  is sol. in 0.5 pt.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 2.05 pt. at  $16^\circ$ . (Gmelin.)  $\text{CaCl}_2$  is sol. in 1.5 pts. cold, and 0.8 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy.) $\text{CaCl}_2 + \text{Aq}$  sat. in the cold contains 40.7%  $\text{CaCl}_2$ . (Fourcroy.) $\text{CaCl}_2 + \text{Aq}$  sat. at  $12.5^\circ$  contains 53.8%  $\text{CaCl}_2$ . (Hassenratz.)100 pts.  $\text{H}_2\text{O}$  dissolve 165.7 pts.  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ ; 7141 pts. at  $40^\circ$ . (Tilden, Chem. Soc. 45. 409.)100 pts.  $\text{H}_2\text{O}$  dissolve 60.3 pts.  $\text{CaCl}_2$  from  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ , and solution has sp. gr. = 1.367. (Engel, Bull. Soc. (2) 47. 318.)

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains % $\text{CaCl}_2$	Sat. solution contains % $\text{CaCl}_2 + 6\text{H}_2\text{O}$
-22	32.24	63.61
0	36.91	72.82
+ 7.39	38.77	76.49
13.86	41.03	80.95
19.35	42.50	83.85
23.46	44.15	87.11
24.47	45.33	89.44
27.71	46.30	91.35
29.53	50.67	99.97

(Hammerl, W.A.B. 72, 2. 287.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$
0	59.39	13.86	69.49
5	64.83	19.35	73.91
7.88	66.20	21.89	79.77

(Hammerl, calculated by Bakhuis Roozeboom, R. t. c. 8. 5.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$
0	49.6	19	72	38	108
1	50	20	74	39	109
2	51	21	75	40	110
3	52	22	77	41	111
4	53	23	79	42	112
5	54	24	80	43	113
6	55	25	82	44	114
7	56	26	84	45	115
8	57	27	87	46	116
9	58	28	89	47	117
10	60	29	91	48	118
11	61	30	93	49	119
12	62	31	96	50	120
13	63	32	98	51	121
14	65	33	100	52	122
15	66	34	103	53	123
16	68	35	104	54	124
17	69	36	105	55	125
18	71	37	107	56	126
57	127	72	137	87	145
58	128	73	138	88	146
59	129	74	138	89	147
60	129	75	139	90	147
61	130	76	139	91	148
62	131	77	140	92	149
63	131	78	141	93	150
64	132	79	141	94	150
65	133	80	142	95	151
66	133	81	142	96	152
67	134	82	143	97	152
68	135	83	143	98	153
69	135	84	144	99	154
70	136	85	144	179.5	325
71	136	86	145	...	...

(Mulder, Scheik. Verhandel. 1864. 107.)

If solubility  $S$  = pts. anhydrous  $\text{CaCl}_2$  in 100 pts. solution,  $S = 32 + 0.2148t$  from  $-18^\circ$  to  $+6^\circ$ ;  $S = 54.5 + 0.0755t$  from  $50^\circ$  to  $120^\circ$ . (Etard, C. R. 98. 1432.)

According to Bakhuis Roozeboom, the solubility of  $\text{CaCl}_2$  varies according to the hydrate employed, and the following data were obtained as the result of very exact experiments.

Solubility of  $\text{CaCl}_2 + 6\text{H}_2\text{O}$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$
20.4	75.1	28.0	88.8	29.5	96.07
25.05	81.67	28.9	92.05	30.2	102.7

There are two modifications of  $\text{CaCl}_2 + 4\text{H}_2\text{O}$ ,  $\alpha$  and  $\beta$ .

Solubility of  $\text{CaCl}_2 + 4\text{H}_2\text{O}\beta$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$
18.4	103.3	35.0	122.74
25.0	108.8	38.4	127.50
30.0	114.1	....	....

Solubility of  $\text{CaCl}_2 + 4\text{H}_2\text{O}\alpha$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$
22.0	92.67	35.95	107.21
24.7	95.59	40.00	115.3
29.8	100.6	45.00	129.9

Solubility of  $\text{CaCl}_2 + 2\text{H}_2\text{O}$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$	$t^\circ$	Pts. $\text{CaCl}_2$
40	128.1	95.8	156.5	139	191.0
45	129.9	115	169.5	155	214.3
50	132.3	124	176.0	165	236.2
59.5	136.5	137	187.6	174	275.7
80.5	145.3	...	...	...	...

Solubility of  $\text{CaCl}_2 + \text{H}_2\text{O}$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaCl}_2$
191	306
235	331

(Bakhuis Roozeboom, R. t. c. 8.1.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq.}$ 

% $\text{CaCl}_2$	Sp. gr.	% $\text{CaCl}_2$	Sp. gr.	% $\text{CaCl}_2$	Sp. gr.
3.95	1.03	20.85	1.18	34.57	1.33
7.66	1.06	23.93	1.21	36.49	1.36
11.23	1.09	26.86	1.24	38.31	1.39
14.42	1.12	29.67	1.27	40.43	1.42
17.60	1.15	32.35	1.30	41.91	1.45

(Richter.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $19.5^\circ$  containing pts.  $\text{CaCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ .

Pts. $\text{CaCl}_2$	Sp. gr.	Pts. $\text{CaCl}_2$	Sp. gr.
6.97	1.0545	36.33	1.2469
12.58	1.0954	50.67	1.3234
23.33	1.1681	62.90	1.3806

(Kremers, Pogg. 99. 444.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq.}$   $G = \text{sp. gr. at } 15^\circ \text{ if } \% \text{ is } \text{CaCl}_2$ , according to Gerlach;  $S = \text{sp. gr. at } 18.3^\circ \text{ if } \% \text{ is } \text{CaCl}_2 + 6\text{H}_2\text{O}$ , according to Schiff.

%	G	S	%	G	S
1	1.00852	1.0039	36	1.35610	1.1575
2	1.01704	1.0079	37	1.36790	1.1622
3	1.02555	1.0119	38	1.37970	1.1671
4	1.03407	1.0159	39	1.39150	1.1719
5	1.04259	1.0200	40	1.40330	1.1768
6	1.05146	1.0241	41	...	1.1816
7	1.06033	1.0282	42	...	1.1865
8	1.06921	1.0323	43	...	1.1914
9	1.07808	1.0365	44	...	1.1963
10	1.08695	1.0407	45	...	1.2012
11	1.09628	1.0449	46	...	1.2062
12	1.00561	1.0491	47	...	1.2112
13	1.10494	1.0534	48	...	1.2162
14	1.12427	1.0577	49	...	1.2212
15	1.13360	1.0619	50	...	1.2262
16	1.14332	1.0663	51	...	1.2312
17	1.15305	1.0706	52	...	1.2363
18	1.16277	1.0750	53	...	1.2414
19	1.17250	1.0794	54	...	1.2465
20	1.18222	1.0838	55	...	1.2516
21	1.19251	1.0882	56	...	1.2567
22	1.20279	1.0927	57	...	1.2618
23	1.21308	1.0972	58	...	1.2669
24	1.22336	1.1017	59	...	1.2721
25	1.23365	1.1062	60	...	1.2773
26	1.24450	1.1107	61	...	1.2825
27	1.25535	1.1153	62	...	1.2877
28	1.26619	1.1199	63	...	1.2929
29	1.27704	1.1246	64	...	1.2981
30	1.28789	1.1292	65	...	1.3034
31	1.29917	1.1339	66	...	1.3087
32	1.31045	1.1386	67	...	1.3140
33	1.32174	1.1433	68	...	1.3193
34	1.33602	1.1480	69	...	1.3246
35	1.34430	1.1527	70	...	1.3300

(Calculated by Gerlach, Z. anal. 8, 283.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  :  $a = \text{no. of half molecules in grammes dissolved in 1000 g. } \text{H}_2\text{O}$ ;  $b = \text{sp. gr. at } 24.3^\circ \text{ when } a = \text{CaCl}_2 + 6\text{H}_2\text{O}$  ( $\frac{1}{2} \text{ mol.} = 109.5 \text{ g.}$ );  $c = \text{sp. gr. at } 24.3^\circ \text{ when } a = \text{CaCl}_2$  ( $\frac{1}{2} \text{ mol.} = 55.5 \text{ g.}$ ).

a	b	c	a	b	c
1	1.041	1.043	7	1.198	1.258
2	1.076	1.084	8	1.214	...
3	1.106	1.122	9	1.229	...
4	1.133	1.159	10	1.242	...
5	1.157	1.193	11	1.255	...
6	1.179	1.227	..	...	...

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{CaCl}_2$	Sp. gr.	% $\text{CaCl}_2$	Sp. gr.
5	1.0409	25	1.2305
10	1.0852	30	1.2841
15	1.1311	35	1.3420
20	1.1794	..	....

(Kohlrausch, W. Ann. 1879. 1.)

$\text{CaCl}_2 + \text{Aq}$  sat. at  $0^\circ$  has sp. gr. = 1.367. (Engel, Bull. Soc. 1887, (2) 47. 318.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $9.5^\circ\text{C}$ .

Mass of salt per unit mass of solution	Density of solution (g. per cc.)
0.00191	1.00168
0.00381	1.00317
0.00570	1.00465
0.00759	1.00615
0.00947	1.00765
0.01320	1.01050

(McGregor, C. N. 1887, 55. 6.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CaCl}_2 + \text{Aq.}$	Sp. gr.
1-normal	1.0446
$\frac{1}{2}r$ "	1.0218
$\frac{1}{4}r$ "	1.0105
$\frac{1}{8}r$ "	1.0050

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{CaCl}_2 + \text{Aq}$  containing 12.1638%  $\text{CaCl}_2 = 1.10489$ . (Schönrock, Z. phys. Ch. 1893, 11. 768.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $17.925^\circ\text{C}$ .

$\frac{\%}{\text{CaCl}_2}$	Sp. gr.	$\frac{\%}{\text{CaCl}_2}$	Sp. gr.	$\frac{\%}{\text{CaCl}_2}$	Sp. gr.
0.0	0.99869	13	1.11206	33	1.31562
0.1	0.99954	14	1.12130	34	1.32689
0.2	1.00037	15	1.13067	35	1.33821
0.3	1.00116	16	1.14016	36	1.34956
0.4	1.00201	17	1.14969	37	1.36100
0.6	1.00371	18	1.15926	38	1.37242
0.8	1.00539	19	1.16920	39	1.38400
1.0	1.00703	20	1.17910	40	1.39489
1.5	1.01127	21	1.18897	41	1.40641
2	1.01548	22	1.19901	42	1.41770
3	1.02386	23	1.20901	43	1.42882
4	1.03238	24	1.21918	44	1.44007
5	1.04089	25	1.22941	45	1.45124
6	1.04951	26	1.23969	46	1.46238
7	1.05822	27	1.25030	47	1.47329
8	1.06680	28	1.26092	48	1.48450
9	1.07569	29	1.27182	49	1.49573
10	1.08467	30	1.28271	50	1.50676
11	1.09373	31	1.29360	51	1.51778
12	1.10288	32	1.30461		

(Pickering, B. 1894, 27. 1385.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Concentration of $\text{CaCl}_2 + \text{Aq}$	Sp. gr.
20	1 pt. $\text{CaCl}_2$ in 7.1045 pts. $\text{H}_2\text{O}$	1.1062
20	1 " " " 164.25 " "	1.0032

(Hittorf, Z. phys. Ch. 1902, 39. 628.)

Sp. gr. of  $\text{CaCl}_2 + \text{Aq}$  at  $20^\circ$ .

g. mols. $\text{CaCl}_2$ per l.	Sp. gr.
0.010	1.000982
0.025	1.002539
0.050	1.004874
0.075	1.006814
0.10	1.008971
0.25	1.02287
0.50	1.04451
0.75	1.06641
1.00	1.08744

(Jones and Pearce, Am. Ch. J. 1907, 38. 696.)

Sat.  $\text{CaCl}_2 + \text{Aq}$  forms a crust at  $150^\circ$ , and contains 178 pts.  $\text{CaCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . (Gerlach.)

Sat.  $\text{CaCl}_2 + \text{Aq}$  boils at  $180^\circ$ . (Rüdorff.)

B.-pt. of  $\text{CaCl}_2 + \text{Aq}$  containing pts.  $\text{CaCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26. 440); L=according to Le-grand (A. ch. (2) 39. 43).

B.-pt	G	L	B.-pt.	G	L
101°	6.0	10	134°	...	117.2
102	11.5	16.5	135	119	...
103	16.5	21.6	136	...	123.5
104	21.0	25.8	138	...	129.9
105	25.0	29.4	140	137.5	136.3
106	29.0	32.6	142	...	142.8
107	32.5	35.6	144	...	149.4
108	35.5	38.5	145	157	...
109	38.5	41.3	146	...	156.2
110	41.5	44.0	148	...	163.2
111	...	46.8	150	178	170.5
112	...	49.7	152	...	178.1
113	...	52.6	154	...	186.0
114	...	55.6	155	200	...
115	55.0	58.6	156	...	194.3
116	...	61.6	158	...	203.0
117	...	64.6	160	222	212.1
118	...	67.6	162	...	221.6
119	...	70.6	164	...	231.5
120	69.0	73.6	165	245	...
121	...	76.7	166	...	241.9
122	...	79.8	168	...	252.8
123	...	82.9	170	268	264.2
124	...	86.0	172	...	276.1
125	...	89.1	174	...	285.5
126	...	92.2	175	292	...
128	...	98.4	176	...	301.4
130	101	104.6	178	305	314.8
130.4	102.67	...	179.5	...	325.0
132	...	110.9	...	...	...

B.-pt. of  $\text{CaCl}_2 + \text{Aq}$ .

% $\text{CaCl}_2$	B.-pt.	% $\text{CaCl}_2$	B.-pt.
5.6	101°	17.5	104°
10.3	102	20.0	105
14.5	103	...	...

(Skinner, Chem. Soc. 61. 340.)

Less sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .  $\text{HCl} + \text{Aq}$  sat. at  $12^\circ$  dissolves 27%  $\text{CaCl}_2$ , which crystallizes out with  $2\text{H}_2\text{O}$ . (Ditte, C. R. 92. 242.)

Solubility of  $\text{CaCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .

Sp. gr. of solutions	g. per 100 cc. solution	
	$\text{CaCl}_2$	$\text{HCl}$
1.367	51.45	0.0
1.344	46.45	3.32
1.326	42.80	5.83
1.310	36.77	10.66
1.283	29.84	15.84
1.250	20.12	23.05
1.238	11.29	34.62

(Engel, C. R. 1887, 104, 434.)

$\text{CaCl}_2 + \text{CaO}_2\text{H}_2$ . Solubility of  $\text{CaCl}_2 + \text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% $\text{CaCl}_2$	% $\text{CaO}_2\text{H}_2$	Solid phase
5.02	0.101	$\text{CaO}_2\text{H}_2$
10.00	0.115	"
12.94	0.128	"
15.14	0.140	"
17.20	0.145	"
18.15	0.148	$\text{CaO}_2\text{H}_2 + \text{CaCl}_2, 4\text{CaO} \cdot 14\text{H}_2\text{O}$
18.01	0.152	$\text{CaCl}_2, 4\text{CaO} \cdot 14\text{H}_2\text{O}$
21.02	0.147	"
23.80	0.146	"
24.33	0.147	"
28.37	0.170	"
29.54	0.180	"
32.67	0.225	$\text{CaO}_2\text{H}_2(?)$
33.21	0.245	$\text{CaCl}_2, 4\text{CaO} \cdot 14\text{H}_2\text{O}$
33.72	0.254	$\text{CaCl}_2, 4\text{CaO} \cdot 14\text{H}_2\text{O} + \text{CaCl}_2, \text{CaO} \cdot 2\text{H}_2\text{O}$
34.36	0.173	$\text{CaCl}_2, \text{CaO} \cdot 2\text{H}_2\text{O}$
38.61	0.060	"
41.32	0.048	"
44.30	0.030	"
44.60	0.029	$\text{CaCl}_2, 6\text{H}_2\text{O} + \text{CaCl}_2, \text{CaO} \cdot 2\text{H}_2\text{O}$
44.77	...	$\text{CaCl}_2, 6\text{H}_2\text{O}$

(Schreinemakers and Feege, Chem. Weekhl. 1911, 8. 685.)

See also under Calcium hydroxide

$\text{CaCl}_2 + \text{KCl}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 56 pts.  $\text{CaCl}_2$  at  $7^\circ$ ; 100 pts.  $\text{H}_2\text{O}$  dissolve 31 pts.  $\text{KCl}$  at  $7^\circ$ ; 100 pts.  $\text{H}_2\text{O}$  dissolve 63.5 pts.  $\text{CaCl}_2 + 4.9$  pts.  $\text{KCl}$  at  $7^\circ$ . (Mulder, J. B. 1866. 67.)

$\text{CaCl}_2 + \text{NaCl}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 53 pts.  $\text{CaCl}_2$  at  $4^\circ$ , and 56 pts. at  $7^\circ$ ; 100 pts.  $\text{H}_2\text{O}$  dissolve 35.7 pts.  $\text{NaCl}$  at  $4^\circ$ , and 35.7 pts. at  $7^\circ$ ; 100 pts.  $\text{H}_2\text{O}$  dissolve 57.6 pts.  $\text{CaCl}_2 + 2.4$  pts.  $\text{NaCl}$  at  $4^\circ$ ; 100 pts.  $\text{H}_2\text{O}$  dissolve 59.5 pts.  $\text{CaCl}_2 + 4.6$  pts.  $\text{NaCl}$  at  $7^\circ$ . (Mulder, l. c.)

100 g.  $\text{H}_2\text{O}$  dissolve 72.6 g.  $\text{CaCl}_2 + 16.0$  g.  $\text{NaCl}$  at  $15^\circ$ . (Rüdröf.)

Sol. in sat.  $\text{KNO}_3 + \text{Aq.}$  (Fourcroy.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in 1 pt. strong boiling alcohol. (Wenzel.)

Sol. in 8 pts. alcohol at  $15^\circ$ , and in 1 pt. spirits of wine. (Bergman.)

Sol. in 0.7 pt. boiling absolute alcohol. (Otto.)

Sol. in 1.43 pts. boiling absolute alcohol at  $78.3^\circ$ . (Graham.)

Solubility of  $\text{CaCl}_2$  in methyl alcohol.

$\text{CaCl}_2$  forms with methyl alcohol two complexes:  $\text{CaCl}_2 \cdot 4\text{CH}_3\text{OH}$  and  $\text{CaCl}_2 \cdot 3\text{CH}_3\text{OH}$ .

Solubility of  $\text{CaCl}_2, 4\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$ .

$t^\circ$	% by weight of $\text{CaCl}_2, 4\text{CH}_3\text{OH}$
0	33.3
10	37.6
20	42.2
30	47.0
40	52.0
50	57.3
55	60.0
56	61.3

Solubility of  $\text{CaCl}_2, 3\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$ .

$t^\circ$	% by weight of $\text{CaCl}_2, 3\text{CH}_3\text{OH}$
55	60.5
75	63.1
95	66.3
115	70.3
135	75.2
155	81.8
165	86.2
170	89.5
174	93.5
177 (mpt.)	100

(Menschutkin, Z. anorg. 1907, 52. 21.)

Solubility of  $\text{CaCl}_2$  in ethyl alcohol.

$\text{CaCl}_2$  forms with ethyl alcohol a complex,  $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$ .

Solubility of  $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{CaCl}_2 \cdot 3\text{C}_2\text{H}_5\text{OH}$
0	34.8	80	86.8
20	46.0	85	89.2
40	58.7	90	91.9
60	73.0	95	96.2
70	80.8	97 mpt.	100

(Menschutkin, Z. anorg. 1907, 52. 23.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{CaCl}_2 + \text{alcohol}$  containing 5.668%  $\text{CaCl}_2 = 0.83636$ . (Schönrock, Z. phys. Ch. 1893, 11. 768.)

B-pt. of an alcoholic solution of  $\text{CaCl}_2$ .

% $\text{CaCl}_2$	B-pt.
2.4	$78.43^\circ + 0.70^\circ$
5.39	$78.43^\circ + 2.15^\circ$
8.01	$78.32^\circ + 4.18^\circ$
9.93	$78.43^\circ + 5.55^\circ$
15.94	$78.43^\circ + 11.75^\circ$

(Skinner, Chem. Soc. 61. 340.)

Sl. sol. in propyl alcohol. (Berthelot.)

100 g. propyl alcohol dissolve 10.75 g.  $\text{CaCl}_2$ . (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Sl. sol. in amyl alcohol. (Bouis.)

Pptd. from alcoholic solution by ether. (Döbbereiner.)

Sol. in wood-spirit; sol. in lignone (Liebig); insol. in lignone. (Gmelin.)

Insol. in acetone; sol. in butyl alcohol. (Wurtz.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Solubility in acetone + Aq at 20°.

CaCl<sub>2</sub> will salt out acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of CaCl<sub>2</sub>, acetone and H<sub>2</sub>O just become homogeneous at 20°. 100 g. of the solution contain:

g. CaCl <sub>2</sub>	g. H <sub>2</sub> O	g. acetone
13.03	52.49	34.48
8.5	45.37	46.15
6.38	39.51	54.11
5.35	35.95	58.70
4.11	31.8	64.09
3.58	29.88	66.54
3.31	28.59	68.10
3.04	27.03	69.93
2.77	26.67	70.56
13.90	53.47	32.63
10.12	48.86	41.02
8.47	45.59	45.94
6.92	41.24	51.84
6.31	39.15	54.54
5.28	36.09	58.63
4.94	34.72	60.34
4.37	33.8	61.83
1.99	23.38	74.63
1.6	21.4	77.00
1.35	19.92	78.73
18.787	55.301	25.913
12.443	52.153	35.404
10.70	49.61	39.69
9.59	47.75	42.66
8.82	46.04	45.14
7.48	42.75	49.77
7.07	41.54	51.39
6.72	40.48	52.8
30.04	49.39	20.57
18.23	55.01	26.76
15.49	54.00	30.51
13.18	52.52	34.3
11.40	50.20	38.40
28.09	51.71	20.20
26.81	52.01	21.18
22.67	55.66	21.67
18.189	56.21	25.60
31.21	48.00	20.81
2.23	24.93	72.84
1.82	22.27	75.89
0.68	15.87	83.44
0.58	14.93	84.49
0.45	13.55	86.00
0.48	14.49	85.13
0.27.	12.31	87.42
0.20	9.95	89.85
0.15	9.05	90.81

(Frankforter, J. Am. Chem. Soc. 1914, 36. 1125.)

Sol. in many compound ethers, as ethyl acetate (Liebig), ethyl lactate (Strecker).

Sol. in considerable quantity in amyl sulphocyanide. (Medlock, Chem. Soc. 1. 374.)

Sol. in valyl. (Kolbe.)

Very sol. in conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Liebig.)

Solubility of CaCl<sub>2</sub> in acetic acid.

CaCl<sub>2</sub> forms with acetic acid a complex, CaCl<sub>2</sub>·4CH<sub>3</sub>COOH.

Solubility of CaCl<sub>2</sub>·4CH<sub>3</sub>COOH in CH<sub>3</sub>COOH at t°.

t°	% by wt. CaCl <sub>2</sub> ·4CH <sub>3</sub> COOH
11.1	42.0
30	47.6
35	50.0
40	54.7
45	63.0
50	69.5
60	79.5
65	84.5
70	91.2
73	100.0

(Menschutkin, Z. anorg. 1907, 54. 95.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sl. sol. in anhydrous pyridine.

Sol. in 97%, 95% and 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

100 g. sat. solution of CaCl<sub>2</sub> in sat. sugar + Aq at 31.25° contain 42.84 g. sugar + 25.25 g. CaCl<sub>2</sub>, or 100 g. H<sub>2</sub>O dissolve 135.1 g. sugar + 79.9 g. CaCl<sub>2</sub> at 31.25°. (Köhler, Z. Ver. Zuckerind, 1907, 47. 447.)

+H<sub>2</sub>O. (Bakhuis Roozeboom.) See above.

+2H<sub>2</sub>O. (Bakhuis Roozeboom.) See above.

+4H<sub>2</sub>O. Two modifications. (Bakhuis Roozeboom.) See above.

α and β modifications (α = stable form.)

(Kusnetzov, C. A. 1911, 842.)

+6H<sub>2</sub>O. Very deliquescent. Sol. in H<sub>2</sub>O with absorption of much heat.

250 pts. CaCl<sub>2</sub> + 6H<sub>2</sub>O with 100 pts. H<sub>2</sub>O at 10.8° lower the temp. 23.2°. (Rüdorff, B. 2. 68.)

Melts in crystal H<sub>2</sub>O at 28° (Tilden, Chem. Soc. 45. 409); at 30.2° (Bakhuis Roozeboom.)

Sat. solution in H<sub>2</sub>O contains at:

-22°	-17°	-5°	-5°	+4°
31.5	32.4	35.1	35.2	36.5% salt,
8°	22°	29°	35°	49°
37.9	42.1	46.1	49.0	55.1% salt,
63°	80°	104°	115°	
55.9	57.5	58.5	58.6% salt.	

(Étard, A. ch. 1894, (7) 2. 532.)

Sat. solution of CaCl<sub>2</sub> + 6H<sub>2</sub>O contains

44.77 g.  $\text{CaCl}_2$  at  $25^\circ$ . (Schreinemakers and Figeo, Chem. Weekbl. 1911, 8. 685.)

See also above.

Solubility of  $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$  in ethyl alcohol + Aq under addition of increasing amounts of  $\text{CaCl}_2$ .

Per cent of alcohol by volume	G. $\text{CaCl}_2$ added	Grams $\text{CaCl}_2$ in 5 cc. of solution
92.3		1.430
97.3		1.409
99.3		1.429
"	1	1.529
"	2	1.561
"	3	1.590
"	4	1.641
"	5	1.709

(Böttker, Z. phys. Ch. 1897, 22. 510.)

**Calcium hydroxylamine chloride**,  $\text{CaCl}_2 \cdot 3\text{NH}_2\text{OH} \cdot \text{HCl}$ .

(Antonow, J. Russ. Phys. Chem. Soc. 1905, 37. 479.)

**Calcium iodine trichloride**,  $2\text{ICl}_3 \cdot \text{CaCl}_2 + 8\text{H}_2\text{O}$ .

Hydroscopic. (Weinland, Z. anorg. 1902, 30. 142.)

**Calcium mercuric chloride**,  $\text{CaCl}_2 \cdot 5\text{HgCl}_2 + 8\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ , which dissolves out  $\text{CaCl}_2$ , but all dissolves on heating. (v. Bonsdorff, 1829.)

$\text{CaCl}_2 \cdot 2\text{HgCl}_2 + 6\text{H}_2\text{O}$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

$\text{CaCl}_2 \cdot 6\text{HgCl}_2 + 6\text{H}_2\text{O}$ . Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Strömholm, J. pr. 1902, (2) 66. 521.)

**Calcium lead chloride, basic.**

See Calcium lead oxychloride.

**Calcium magnesium chloride**,  $\text{CaCl}_2 \cdot 2\text{MgCl}_2 + 12\text{H}_2\text{O}$ .

Min. *Tachhydrite*. Deliquescent.

100 pts.  $\text{H}_2\text{O}$  dissolve 160.3 pts. at  $18.75^\circ$ . By dissolving 20 pts. in 80 pts.  $\text{H}_2\text{O}$  the temp. is raised  $7.75^\circ$ . (Bischof.)

**Calcium mercuric chloride, basic**,  $\text{CaCl}_2 \cdot 2\text{HgO} + 4\text{H}_2\text{O}$ .

See Calcium mercuric oxychloride.

**Calcium thallic chloride**,  $2\text{TiCl}_3 \cdot \text{CaCl}_2 + 6\text{H}_2\text{O}$ .

Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke A. 1909, 366. 222.)

**Calcium tin (stannic) chloride.**

See Chlorostannate, calcium.

**Calcium uranium chloride**,  $\text{CaCl}_2 \cdot \text{UCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1899, (3) 21. 265.)

**Calcium zinc chloride.**

$\text{CaZnCl}_4 + 5\frac{1}{2}\text{H}_2\text{O}$ , and  $\text{Ca}_2\text{ZnCl}_6 + 6\text{H}_2\text{O}$ . Very hygroscopic. (Ephraim, Z. anorg. 1910, 67. 379.)

**Calcium chloride ammonia**,  $\text{CaCl}_2 \cdot 8\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Faraday.)

**Calcium chloride hydrazine**,  $\text{CaCl}_2 \cdot 2\text{N}_2\text{H}_4(?)$ .

Ppt. (Franzen, Z. anorg. 1908, 60. 288.)

**Calcium chloride hydroxylamine**,  $\text{CaCl}_2 \cdot \text{NH}_2\text{OH} + 5\text{H}_2\text{O}$ .

Not hygroscopic. (Antonow, J. Russ. Phys. Chem. Soc. 1905, 37. 479.)

$\text{CaCl}_2 \cdot 2\text{NH}_2\text{OH}$ .

+  $\text{H}_2\text{O}$ . Aqueous solution sat. at  $20^\circ$  contains 56.6 pts. salt.

+  $2\text{H}_2\text{O}$ . (Antonow, l. c.)

$2\text{CaCl}_2 \cdot 3\text{NH}_2\text{OH} + 6\text{H}_2\text{O}$ . (Antonow, l. c.)

$2\text{CaCl}_2 \cdot 5\text{NH}_2\text{OH} + 4\text{H}_2\text{O}$ . (Antonow, l. c.)

**Calcium chloride lead oxide**,  $\text{CaCl}_2 \cdot 3\text{PbO} + 3\text{H}_2\text{O}$ .

See Calcium lead oxychloride.

**Calcium chloroferrite**,  $\text{CaO} \cdot \text{CaCl}_2 \cdot \text{Fe}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (le Chatelier, C. R. 99. 276.)

**Calcium chlorofluoride**,  $\text{CaF}_2 \cdot \text{CaCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ , by very dil.  $\text{HCl}$ ,  $\text{HNO}_3$ , or acetic acid, by hot dil. or conc.  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{HCl}$  or  $\text{HNO}_3$ . Insol. in, and not decomp. by cold or boiling alcohol. (Defacqz, A. ch. 1904, (8) 1. 355.)

**Calcium cyanamide, basic**,  $\text{CN}_2(\text{CaOH})_2 + 6\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Meyer, J. pr. 1878, (2) 18. 425.)

**Calcium cyanamide**,  $\text{CaCN}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Meyer, J. pr. 1878, (2) 18. 425.)

**Calcium subfluoride**,  $\text{CaF}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in hot dil.  $\text{HCl}$  and somewhat sol. in dil. acetic acid.

Somewhat sol. in boiling absolute alcohol. (Wöhler, Z. anorg. 1909, 61. 81.)

**Calcium fluoride**,  $\text{CaF}_2$ .

Sol. in 26,923 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ . (Wilson, Ch. Gaz. 1850. 366.)

1 l.  $\text{H}_2\text{O}$  dissolves 16 mg.  $\text{CaF}_2$  at  $18^\circ$ .

(Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

16.3 mg. in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

When pptd. not completely insol. in  $H_2O$ ; scarcely sol. in dil., more sol. in conc.  $HCl + Aq$ ; decomp. by conc.  $H_2SO_4$ ; not decomp. by dil. alkaline solutions. (Fresenius.)

Not decomp. by conc.  $H_2SO_4$  below  $40^\circ$ , but forms a transparent syrup.  $CaF_2$  is pptd. from this solution by addition of  $H_2O$ .

Sol. in conc.  $HCl$  and  $HNO_3 + Aq$  in the same way, but the liquid is not viscid. Very sl. sol. in  $HF$ . Boiling  $HCl + Aq$  dissolves slightly. Decomp. by boiling  $HNO_3 + Aq$ .

Sol. in  $NH_4$  salts +  $Aq$ . (Rose.) Partly decomp. by boiling  $K_2CO_3$ , and  $Na_2CO_3 + Aq$ . (Dulong, A. ch. 82. 278.)

Insol. in liquid  $HF$ . (Franklin, Z. anorg. 1905, 46. 2.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Min. *Fluorite* (*Fluorspar*). Calculated from electrical conductivity of  $CaF_2 + Aq$ , 1 l.  $H_2O$  dissolves 14 mg.  $CaF_2$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

**Calcium hydrogen fluoride,  $CaH_2F_4 + 6H_2O$ .**

Decomp. by boiling  $H_2O$ . Sol. in  $HF + Aq$ . (Fremy, A. ch. (3) 47. 35.)

**Calcium tantalum fluoride.**

See *Fluotantalate, calcium*.

**Calcium stannic fluoride.**

See *Fluostannate, calcium*.

**Calcium titanium fluoride.**

See *Fluotitanate, calcium*.

**Calcium fluoiodide,  $CaF_2, CaI_2$ .**

Very deliquescent. Decomp. by cold  $H_2O$ , more rapidly by hot  $H_2O$ , by dil.  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ , conc.  $H_2SO_4$ , and by alcohol and by ether if these reagents are not absolute. (De-facqz, A. ch. 1904, (8) 1. 358.)

**Calcium hydride,  $CaH_2$ .**

Decomp. by  $HCl + Aq$ . (Winkler, B. 24. 1975. (Moldenhauer, Z. anorg. 1913, 52. 136.)

$CaH_2$ . Readily decomp. by  $H_2O$  and dil. acids, almost insol. in conc. acids. Insol. in benzene, turpentine and alkyl haloids. (Moissan, C. R. 1898, 127. 30-31.)

Decomp.  $H_2O$  and ether; sol. in dil.  $H_2SO_4$  and  $HNO_3$ ; almost insol. in conc.  $H_2SO_4$  and  $HNO_3$ . (von Lengyll, C. C. 1898, II. 262.)

Insol. in  $CCl_4$ ,  $CS_2$ , alcohols and ethers. No known solvent. (Moissan, C. C. 1903, I. 863.)

**Calcium hydrosulphide,  $CaS_2H_2$ .**

Cryst. with  $6H_2O$ . Extremely sol. in  $H_2O$  and alcohol.  $\frac{1}{4}$  of its weight of  $H_2O$  at or-

dinary temp. more than suffices to hold it in solution. (Divers and Shimidzu, Chem. Soc. 45. 271.)

Sp. gr. of aqueous solution containing 32% anhydrous  $CaS_2H_2$  (64%  $CaS_2H_2 + 6H_2O$ ) = 1.255; 37.5%  $CaS_2H_2$  (75.5%  $CaS_2H_2 + 6H_2O$ ) = 1.310. (Divers and Shimidzu.)

**Calcium hydroxide,  $CaO, H_2$ .**

See also *Calcium oxide*.

Sl. sol. in cold, and less in hot  $H_2O$ .

1 pt.  $CaO$  dissolves at  $t^\circ$  in pts.  $H_2O$ .

$t^\circ$	Pts. $H_2O$	Authority
20	450	Davy.
0	656	Phillips (A. Phil. 17. 107)
	700	Bergman (Essays, etc.).
13	785	Pavesi and Rotondi (B. 7. 817)
18	780	Bineau (A. ch. (3) 81. 290).
19.5	806	P. and R. (l. c.).
23	814	P. and R. (l. c.).
18.75	960	Abi.
54.4	972	Dalton (Syst. 2. 231).
15.6	778	Dalton (l. c.).
15.6	752	Phillips (l. c.).
15.6	731	Wittstein (Repert. Pharm. 1. 182).
15.6	741	Tiechborne (Bull. Soc. (2) 17. 24).
100	1270	Dalton (l. c.).
100	1280	Phillips (l. c.).
100	1330	Wittstein (l. c.).
100	1340	Tiechborne (l. c.).
100	1500	Bineau (l. c.).
100	1758	Tiechborne (l. c.).

Solubility in  $H_2O$ . 1000 pts.  $CaO, H_2 + Aq$  sat. at  $t^\circ$  contain pts.  $CaO$ .

$t^\circ$	Pts. $CaO$		
	From Nitrate	Marble	Hydrate
0	1.362	1.381	1.430
10	1.311	1.342	1.384
15	1.277	1.299	1.344
30	1.142	1.162	1.195
45	0.996	1.005	1.033
60	0.884	0.868	0.885
100	0.562	0.576	0.584

(Lamy, C. R. 86. 333.)

Solubility of  $CaO, H_2$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $H_2O$ to 1 pt. $CaO$	Pts. $CaO$ in 100 pts. $H_2O$	$t^\circ$	Pts. $H_2O$ to 1 pt. $CaO$	Pts. $CaO$ in 100 pts. $H_2O$
0	759	0.131	60	1136	0.088
10	770	0.129	70	1235	0.080
20	791	0.128	80	1362	0.073
30	862	0.116	90	1579	0.063
40	932	0.107	100	1650	0.060
50	1019	0.098	...	...	...

(Maben, Pharm. J. Trans. (3) 14. 505.)

1 pt.  $CaO, H_2$  is sol. in 640 pts.  $H_2O$  at  $19^\circ$ , and 3081 pts. at  $150^\circ$ . (Shenstone and Cundall, Chem. Soc. 53. 550.)

1000 g.  $H_2O$  dissolve 1.251 g.  $CaO$ . (Carles, Arch. Pharm. (3) 4. 558.)



Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{CaO}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{CaO}$	$t^\circ$	Pts. $\text{CaO}$
20	0.1374	80	0.0845
40	0.1162	100	0.0664
60	0.1026	...	...

(Zahorsky, Z. anorg. 3. 34.)

1 pt.  $\text{CaO}$  is sol. in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	15°	20°	25°	30°	35°	40°	45°
pts. $\text{H}_2\text{O}$	776	813	848	885	924	962	1004

$t^\circ$	50°	55°	60°	65°	70°	75°	80°
pts. $\text{H}_2\text{O}$	1044	1108	1158	1244	1330	1410	1482

(Hersfeld, C. C. 1897, I, 932.)

100 g. sat.  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contain g.  $\text{CaO}$  at  $t^\circ$ :

$t^\circ$	5	10	15	20	25
g. $\text{CaO}$	0.135	0.1342	0.132	0.1293	0.1254

$t^\circ$	30	35	40	50	60
g. $\text{CaO}$	0.1219	0.1161	0.1119	0.0981	0.0879

$t^\circ$	70	80	90	100
g. $\text{CaO}$	0.0781	0.074	0.0696	0.0597

(Guthrie, J. Soc. Chem. Ind. 1901, 20. 223.)

Solubility in  $\text{H}_2\text{O}$  at high temp.

1 litre of the solution contains at:

	120°	150°	190°
	0.305	0.169	0.064 g. $\text{CaO}$ .

(Herold, Z. elektrochem. 1905, 11. 421.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	1 g. $\text{CaO}$ is sol. in g. $\text{H}_2\text{O}$ at $t^\circ$
2	768.5
10	786.8
15	804.3
20	826.4
25	868.7
30	908.2
40	988.1
50	1083.0
60	1179.0
70	1274.8
80	1368.1

(Moody, Chem. Soc. 1906, 93. 1772.)

Sat.  $\text{CaO}_2\text{H}_2 + \text{Aq}$  contains at:

	95°	76°
	0.0580	0.0705% by wt. $\text{CaO}$ .

(Tschugaeff, Z. anorg. 1914, 86. 159.)

100 g. sat. solution of  $\text{CaO}_2\text{H}_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$  contain 0.117 g.  $\text{CaO}_2\text{H}_2$ . (Cameron and Potter, J. phys. Ch. 1911, 15. 70.)

Readily sol. in most acids.

Sol. in  $\text{H}_2\text{BO}_3 + \text{Aq}$  at  $30^\circ$ . (Sborgi, Real. Ac. Linc. 1913, (5) 22. I, 715 and 798.)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Much more sol. in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Rose.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{NH}_4\text{Cl} + \text{Aq}$ in millimols per liter	Solubility of $\text{CaO}_2\text{H}_2$ in millimols per liter
0.00	20.22
21.76	29.08
43.52	39.23
87.03	59.68

(Noyes and Chapin, Z. phys. Ch. 1899, 23. 520.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaCl}_2 + \text{Aq}$ . 100 pts.  $\text{CaCl}_2 + \text{Aq}$  of given strength dissolve pts.  $\text{CaO}$  at  $t^\circ$ .

$t^\circ$	$\text{CaCl}_2 + \text{Aq}$ 5% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 10% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 15% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 20% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 25% $\text{CaCl}_2$	$\text{CaCl}_2 + \text{Aq}$ 30% $\text{CaCl}_2$
20	0.1370	0.1661	0.1993	0.1857*	0.1661*	0.1630*
40	0.1160	0.1419	0.1781	0.2249	0.3030*	0.3684*
60	0.1020	0.1313	0.1706	0.2204	0.2989	0.3664
80	0.0936	0.1328	0.1736	0.2295	0.3261	0.4122
100	0.0906	0.1389	0.1842	0.2325	0.3710	0.4922

\* In these cases, ppts. of  $3\text{CaO}$ ,  $\text{CaCl}_2 + 15\text{H}_2\text{O}$  were formed.

(Zahorsky, Z. anorg. 3. 34.)

See also  $\text{CaCl}_2 + \text{CaO}_2\text{H}_2$  under Calcium chloride.

Solubility in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Sp. gr. $25^\circ/25^\circ$	$\text{Ca}(\text{OH})_2$ in 100 g. $\text{H}_2\text{O}$	$\text{Ca}(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$	Solid phase
1.0249	0.096	3.38	$\text{Ca}(\text{OH})_2$
1.0484	0.109	8.52	
1.0940	0.125	13.42	
1.1383	0.181	20.73	
1.1840	0.187	28.98	$\text{Ca}(\text{OH})_2$ and solid solution $\text{CaO}$ , $x\text{N}_2\text{O}_x$ , $y\text{H}_2\text{O}$
1.2101	0.198	32.84	
1.2287	0.212	36.83	
1.2290	0.213	37.55	
1.2541	0.224	40.25	Solid solution $\text{CaO}$ , $x\text{N}_2\text{O}_x$ , $y\text{H}_2\text{O}$
1.2581	0.230	41.98	
1.2826	0.260	47.00	
1.2905	0.263	47.16	
1.3337	0.332	58.67	Solid solution $\text{CaO}$ , $x\text{N}_2\text{O}_x$ , $y\text{H}_2\text{O}$ and $\text{Ca}(\text{NO}_3)_2$ , $3\frac{1}{2}\text{H}_2\text{O}$
1.3735	0.429	69.40	
1.4195	0.545	83.03	
1.4840	0.449	99.70	
1.5330	0.371	115.50	$\text{Ca}(\text{NO}_3)_2$ , $3\frac{1}{2}\text{H}_2\text{O}$ and $\text{Ca}(\text{NO}_3)_2$ , $4\text{H}_2\text{O}$
1.5809	0.303	135.30	
1.5842	0.000	139.30	$\text{Ca}(\text{NO}_3)_2$ , $4\text{H}_2\text{O}$

(Cameron and Robinson, J. phys. Chem. 1907, 11, 275.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq.}$   
Temp. =  $25^\circ$ .

G. per 100 g. sat. solution		Solid phase
CaO	$\text{Ca}(\text{NO}_3)_2$	
0.1150	0	$\text{CaO}_2\text{H}_2$
0.0978	4.84	"
0.1074	9.36	"
0.1193	13.77	"
0.1444	22.46	"
0.1650	27.83	"
0.1931	32.94	"
0.2579	40.66	"
0.3060	44.44	"
0.2802	45.28	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$
0.2314	47.79	"
0.1894	51.07	"
0.1659	53.20	"
0.1486	55.25	"
0.0836	57.72	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
0	57.98	"

Temp. =  $100^\circ$ .

0.0561	0	$\text{CaO}_2\text{H}_2$
0.0550	2.42	"
0.0624	4.91	"
0.1110	15.39	"
0.1200	16.10	"
0.155	21.86	"
0.269	33.03	"
0.480	42.26	"
0.973	50.94	"
1.261	53.75	"
1.477	55.40	"
1.476	55.43	"
1.491	55.65	"
1.635	56.89	$\text{CaO}_2\text{H}_2 + \text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
1.686	57.03	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$
1.596	57.91	"
1.576	58.67	"
1.348	60.44	"
1.167	62.82	"
1.077	66.44	"
1.141	69.12	"
1.252	70.60	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot 2\text{H}_2\text{O} + \text{Ca}_2\text{N}_2\text{O}_7 \cdot \frac{1}{2}\text{H}_2\text{O}$
1.203	70.40	$\text{Ca}_2\text{N}_2\text{O}_7 \cdot \frac{1}{2}\text{H}_2\text{O}$
1.103	71.44	"
0.937	73.85	"
0.849	75.74	"
0.815	76.94	"
0.804	77.62	$\text{Ca}(\text{NO}_3)_2$
0.412	77.74	"
0	78.43	"

(Bassett and Taylor, Chem. Soc. 1914, 105. 1926.)

Solubility of  $\text{CaO}$  in  $\text{KCl}$  and  $\text{NaCl} + \text{Aq.}$   
Curves are given which show that the solubility of lime in solutions of either  $\text{NaCl}$  or

$\text{KCl}$  is a maximum for all temps. when the solution contains about 60 g. of salt per l. It is a minimum at any fixed temp. when the solution is sat., the solubility then being much less than in pure  $\text{H}_2\text{O}$  of the same temp. A solution of  $\text{NaCl}$  dissolves more lime at all temps. and concentrations than a corresponding solution of  $\text{KCl}$ . In all cases the maximum solubility of lime occurs when the temp. is lowest. With solutions of all concentrations the solubility decreases regularly as the temp. increases. (Cabot, J. Soc. Chem. Ind. 1897, 16. 417-419.)

Solubility in  $\text{KCl} + \text{Aq}$  increases with increased quantities of  $\text{KCl}$  and then diminishes, becoming less than the solubility in  $\text{H}_2\text{O}$  alone. (Kernot, Gazz. ch. it. 1908, 38. (1) 532.)

$\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  containing 1 pt.  $\text{KOH}$  or  $\text{NaOH}$  in 100 pts.  $\text{H}_2\text{O}$  do not dissolve more than  $\frac{1}{10000}$  pt.  $\text{CaO}_2\text{H}_2$ , but it is sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Pelouze, A. ch. (3) 33. 11.)

Solubility in  $\text{NaOH} + \text{Aq}$  at  $t^\circ$ .

G. $\text{NaOH}$ per l	Solubility of $\text{CaO}$ in g. per liter at			
	$20^\circ$	$50^\circ$	$70^\circ$	$100^\circ$
0	1.17	0.88	0.75	0.54
0.400	0.94	0.65	0.53	0.35
1.600	0.57	0.35	0.225	0.14
2.666	0.39	0.20	0.11	0.05
5.000	0.18	0.06	0.04	0.01
8.000	0.11	0.02	0.01	traces
20.000	0.02	traces	0	0

(d'Anselme, Bull. Soc. 1903, (3) 29. 936.)

Solubility of  $\text{CaO}$  in  $\text{NaCl} + \text{NaOH} + \text{Aq.}$

G. $\text{NaCl}$ per l.	G. $\text{CaO}$ per l. of solution containing		
	No $\text{NaOH}$	0.89 g. $\text{NaOH}$ per l.	4.09 g. $\text{NaOH}$ per l.
0	1.3	0.8	0.22
5	1.4	0.9	....
10	1.6	1.0	....
25	1.7	1.1	....
50	1.8	1.25	....
75	1.9	1.4	0.55
100	1.85	1.4	....
150	1.65	1.25	0.44
175	1.6	1.2	....
182	1.6	1.2	....
225	1.4	1.0	....
250	1.3	0.9	....
300	1.1	0.7	0.22

(Maigret, Bull. Soc. 1905, (3) 33. 631.)

Solubility of  $\text{CaO}_2\text{H}_2$  in  $\text{CaSO}_4 + \text{Aq}$  at  $25^\circ$ .

G. per 100 cc. sat. solution		Solid phase
$\text{CaSO}_4$	$\text{CaO}$	
0	0.1166	$\text{CaO}_2\text{H}_2$
0.0391	0.1141	"
0.0666	0.1150	"
0.0955	0.1215	"
0.1214	0.1242	"
0.1588	0.1222	$\text{CaO}_2\text{H}_2 + \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
0.1634	0.0939	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
0.1722	0.0611	"
0.1853	0.0349	"
0.1918	0.0176	"
0.2030	0.0062	"
0.2126	0	"

(Cameron and Bell, J. Am. Chem. Soc. 1906, 28, 1220.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Alcohol dissolves traces.

Methyl alcohol forms colloidal solution containing 1.125 g. per l. (Neuberg and Rewald, Biochem. Z. 1908, 9, 545.)

Insol. in ether.

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Much more sol. in glycerine, or sugar + Aq than in  $\text{H}_2\text{O}$ .

Solubility of  $\text{CaO}$  in glycerine.

Wt. of glycerine in 100 ccm. of solution	Wt. $\text{CaO}$ contained in 100 ccm. of liquid sat. with $\text{CaO}$	Relation of $\text{CaO}$ to glycerine	
		$\text{CaO}$	Glycerine
10.00	0.370	3.6	96.4
5.00	0.240	4.6	95.4
2.86	0.196	6.4	93.6
2.50	0.192	7.1	92.9
2.00	0.186	8.5	91.5
1.00	0.165	14.2	85.8

(Berthelot, A. ch. (3) 46, 176.)

1000 g.  $\text{H}_2\text{O}$  dissolve 1.251 g.  $\text{CaO}$ ; 1000 g.  $\text{H}_2\text{O} + 50$  g. glycerine dissolve 1.865 g.  $\text{CaO}$ ; 1000 g.  $\text{H}_2\text{O} + 100$  g. glycerine dissolve 2.583 g.  $\text{CaO}$ ; 1000 g.  $\text{H}_2\text{O} + 200$  g. glycerine dissolve 4.040 g.  $\text{CaO}$ ; 1000 g.  $\text{H}_2\text{O} + 400$  g. glycerine dissolve 6.569 g.  $\text{CaO}$ . (Carles, Arch. Pharm. (3) 4, 558.)

Insol. in pure glycerine.

Solubility of  $\text{CaO}_2\text{H}_2$  in glycerine + Aq at  $25^\circ$ .

G = g. glycerine in 100 g. glycerine + Aq.  
 $\frac{1}{2}\text{Ca}(\text{OH})_2$  = millimols sol. in 100 cc. glycerine + Aq.

G	$\frac{1}{2}\text{Ca}(\text{OH})_2$	Sp. gr.
0	4.3	1.0003
7.15	8.13	1.0244
20.44	14.9	1.0537
31.55	22.5	1.0842
40.95	40.1	1.1137
48.7	44.0	1.1356
69.2	95.8	1.2027

(Herz and Knoch, Z. anorg. 1905, 46, 193.)

Solubility in glycerine + Aq at  $25^\circ$ .

Solution contains			Sp. gr.
% $\text{Ca}(\text{OH})_2$	% glycerine	% $\text{H}_2\text{O}$	
0.117	0	...	...
0.178	3.50	96.32	1.008
0.413	15.59	80.28	...
0.48	17.84	81.68	1.042
0.88	34.32	64.80	1.088
1.34	55.04	43.62	1.149

Solid phase in this system is  $\text{CaO}_2\text{H}_2$ .

(Cameron and Patten, J. phys. Chem. 1911, 15, 71.)

100 pts. sugar dissolved in  $\text{H}_2\text{O}$  dissolve 55.6 pts.  $\text{CaO}$  (Osann); 50 pts.  $\text{CaO}$  (Ure); 49.6 pts.  $\text{CaO}$  (Daniell); 29-30.6 pts.  $\text{CaO}$  (Hunton); 23 pts.  $\text{CaO}$  (Soubeiran.)

Sugar solution at  $100^\circ$  takes up  $\frac{1}{4}$  mol.  $\text{CaO}$  for each mol. sugar; at  $0^\circ$ , if it contains not less than 25% of sugar, it takes up 2 mols.  $\text{CaO}$  to 1 mol. sugar. (Dunbrunfaut.)

Amount dissolved is proportional to the density and temperature of the solutions.

Solubility of  $\text{CaO}$  in sugar + Aq.

Pts. sugar dissolved in 100 pts. $\text{H}_2\text{O}$	Relation of $\text{CaO}$ to sugar	
	$\text{CaO}$	Sugar
40	21.0	79.8
37.5	20.8	79.2
35.0	20.5	79.5
32.5	20.3	79.7
30.0	20.1	79.9
27.5	19.9	80.1
25.0	19.8	80.2
22.5	19.3	80.7
20.0	18.8	81.2
17.5	18.7	81.3
15.0	18.5	81.5
12.5	18.3	81.7
10.0	18.1	81.9
7.5	16.9	83.1
5.0	15.3	84.7
2.5	13.8	86.2

(Peligot, C. R. 22, 335.)

100 g. solution of sugar sat. with  $\text{CaO}$  between  $10^\circ$  and  $54.4^\circ$  contain 22.5 to 23.5%  $\text{CaO}$ . (Hunton, 1857.)

## Solubility of CaO in dil. sugar solutions.

Wt. of sugar in 100 ccm. of solution	Wt. of CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to sugar	
		CaO	Sugar
4.850	1.031	17.5	82.5
2.401	0.484	16.8	83.2
2.000	0.433	17.8	82.2
1.660	0.364	18.0	82.0
1.386	0.326	19.0	81.0
1.200	0.316	20.8	79.2
1.058	0.281	21.0	79.0
0.960	0.264	21.6	78.4
0.400	0.194	32.7	67.3
0.191	0.172	47.4	52.6
0.096	0.154	61.6	78.4
0.000	0.148	...	...

(Berthelot, A. ch. (3) 46. 176.)

## Solubility in sugar + Aq at t°.

t°	G. sugar in 100 ccm. of solution	G. CaO dissolved per 100 g. sugar
16-17°	0.7814	37.9
	0.9120	32.3
	1.4000	30.5
	1.6930	28.9
	4.754	27.7
	5.730	27.1
	10.159	27.5
	11.200	27.2
	12.500	27.3
	13.930	27.9
	14.487	27.5
	16.410	28.0
15°	0.625	71.6
	0.964	53.4
	2.084	36.0
	3.028	32.3
	3.451	31.7
	4.168	30.2
	4.880	28.7
	5.73	28.3
	6.12	27.4
	6.25	27.7
	6.51	27.5
	7.55	27.9
	8.20	27.3

(Weisberg, Bull. Soc. 1899, (3) 21. 775.)

## Solubility in sugar + Aq at 25°.

Solution contains			Sp. gr.
% Ca(OH) <sub>2</sub>	% sugar	% H <sub>2</sub> O	
0.117	0	...	0.983
0.188	0.62	99.19	1.000
0.730	4.82	94.50	1.021
1.355	7.50	91.12	1.037
2.31	9.87	87.85	1.051
3.21	11.90	84.89	1.067
4.57	15.10	80.33	1.092
5.38	17.42	76.93	1.109
6.07	19.86	73.07	1.123

The solid phase in this system consists of a series of solid solutions with Ca(OH)<sub>2</sub>, a limiting case.

(Cameron and Patten, J. phys. Chem. 1911, 15. 70.)

## Solubility of CaO in sugar + Aq at 80°.

% sugar	% CaO	% Sugar	% CaO
4.90	0.117	19.50	0.368
9.90	0.189	24.60	0.458
14.75	0.230	29.70	1.017

Solid phase, CaO<sub>2</sub>H<sub>2</sub>.  
(von Ginneken, Proc. Kon. Akad. v. Wetensch, Amsterdam, 1911, 14. 457.)

## Solubility of CaO in mannite + Aq.

Wt. of mannite in 100 ccm. of solution	Wt. of CaO contained in 100 ccm. of liquid sat. with CaO	Relation of CaO to mannite	
		CaO	Mannite
9.60	0.753	7.3	92.7
4.80	0.372	7.2	92.8
2.40	0.255	9.6	90.4
1.92	0.225	10.5	89.5
1.60	0.207	11.4	88.6
1.37	0.194	12.5	87.5
1.20	0.193	13.9	86.1
1.07	0.190	15.1	84.9
0.96	0.186	16.2	86.8
0.192	0.155	44.6	55.4
0.096	0.154	61.6	38.4
0.000	0.148	...	...

(Berthelot, A. ch. (3) 46. 176.)

Solutions of CaO in sugar, mannite, or glycerine afford an abundant ppt. on being heated, but this redissolves on cooling. (Berthelot.)

Sol. in sorbite + Aq (Pelouze); sl. sol. in quercite + Aq. Sol. in monobasic Ca saccharate + Aq. (Peligot.) Much more sol. in gelatine + Aq than in pure H<sub>2</sub>O.

**Calcium hydroxyhydrosulphide, Ca(OH)SH + 3H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O with almost immediate decomposition. Insol. in alcohol, but slowly

decomp. thereby. (Divers and Shimidzu, Chem. Soc. **45**. 270.)

**Calcium subiodide,  $\text{CaI}$ .**

Decomp. by moisture. (Wöhler, Z. anorg. 1909, **61**. 76.)

**Calcium iodide,  $\text{CaI}_2$ .**

Deliquescent. 100 pts.  $\text{H}_2\text{O}$  dissolve—

at 0°	20°	40°	43°	92°
192	204	228	286	435 pts. $\text{CaI}_2$ .

(Kremers, Pogg. **103**. 65.)

Sp. gr. of  $\text{CaI}_2 + \text{Aq}$  at 19.5° containing:

5	10	15	20	25	30% $\text{CaI}_2$
1.044	1.09	1.14	1.198	1.26	1.321

35	40	45	50	55	60% $\text{CaI}_2$
1.398	1.477	1.567	1.665	1.78	1.91

(Kremers, calculated by Gerlach, Z. anal. **8**. 285.)

Sol. in absolute alcohol. (Gay-Lussac, A. ch. **91**. 57.)

Sol. in acetone. (Naumann, B. 1904, **37**. 4328; Eidmann, C. C. 1899, II. 1014.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43**. 314.)

+4 $\text{H}_2\text{O}$ . (Kuznetsov, C. A. 1911. 842.)

+6 $\text{H}_2\text{O}$ . Sat. aq. solution contains at:

-22°	+7°	10°	19°
61.6	65.0	65.1	66.3% salt.

51°	64°	130°	248°
69.4	75.9	81.3	87.1% salt.

(Étard, A. ch. 1894, (7) **2**. 543.)

+7 $\text{H}_2\text{O}$ . (Kuznetsov.)

**Calcium periodide,  $\text{CaI}_2 + 15\text{H}_2\text{O}$ .**

(Mosnier, A. ch. 1897, (7) **12**. 401.)

$\text{CaI}_2$ . (Herz and Bulla, Z. anorg. 1911, **71**. 255.)

**Calcium mercuric iodide,  $\text{CaI}_2 \cdot \text{HgI}_2 + 8\text{H}_2\text{O}$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohols, allyl iodide, aldehyde, acetic acid, ethyl oxalate and aniline. Sl. sol. in nitrobenzene. Completely insol. in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl iodide, ethylene bromide,  $\text{C}_6\text{H}_6$ , monochlorobenzene and toluene. (Duboin, C. R. 1906, **142**. 573.)

3 $\text{CaI}_2$ , 4 $\text{HgI}_2 + 24\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with pptn. of red  $\text{HgI}_2$ .

Very sol. in alcohols, glycerine, ethyl acetate, methyl and isobutyl propionate, allyl iodide, aldehyde, acetone, aniline and ethyl oxalate. Insol. or sl. sol. in nitrobenzene. Insol. in  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , ethyl iodide, monochlorobenzene, etc. (Duboin, C. R. 1906, **142**. 397.)

$\text{CaI}_2$ , 2 $\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Boullay.)

$\text{CaI}_2$ , 5 $\text{HgI}_2 + 8\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ ,

alcohols, glycerine, aldehyde, and acetic acid; slowly by nitrobenzene and ethyl oxalate. Insol. in monochlorobenzene, toluene,  $\text{CHCl}_3$  and ethylene bromide. (Duboin, l. c.)

**Calcium silver iodide,  $\text{CdI}_2$ , 2 $\text{AgI} + 6\text{H}_2\text{O}$ .**

Immediately decomp. by  $\text{H}_2\text{O}$ . (Simpson, Roy. Soc. Proc. **37**. 120.)

**Calcium zinc iodide,  $\text{CaI}_2$ ,  $\text{ZnI}_2 + 8\text{H}_2\text{O}$ .**

Very hygroscopic. (Ephraim, Z. anorg. 1910, **67**. 384.)

**Calcium iodide ammonia,  $\text{CaI}_2$ , 6 $\text{NH}_3$ .**

(Isambert, C. R. **66**. 1259.)

**Calcium nitride,  $\text{Ca}_3\text{N}_2$ .**

Sol. in dil. acids; insol. in conc. (water free) acids. (Moissan, C. R. 1898, **127**. 499.)

**Calcium oxide,  $\text{CaO}$ .**

Decomp. by  $\text{H}_2\text{O}$ , with evolution of much heat, to form  $\text{CaO}_2\text{H}_2$ , which see for solubility in  $\text{H}_2\text{C}$ , etc.

**Calcium peroxide,  $\text{CaO}_2$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids, and  $\text{NH}_4$  salts +  $\text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Conroy, Chem. Soc. (2) **11**, 808.)

+2 $\text{H}_2\text{O}$ . True composition is  $\text{CaO}_2\text{H}_2 + \text{H}_2\text{O}_2$ . (de Forcrand, C. R. 1900, **130**. 1390.)

+8 $\text{H}_2\text{O}$ . Efflorescent. Difficultly sol. in  $\text{H}_2\text{O}$  with gradual decomp. Insol. in alcohol or ether. (Gay-Lussac and Thénard, A. ch. (2) **8**. 313.)

**Calcium oxybromide, 3 $\text{CaO}$ ,  $\text{CaBr}_2 + 16\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Very easily sol. in hydracids and dil.  $\text{HNO}_3$ . (Tassily, C. R. 1894, **119**. 372.)

**Calcium oxychloride,  $\text{Ca}_2\text{O}_2\text{Cl}_2 + 15\text{H}_2\text{O} = 3\text{CaO}$ ,  $\text{CaCl}_2 + 15\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Rose.)

Formula is  $\text{Ca}_2\text{HO}_2\text{Cl} + 7\text{H}_2\text{O}$ . (Grimshaw, C. N. **30**. 280.)

+16 $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{CaO}_2\text{H}_2$  and  $\text{CaCl}_2$  until a maximum of 85 g.  $\text{CaCl}_2$  are dissolved per litre. (Ditte, C. R. **91**. 576.)

4 $\text{CaO}$ ,  $\text{CaCl}_2 + 14\text{H}_2\text{O}$ . (Schreinemakers and Figeé, Chem. Weekbl. 1911, **8**. 685.)

$\text{CaO}$ ,  $\text{CaCl}_2$ . (Schreinemakers and Figeé.)

**Calcium lead oxychloride,  $\text{CaCl}_2$ ,  $\text{CaO}$ , 2 $\text{PbO} + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (André, C. R. **104**. 359.)

$\text{CaCl}_2$ , 3 $\text{PbO} + 3\text{H}_2\text{O}$ . (André.)

**Calcium mercuric oxychloride,  $\text{CaCl}_2$ , 2 $\text{HgO} + 4\text{H}_2\text{O}$ .**

Decomp. immediately by  $\text{H}_2\text{O}$ . (Klinger, B. **16**. 997.)

**Calcium oxyiodide**,  $3\text{CaO}, \text{CaI}_2 + 16\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , alcohol, and acids. Sol. in hydracids and in very dil.  $\text{HNO}_3$ . (Tassily, C. R. 1894, 119. 372.)

**Calcium oxysulphide**,  $\text{Ca}_2\text{O}_3\text{S}_4 + 12\text{H}_2\text{O} = 3\text{CaO}, \text{CaS}_4 + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Not acted on by absolute alcohol. (Schöne, Pogg. 117. 77.)

According to Geuther (A. 224. 178) =  $\text{CaS}_3, 2\text{CaO} + 10$ , or  $11\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  with separation of S.

$\text{Ca}_2\text{O}_3\text{S}_4 + 18\text{H}_2\text{O} = 4\text{CaO}, \text{CaS}_4 + 18\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ , but not acted on by absolute alcohol. (Schöne, Pogg. 117. 82.)

According to Geuther (A. 224. 178) =  $\text{CaS}_3, 3\text{CaO} + 14$ , or  $15\text{H}_2\text{O}$ .

$\text{Ca}_2\text{O}_3\text{S}_4 + 20\text{H}_2\text{O} = 5\text{CaO}, \text{CaS}_4 + 20\text{H}_2\text{O}$ . (Rose, Pogg. 55. 433.)

Sol. in 400 pts. cold, decomp. by boiling  $\text{H}_2\text{O}$  (Buchner); sl. sol. in cold, much more in hot  $\text{H}_2\text{O}$ , but it is not deposited on cooling. Aqueous solution sat. at  $6^\circ\text{--}7.2^\circ$  has sp. gr. = 1.0105 (Herschel); sol. in alcohol (Gay-Lussac); insol. in alcohol (Gmelin).

**Calcium phosphide**,  $\text{CaP}$ .

Deliquescent. Decomp. in moist air or with  $\text{H}_2\text{O}$ . Not attacked by conc.  $\text{HNO}_3$ , but decomp. by dil.  $\text{HNO}_3 + \text{Aq}$ . (Thénard, A. ch. (3) 14. 14.)

$\text{Ca}_3\text{P}_2$ . Crystallized.

Decomp. by  $\text{H}_2\text{O}$ .

Not attacked by conc.  $\text{H}_2\text{SO}_4$ . Violently attacked by dil.  $\text{H}_2\text{SO}_4$ .

Not attacked by abs. alcohol, ether, benzene or oil of turpentine. (Moissan, C. R. 1899, 128. 792.)

$\text{Ca}_3\text{P}_2$ . Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

**Calcium selenide**,  $\text{CaSe}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Very easily decomp. (Fabre, C. R. 102. 1469.)

**Calcium silicide**,  $\text{CaSi}$ .

Slowly decomp. by  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{H}_2\text{SO}_4$  and dil.  $\text{HNO}_3$  with evolution of  $\text{H}_2$ . With conc.  $\text{HCl}$  it gives  $\text{H}_2$ , Si and silicon hydride; with dil.  $\text{HCl}$ ,  $\text{H}_2$  and a yellow substance. Sol. in alkali +  $\text{Aq}$  or  $\text{NH}_3 + \text{Aq}$  with evolution of  $\text{H}_2$ . (Moissan, C. R. 1902, 134. 505.)

Two modifications:

(a) Only sl. sol. in  $\text{HNO}_3$ ; decomp.  $\text{H}_2\text{O}$  to give an insol. ppt. on addition of  $\text{HCl}$ .

(b) Easily sol. in  $\text{HNO}_3$  and acetic acid; decomp.  $\text{HCl}$  to give a ppt. which is sol. in  $\text{KOH} + \text{Aq}$ . (de Chalmot, Am. Ch. J. 1896, 18. 320.)

$\text{CaSi}_2$ . Slowly decomp. by  $\text{H}_2\text{O}$ , rapidly by dil. acetic acid or by  $\text{H}_2\text{SO}_4 + \text{Aq}$  without evolution of spontaneously inflammable gas. (Honigschmid, M. 1909, 30. 497.)

Decomp. by dil. min. acids, with evolution

of spontaneously inflammable gas. (Hackspill, Bull. Soc. 1908, (4) 3. 619.)

$\text{CaSi}_3$ . Insol. in all solvents. Decomp. by boiling  $\text{H}_2\text{O}$ , by conc.  $\text{HCl}$  and by acetic acid. Sol. in dil. alkali and alkali carbonates +  $\text{Aq}$ . Hardly attacked by conc.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . (Kolb, Z. anorg. 1909, 64. 349.)

$\text{Ca}_{11}\text{Si}_{10}$ . Easily decomp. by boiling with  $\text{H}_2\text{O}$ . Decomp. by dil. acetic acid, dil. or conc.  $\text{HCl}$ . (Kolb, Z. anorg. 1909, 64. 349 and 356.)

**Calcium siliconitride**,  $\text{CaSi}_2\text{N}_2$ .

(Kolb, Z. anorg. 1909, 64. 363.)

$\text{Ca}_2\text{Si}_3\text{N}_4$ . Slowly decomp. by boiling with  $\text{H}_2\text{O}$ , somewhat more rapidly with dil.  $\text{NaOH} + \text{Aq}$ . Slowly decomp. by conc.  $\text{HCl}$ . (Kolb, l. c.)

$\text{Ca}_{11}\text{Si}_{10}\text{N}_{10}$ . Completely decomp. by  $\text{HCl}$ . (Kolb, l. c.)

**Calcium sulphide**,  $\text{CaS}$ .

500 pts.  $\text{H}_2\text{O}$  dissolve 1 pt.  $\text{CaS}$  completely; less  $\text{H}_2\text{O}$  dissolves out  $\text{CaS}_2\text{H}_2$  and leaves  $\text{CaO}_2\text{H}_2$ . Very much  $\text{H}_2\text{O}$  decomposes completely into  $\text{CaO}_2\text{H}_2$  and  $\text{H}_2\text{S}$ . (Béchamp, A. ch. (4) 16. 222.)

Not decomp. by  $\text{H}_2\text{O}$ , and only sl. sol. therein at ordinary temp. (Pelouze.)

After 48 hours contact with  $\text{CaS}$ , 1 l.  $\text{H}_2\text{O}$  contains at:

10°	18°	40°	60°	90°
0.15	0.23	0.30	0.48	0.33 g. $\text{CaS}$ .

After boiling for 2 hours, 0.27 g.  $\text{CaS}$  is dissolved; addition of  $\text{NaCl}$  diminishes solubility, but  $\text{Na}_2\text{SO}_4$  increases it. Lime-water dissolves at  $14^\circ$  0.18 g.  $\text{CaS}$ , the same amount which  $\text{H}_2\text{O}$  dissolves at  $60^\circ$ . Milk of lime dissolves 0.55 g. at  $60^\circ$ .  $\text{H}_2\text{O}$  containing 3 to 79 g.  $\text{Na}_2\text{O}$  per litre dissolves only traces of  $\text{CaS}$  at  $10^\circ$ , but at  $40\text{--}60^\circ$ , or by boiling, a large amount of  $\text{Na}_2\text{S}$  is formed. (Kolb, A. ch. (4) 7. 126.)

Sol. in 12,500 pts.  $\text{H}_2\text{O}$  at  $12.6^\circ$ . (Scheurer-Kestner, Répert. chim. appl. 1862. 331.)

Sat.  $\text{Na}_2\text{CO}_3 + \text{Aq}$  has scarcely any action on  $\text{CaS}$ , but a dilute solution has more action. (Kolb.)

Sol. in  $\text{H}_2\text{O}$  and sulphur, forming  $\text{CaS}_2$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) 26. 81.)

Sol. in sugar +  $\text{Aq}$ . (Stolle, C. C. 1900, I. 1044.)

**Calcium tetrasulphide**,  $\text{CaS}_4$ .

Known only in solution.

**Calcium pentasulphide,  $\text{CaS}_5$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius.)  
Exists only in aqueous solution. (Schöne, Pogg. 117. 73.)

**Calcium hydroxyl sulphide,  $\text{Ca}(\text{OH})\text{SH} + 3\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  with immediate decomp. and separation of  $\text{Ca}(\text{OH})_2$ . Insol. in alcohol, but slowly decomp. thereby. (Divers and Shimidzu, Chem. Soc. 45. 270.)

**Calcium stannic sulphide.**

See Sulphostannate, calcium.

**Calomel.**

See Mercurous chloride.

**Carbamic acid.****Ammonium carbamate acid carbonate (commercial carbonate of ammonia).**

See Carbonate carbamate, ammonium hydrogen.

— (salts of hartshorn),  $2\text{NH}_4\text{HCO}_3$ ,  $\text{NH}_4\text{CONH}_2$ .

See Carbonate carbamate, ammonium hydrogen.

**Carbazote silicon,  $\text{C}_2\text{SiN}$ .**

Insol. in acids, even HF; also in boiling  $\text{KOH} + \text{Aq.}$  (Schützenberger and Colson, C. R. 92. 1508.)

**Carbon, C.**

Insol. in all solvents.

Diamond is unacted upon by  $\text{KClO}_3 + \text{fum. HNO}_3$ ; graphite forms graphitic acid by  $\text{KClO}_3 + \text{fum. HNO}_3$ ; amorphous carbon is sol. in  $\text{KClO}_3 + \text{fum. HNO}_3$ . (Berthelot, A. ch. (4) 19. 399.)

Diamond is sol. in molten iron at  $1160^\circ$ . Amorphous carbon is insol. in molten iron at  $1160^\circ$ , but becomes sol. therein by heating to  $1400^\circ$ . (Hempel, B. 18. 998.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Charcoal is insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

The quantity of carbon dissolved by iron diminishes by increasing phosphorus, falling by about 0.5% for each additional 2.0% of phosphorus. (Fettweis, Metallurgie, 1906, 3. 60.)

Solubility in iron is reduced by the presence of tin and of sulphur. (Wüst, Metallurgie, 1906, 3. 169.)

The solubility of C in iron is increased by the presence of chromium; 9.2% C dissolved when 62% Cr is present in the mixture. (Goerens, Metallurgie, 1907, 4. 18.)

**Carbon boride,  $\text{CB}_3$ .**

Insol. in boiling  $\text{HNO}_3 + \text{Aq.}$  (Joly, C. R. 97. 456.)

**Carbon suboxide,  $\text{C}_2\text{O}_2$ .**

B.-pt.  $+7^\circ$  at 761 mm.

Sol. in  $\text{H}_2\text{O}$  with formation of malonic acid. Slowly decomp. on standing in a sealed tube. (Diels, B. 1906, 39. 696.)

**Carbon monoxide, CO.**

Sol. in 50 vols. recently boiled  $\text{H}_2\text{O}$ . (Davy.)

Sol. in 16 vols.  $\text{H}_2\text{O}$ . (de Saussure.)

Sol. in 27 vols.  $\text{H}_2\text{O}$ . (Dalton.)

100 vols.  $\text{H}_2\text{O}$  dissolve 6.2 vols. CO at  $18^\circ$ . (de Saussure.)

Solubility of CO in  $\text{H}_2\text{O}$ : 1 vol.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolves V vols. CO reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.03287	7	0.02796	14	0.02466
1	0.03207	8	0.02739	15	0.02432
2	0.03131	9	0.02686	16	0.02402
3	0.03057	10	0.02635	17	0.02374
4	0.02987	11	0.02588	18	0.02350
5	0.02920	12	0.02544	19	0.02329
6	0.02857	13	0.02504	20	0.02312

(Bunsen's Gasometry, pp. 287, 128, 146.)

Coefficient of absorption =  $0.032874 - 0.00081632t + 0.000016421t^2$ . (Bunsen and Pauli, A. 93. 16.)

**Solubility of CO in  $\text{H}_2\text{O}$ .**

$\beta$  = Vol. CO absorbed by 1 vol.  $\text{H}_2\text{O}$  at a partial pressure of 760 mm.

$\beta^1$  = Vol. CO (reduced to  $0^\circ$  and 760 mm.) absorbed by 1 vol. of  $\text{H}_2\text{O}$  under a total pressure of 760 mm.

q = g. CO dissolved by 100 g.  $\text{H}_2\text{O}$  at a total pressure of 760 mm.

$t^\circ$	$\beta$	$\beta^1$	q
0	0.03537	0.03516	0.0044
5	0.03149	0.03122	0.0039
10	0.02816	0.02782	0.0035
15	0.02543	0.02501	0.0031
20	0.02319	0.02266	0.0028
25	0.02142	0.02076	0.0026
30	0.01998	0.01915	0.0024
40	0.01775	0.01647	0.0021
50	0.01615	0.01420	0.0018
60	0.01488	0.01197	0.0015
70	0.01440	0.00998	0.0013
80	0.01430	0.00762	0.0010
90	0.01420	0.00438	0.0006
100	0.01410	0.00000	0.0000

(Winkler, B. 1901, 34. 1416.)

Solubility in  $H_2O$  at various pressures.  
 $V$  = Volume of the absorbing liquid.  
 $P$  = Hg pressure in metres.  
 $\lambda$  = Coefficient of solubility.

V	t°	P	$\lambda$
30.830 ccm.	17.7	0.9202	0.02791
		1.1438	0.02787
		1.4624	0.02786
		1.7986	0.02783
		2.3659	0.02782
		2.8390	0.02776
		3.2622	0.02771
		4.0114	0.02770
		4.6017	0.02763
		5.1953	0.02761
		5.8717	0.02756
		6.5462	0.02744
31.939 ccm.	19.0	7.0983	0.02738
		7.6470	0.02723
		8.0184	0.02715
		0.9176	0.02716
		1.1506	0.02717
		1.3897	0.02715
		1.7044	0.02712
		2.1239	0.02708
		2.7173	0.02701
		3.2576	0.02693
		3.9311	0.02689
		4.4584	0.02680
		5.2470	0.02673
		6.0346	0.02665
		6.6303	0.02654
		7.1842	0.02636
		7.9542	0.02617

(Cassuto, Phys. Zeit. 1904, 5. 236.)

Coefficient of absorption of CO in  $H_2O$  at 25° equals 0.0154. (Findlay and Creighton, Biochem. J. 1911, 5. 294.)

Cuprous chloride in an hydrochloric acid or ammoniacal solution, and ammoniacal solutions of cuprous salts absorb large amounts of CO. (Leblanc, C. R. 30. 488.)

Cuprous chloride dissolved in HCl + Aq absorbs 15-20 vols. CO. (Berthelot, A. ch. (3) 51. 66.)

Absorbed by KOH, NaOH, Ba(OH)<sub>2</sub>, and Ca(OH)<sub>2</sub> + Aq; more readily by ether, alcohol, and wood spirit, with formation of formic acid. (Berthelot, A. ch. (3) 61. 463.)

Sol. in HCN. (Böttlinger, B. 10. 1122.)

1 vol. alcohol absorbs 0.20443 vols. CO gas at all temperatures between 0° and 25°. (Carius, A. 94. 135.)

100 vols. alcohol (0.84 sp. gr.) dissolve 14.5 vols. CO at 18°; 100 vols. rectified naphtha (0.784 sp. gr.), 20.0 vols. CO at 18°; 100 vols. oil of lavender (0.88 sp. gr.), 15.6 vols. CO at 18°; 100 vols. olive oil (0.915 sp. gr.), 14.2 vols. CO at 18°; 100 vols. sat. KCl + Aq (1.168 sp. gr.), 5.2 vols. CO at 18°. (de Saussure, 1814.)

1 vol. oil of turpentine absorbs 0.16-0.20 vol. CO. (de Saussure.)

Sol. in ether. (Regnault.)

Insol. in caoutchouc.

Solubility in alcohol + Aq.

% alcohol				
by weight	0.00	9.09	16.67	23.08
Solubility	2.41	1.87	1.75	1.68
% alcohol				
by weight	28.57	33.33	50.00	
Solubility	1.50	1.94	3.20	

(Lubarsch, W. Ann. 1889, 37. 524.)

Solubility of CO in organic solvents.

Solvent	Solubility at 20° C.	Solubility at 25° C.
Glycerine	Not measurable	
Water	0.02404	0.02586
Aniline	0.05358	0.05055
Carbon bisulphide	0.08314	0.08112
Nitrobenzene	0.09366	0.09105
Benzene	0.1707	0.1645
Glacial acetic acid	0.1714	0.1689
Amyl alcohol	0.1714	0.1706
Xylene	0.1781	0.1744
Toluene	0.1808	0.1742
Ethyl alcohol (99.8%)	0.1921	0.1901
Chloroform	0.1954	0.1897
Methyl alcohol	0.1955	0.1830
Amyl acetate	0.2140	0.2108
Acetone	0.2225	0.2128
Isobutyl acetate	0.2365	0.2314
Ethyl acetate	0.2516	0.2419

(Just, Z. phys. Ch. 1901, 37. 361.)

Solubility of CO in ether at 0° = 0.3618, and at 10° = 0.3842. (Christoff, Z. phys. Ch. 1912, 79. 459.)

Solubility of CO in organic mixtures.

CO in benzene and naphthalene at 25°C.

Percent by weight of naphthalene	Percent by weight of benzene	* Solubility of CO
0	100	0.174
11.52	88.48	0.164
11.65	88.35	0.163
23.98	76.02	0.149
23.60	76.40	0.148
32.35	67.65	0.142
32.74	67.26	0.143
33.79	66.21	0.141

(Skirrow, Z. phys. Ch. 1902, 41. 144.)

\* See under Oxygen.

CO in benzene and phenanthrene at 25° C.

Percent by weight of phenanthrene	Percent by weight of benzene	Solubility of CO
0	100	0.174
10.48	89.52	0.144
10.48	89.52	0.144
19.22	80.78	0.132
18.99	81.01	0.133
27.04	72.96	0.128
27.39	72.61	0.127

(Skirrow.)



CO in benzene and  $\alpha$ -naphthol at 25° C.

Per cent by weight of $\alpha$ -naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0.174
3.48	96.52	0.149
6.75	93.25	0.145
6.59	93.41	0.144
12.10	87.90	0.139
11.81	88.19	0.139

(Skirrow.)

CO in benzene and  $\beta$ -naphthol at 25° C.

Per cent by weight of $\beta$ -naphthol	Per cent by weight of benzene	Solubility of CO
0	100	0.174
2.06	97.94	0.158
4.14	95.86	0.151
4.36	95.64	0.149

(Skirrow.)

## CO in benzene and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of benzene	Solubility of CO
0	100	0.174
14.5	85.5	0.162
14.12	85.88	0.162
28.18	71.82	0.152
28.14	71.86	0.152
40.58	59.42	0.140
40.63	59.37	0.140
54.9	45.1	0.126
54.9	45.1	0.127
83.33	16.67	0.101
83.2	16.8	0.102
100	0	0.093

(Skirrow.)

## CO in benzene and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of benzene	Solubility of CO
0	100	0.174
12.69	87.31	0.156
12.03	87.97	0.158
19.57	80.43	0.145
19.43	80.57	0.144
28.43	71.57	0.131
28.26	71.74	0.131
57.68	42.32	0.0945
57.38	42.62	0.0953
78.90	21.10	0.0689
78.80	21.20	0.0684
100	0	0.053

(Skirrow.)

## CO in toluene and naphthalene at 25° C.

Per cent by weight of naphthalene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
7.13	92.87	0.169
7.10	92.9	0.171
15.10	84.9	0.161
15.13	84.87	0.161
22.75	77.25	0.153
22.58	77.42	0.154

(Skirrow.)

## CO in toluene and phenanthrene at 25° C.

Per cent by weight of phenanthrene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
5.59	94.41	0.170
5.58	94.42	0.171
11.16	88.84	0.161
11.20	88.8	0.161
21.62	78.38	0.147
21.93	78.07	0.147

(Skirrow.)

## CO in toluene and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of toluene	Solubility of CO
0	100	0.182
8.86	91.14	0.168
8.87	91.13	0.168
18.27	81.73	0.160
18.19	81.81	0.161
26.82	73.18	0.151
26.76	73.24	0.151
49.14	50.86	0.131
49.02	50.98	0.131
76.31	23.69	0.108
76.31	23.69	0.108
100	0	0.093

(Skirrow.)

## CO in toluene and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of toluene	Solubility of CO
0	100	0.182
6.61	93.39	0.169
6.61	93.39	0.168
13.56	86.44	0.157
13.55	86.45	0.156
19.91	80.09	0.148
19.96	80.04	0.148
44.64	55.36	0.115
44.31	55.69	0.116
74.63	25.37	0.0768
75.03	24.97	0.0753
100	0	0.053

(Skirrow.)

CO in toluene and  $\alpha$ -naphthol at 25° C.

Per cent by weight of $\alpha$ -naphthol	Per cent by weight of toluene	Solubility of CO
0	100	0.182
4.46	95.54	0.171
4.44	95.56	0.171
8.75	91.25	0.162
8.89	91.11	0.163

(Skirrow.)

## CO in acetone and naphthalene at 25° C.

Per cent by weight of naphthalene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
13.31	86.69	212.4	0.199
27.40	72.60	196.6	0.187

(Skirrow.)

## CO in acetone and phenanthrene at 25° C.

Per cent by weight of phenanthrene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
12.77	87.23	218	0.205
25.04	74.96	207.5	0.183

(Skirrow.)

CO in acetone and  $\beta$ -naphthol at 25° C.

Per cent by weight of $\beta$ -naphthol	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
13.95	86.05	213	0.190
26.88	73.12	195	0.169

(Skirrow.)

## CO in acetone and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
21.59	78.4	201	0.207
53.20	46.8	152	0.157
100	0	...	0.093

(Skirrow.)

## CO in acetone and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
20.83	79.17	192	0.179
55.10	44.9	120	0.110
100	0	...	0.053

(Skirrow.)

## CO in acetic acid and nitrobenzene at 25° C.

Per cent by weight of nitrobenzene	Per cent by weight of acetic acid	Solubility of CO
0	100	0.173
21.65	78.35	0.156
51.03	48.97	0.130
100	0	0.093

(Skirrow.)

## CO in acetic acid and aniline at 25° C.

Per cent by weight of aniline	Per cent by weight of acetic acid	Solubility of CO
0	100	0.173
13.5	86.5	0.110
41.64	58.36	0.0699
60.77	39.23	0.0618
82.21	17.79	0.0580
100	0	0.053

(Skirrow.)

## CO in methyl alcohol and glycerine at 25° C.

Per cent by weight of glycerine	Per cent by weight of methyl alcohol	Measured vapor pressure	Solubility of CO
0	100	122	0.196
39.6	60.4	106	0.0964
60.5	39.5	91	0.0515
77.1	22.9	63	0.0246
100	0	...	very small

(Skirrow.)

## CO in acetone and chloroform at 25° C.

Per cent by weight of chloroform	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
33.38	66.62	202	0.226
53.2	46.8	179	0.219
65.03	34.97	167	0.220
73.46	26.54	162	0.212
79.83	20.17	163	0.204
87.3	12.7	168	0.207
94.4	5.6	178	0.205
100	0	188	0.207

(Skirrow.)

## CO in acetone and carbon bisulphide at 25° C.

Per cent by weight of carbon bisulphide	Per cent by weight of acetone	Measured vapor pressure	Solubility of CO
0	100	229.6	0.238
8.18	91.82	306	0.236
18.02	81.98	367	0.236
49.46	50.54	443	0.227
62.6	37.4	457	0.210
74.05	25.95	457	0.187
85.51	14.49	433	0.144
96.42	3.58	382	0.114
100	0	356	0.0959

(Skirrow.)

## CO in benzene and ethyl alcohol at 25° C.

Per cent by weight of acetic acid	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	95.9	0.174
15.43	84.56	125	0.179
52.34	47.66	119	0.181
100	0	59	0.192

(Skirrow.)

## CO in chloroform and methyl alcohol at 25° C.

Per cent by weight of alcohol	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	188	0.207
13	87	233	0.202
100	0	122	0.196

(Skirrow.)

## CO in acetic acid and benzene at 25° C.

Percent by weight of acetic acid	Percent by weight of benzene	Measured vapor pressure	Solubility of CO
0	100	95.9	0.174
19.17	80.83	87.5	0.190
33.54	66.46	82	0.198
67.51	32.49	64.5	0.199
100	0	14	0.172

(Skirrow.)

## CO in acetic acid and toluene at 25° C.

Per cent by weight of acetic acid	Per cent by weight of toluene	Measured vapor pressure	Solubility of CO
0	100	9	0.182
20.48	79.52	31.6	0.190
56.89	43.11	28	0.195
74.71	25.29	25.6	0.191
100	0	14	0.172

(Skirrow.)

## CO in acetic acid and chloroform at 25° C.

Per cent by weight of acetic acid	Per cent by weight of chloroform	Measured vapor pressure	Solubility of CO
0	100	188	0.206
26.67	73.33	144.5	0.207
56.46	43.54	88.5	0.196
100	0	14	0.172

(Skirrow.)

## CO in carbon bisulphide and ethylene dichloride at 25° C.

Per cent by volume of carbon bisulphide	Per cent by volume of ethylene dichloride	Measured vapor pressure	Solubility of CO
0	100	77	0.147
25	75	231	0.159
49	51	294	0.160
81.6	18.4	338	0.140
100	0	356.5	0.083

(Skirrow.)

Coefficient of absorption for petroleum = 0.123 at 20°, and 0.134 at 10°. (Gniewasz and Walfisz, *Zeit. phys. Ch.* 1. 70.)

Carbon dioxide, CO<sub>2</sub>.

Gas.—

H<sub>2</sub>O dissolves about its own vol. CO<sub>2</sub> at the ordinary temperature (the solution obtained being of 1.0018 sp. gr.) and pressure, and an additional vol. for the pressure of each additional atmosphere to which it is subjected.

The power of H<sub>2</sub>O to absorb CO<sub>2</sub> does not increase in precisely the same ratio as the pressure. (Soubeiran.)

5 vols. CO<sub>2</sub> dissolve in 1 vol. H<sub>2</sub>O at 7 atmos. pressure, and much greater pressure is necessary in order to increase the amount of gas dissolved; but up to 4 or 5 atmospheres the amount of gas dissolved is very nearly proportional to the pressure. (Coubert, *J. Pharm.* 26, 121.)

100 vols. H<sub>2</sub>O at 12.78° absorb 116 vols. CO<sub>2</sub> (Cavendish); at 29.44°, 84 vols. CO<sub>2</sub> (Henry); at 15.56°, 106 vols. CO<sub>2</sub> (Saussure); at 15.56°, 108 vols. CO<sub>2</sub> (Henry); at 15.56°, 100 vols. CO<sub>2</sub> (Dalton).

100 vols. H<sub>2</sub>O at t° C. absorb V vols. of CO<sub>2</sub> gas reduced to 60° F. and 30 in. pressure.

t°	V	t°	V
0	175.72	26.7	68.60
4.4	147.94	32.2	57.50
10	122.27	37.8	50.39
15.6	100.50	65.6	11.40
21.1	83.86	100	trace

(Rogers, *Am. J. Sci.* (2) 6. 107.)

1 vol. H<sub>2</sub>O at 5° absorbs somewhat more than 1 vol. CO<sub>2</sub>; at 10° scarcely 1 vol., and still less at higher temp. CO<sub>2</sub>+Aq sat. at 2° has 1.0015 sp. gr.; most of the CO<sub>2</sub> escapes upon exposing the solution to the air, the more quickly the higher the temperature. But as CO<sub>2</sub> diminishes, the remainder is more obstinately held, so that boiling for ½ hour is necessary to expel it completely. (Bergman.)

Solubility of CO<sub>2</sub> in H<sub>2</sub>O. 1 vol. H<sub>2</sub>O at t° and 760 mm. dissolves V vols. CO<sub>2</sub> gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	1.7967	7	1.3339	14	1.0321
1	1.7207	8	1.2809	15	1.0020
2	1.6481	9	1.2311	16	0.9753
3	1.5787	10	1.1847	17	0.9519
4	1.5126	11	1.1416	18	0.9318
5	1.4497	12	1.1018	19	0.9150
6	1.3901	13	1.0653	20	0.9014

(Bunsen's Gasometry, pp. 287, 128, 152.)

Coefficient of absorption = 1.7967—0.07761t + 0.0016424t<sup>2</sup>. (Bunsen.)

Solubility in  $H_2O$  at various pressures:  $P$  = pressure in atmospheres.

P	Vol. gas. in 1 ccm. $H_2O$		P	Vol. gas. in 1 ccm. $H_2O$	
	at 0°	at 12.43°		at 0°	at 12.43°
1	1.797	1.086	20	26.65	17.11
5	8.65	5.15	25	30.55	20.31
10	16.03	9.65	30	33.74	23.35
15	21.95	13.63	..	..	...

(Wroblewski, C. R. 94. 1355.)

Absorption of  $CO_2$  in  $H_2O$  at various pressures:  $P$  = pressure in mm.;  $V$  = vols.  $CO_2$ , reduced to 0° and 760 mm., absorbed by 1 vol.  $H_2O$ .

P	V	P	V
697.71	0.9441	2188.65	3.1764
809.03	1.1619	2369.02	3.4857
1289.41	1.8647	2554.00	3.7152
1469.95	2.1623	2738.33	4.0031
2002.06	2.9067	3109.51	4.5006

(Khanikoff and Longuinine, A. ch. (4) 11. 412.)

$C$  = coefficient of absorption in  $H_2O$  at  $t^\circ$  and 760 mm.

$t^\circ$	C	$t^\circ$	C	$t^\circ$	C
15.2	1.009	18.38	0.896	21	0.838
17.6	0.930	18.3	0.885	23	0.798

(Sethenow, Mém. Acad. St. Petersburg. 22. Nos. 6, 7.)

Absorption coefficient of  $CO_2$  in  $H_2O$  at 0° = 1.7306. (Prytz and Holst, W. Ann. 1895, 54. 136.)

Absorption of  $CO_2$  by  $H_2O$  at  $t^\circ$ .  
 $\alpha$  = coefficient of absorption.

$t^\circ$	$\alpha$	$t^\circ$	$\alpha$
0	1.713	19	0.902
1	1.646	20	0.878
2	1.584	21	0.854
3	1.527	22	0.829
4	1.473	23	0.804
5	1.424	24	0.781
6	1.377	25	0.759
7	1.331	26	0.738
8	1.282	27	0.718
9	1.237	28	0.699
10	1.194	29	0.682
11	1.154	30	0.665
12	1.117	35	0.592
13	1.083	40	0.530
14	1.050	45	0.479
15	1.019	50	0.436
16	0.985	55	0.394
17	0.956	60	0.359
18	0.928	..	...

(Bohr, W. Ann. 1899, 68. 504.)

Solubility in  $H_2O$  at 25° = 0.8255; at 15° = 1.070. (Geffcken, Z. phys. Ch. 1904, 49. 273.)  
75 cc.  $H_2O$  absorb 0.1381 g.  $CO_2$  at 15.5° and 720 mm. (Christoff, Z. phys. Ch. 1905, 53. 329.)

Absorption-coefficient of  $CO_2$  in  $H_2O$  at 20° = 0.877, or 1000 g.  $H_2O$  dissolve 878 cc.  $CO_2$ . (Usher, Chem. Soc. 1910, 97. 72.)

Solubility of  $CO_2$  in  $H_2O$  = 1.158 at 12° and 0.825 at 25°. (Findlay and Shenn, Chem. Soc. 1911, 99. 1315.)

Absorption of  $CO_2$  by  $H_2O$  at high pressure.

Amount of  $H_2O$  used  $\begin{cases} a = 0.210 \text{ ccm.} \\ b = 0.102 \text{ ccm.} \end{cases}$

$V$  = ccm. of  $CO_2$  absorbed by  $H_2O$  at  $t^\circ$ , reduced to a pressure of 1 kg. per sq. cm.

$V_1$  = ccm. of  $CO_2$  absorbed by 1 ccm. of  $H_2O$ .

Pressure kg./sq. cm.	$t^\circ$	$V_1$	
		a	b
25	20°	....	17.77
30		....	19.77
40		....	21.52
50		....	28.09
55		....	29.75
30	35°	11.77	13.57
40		14.82	20.00
50		18.96	24.64
60		22.90	22.50
70		27.18	27.62
80		....	32.85
40	60°	10.88	9.798
50		12.24	13.72
60		14.46	15.28
70		16.80	17.46
80		19.74	22.67
90		22.74	21.16
100		26.21	27.85
110		28.92	28.79
120		30.20	33.90
60	100°	8.965	....
70		10.11	6.395
80		11.05	9.591
90		12.63	10.85
100		13.63	12.40
110		14.88	16.31
120		16.40	15.78
130		17.93	16.89
140		19.56	17.71
150		20.58	17.49
160		22.07	....
170		22.78	....

(Sander, Z. phys. Ch. 1912, 78. 537.)

Solubility of carbon dioxide in water at 25°.

P. = Pressure in mm. Hg.

S. = Solubility calculated according to formula for which see the original article. (Findlay, Chem. Soc. 1910, 97. 538.)

P	S	P	S
743	0.816	1059	0.817
752	0.817	1064	0.819
800	0.815	1153	0.818
841	0.817	1243	0.819
955	0.816	1351	0.820
955	0.817	1351	0.820

(Findlay and Creighton, Chem. Soc. 1910, 97. 538.)

Solubility of carbon dioxide in water at 25°.

P. = Pressure in mm. Hg.

S. = Solubility. See above.

P	S	P	S
755	0.826	1069	0.823
759	0.825	1084	0.825
836	0.825	1210	0.825
841	0.826	1211	0.825
927	0.826	1350	0.824
934	0.824	1350	0.826

(Findlay and Creighton, Chem. Soc. 1912, 101. 1460.)

Solubility of carbon dioxide in water at 25°.

P = Pressure in mm. Hg.

S = Solubility. See above.

P	S	P	S
263	0.817	495	0.816
271	0.816	651	0.816
382	0.814	667	0.817
392	0.811	752	0.818
479	0.816	768	0.817

(Findlay and Creighton, Chem. Soc. 1913, 103. 638.)

Sl. sol. in HCl + Aq.

100 vols.  $\text{H}_2\text{SO}_4$  of 1.840 sp. gr. absorb 45 vols.  $\text{CO}_2$ . (de Saussure.)

$\text{H}_2\text{SO}_4$  of ordinary density at 15.56° and common pressure absorbs 94% of its vol. of  $\text{CO}_2$ ; fuming  $\text{H}_2\text{SO}_4$ , 125%; the absorption for pure  $\text{H}_2\text{O}$  under the same conditions being 98%. (Rogers, Am. J. Sci. (2) 8. 115.)

$\text{H}_2\text{SO}_4$  absorbs 7-10%  $\text{CO}_2$ . (Hlasiwetz, W. A. B. 20. 193.)

Coefficient of absorption by conc.  $\text{H}_2\text{SO}_4$  = 0.932, which is the same as that by  $\text{H}_2\text{O}$ ; but this diminishes on diluting, and is at its lowest limit 0.666, when the composition of the solution is  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{O}$ ; upon further dilution the coefficient of solubility gradually increases, and when 58  $\text{H}_2\text{O}$  are present to 1  $\text{H}_2\text{SO}_4$ , the

coefficient of absorption is 0.857. (Set-schenow, J. B. 1876. 46.)

Absorption of  $\text{CO}_2$  by  $\text{H}_2\text{SO}_4$  + Aq.

Solution	Grams $\text{CO}_2$ absorbed by 75 cc. at 15.5° and 720 mm.
$\frac{1}{2}$ -N $\text{H}_2\text{SO}_4$	0.1273
1-N $\text{H}_2\text{SO}_4$	0.1179
2-N $\text{H}_2\text{SO}_4$	0.1092
4-N $\text{H}_2\text{SO}_4$	0.1003

(Christoff, Z. phys. Ch. 1905, 53. 329.)

Solution	Grams $\text{CO}_2$ absorbed by 75 cc. at 15.5° and 720 mm.
2.5% $\text{H}_2\text{SO}_4$	0.1282
5% "	0.1179
10% "	0.0833
20% "	0.0755
30% "	0.0751
40% "	0.0713
45% "	0.0725
70% "	0.0918
90% "	0.1433

(Christoff, l. c.)

Coefficient of absorption for 96%  $\text{H}_2\text{SO}_4$  = 0.926 at 20.2°. (Bohr, Z. phys. Ch. 1910, 71. 48.)

Absorption of  $\text{CO}_2$  by acids.

M = Content in gram-equivalents per liter.

S = Solubility (see under oxygen).

Absorption of  $\text{CO}_2$  by  $\text{HNO}_3$  + Aq.

M	$S_{11}^\circ$	$S_{11}^\circ$
0.472	0.8382	1.073
0.475	0.8366	1.075
0.557	0.8387	1.069
0.704	0.8447	1.080
1.382	0.8620	1.093
1.357	0.8622	1.093
1.860	0.8752	1.105
2.519	0.8839	1.109
2.539	0.8865	1.111

(Geffcken, Z. phys. Ch. 1904, 49. 273.)

Absorption of  $\text{CO}_2$  by  $\text{HCl}$  + Aq.

M	$S_{11}^\circ$	$S_{11}^\circ$
0.499	0.8047	1.041
0.511	0.8074	1.042
1.212	0.7973	1.020
1.249	0.7984	1.023
2.080	0.7951	0.9864
2.180	0.7951	1.009

(Geffcken.)

Absorption of CO<sub>2</sub> by  $\frac{\text{H}_2\text{SO}_4}{2} + \text{Aq.}$ 

M	S <sub>21</sub> °	S <sub>11</sub> °
0.512	0.7923	1.016
0.517	0.7936	1.016
0.995	0.7693	0.9772
1.039	0.7685	0.9775
1.067	0.7672	0.9756
1.956	0.7302	0.9175
2.088	0.7273	0.9143
3.790	0.6736	0.8354
3.800	0.6747	0.8385

(Geffcken.)

In collecting CO<sub>2</sub> gas in pneumatic operations, a saturated solution of common salt is better than H<sub>2</sub>O for filling the trough. This solution will only absorb about 1/3 of the amount of CO<sub>2</sub> absorbed by pure H<sub>2</sub>O. (de Saussure, l. c.)

100 vols. of the following solutions at 18° and ordinary pressure absorb vols. CO<sub>2</sub>—

	Sp. gr.	Vols. CO <sub>2</sub>
Sat. NaCl + Aq (containing 29% of NaCl)	1.212	32.9
Sat. NH <sub>4</sub> Cl + Aq (containing 27.53% of NH <sub>4</sub> Cl)	1.078	75
Sat. KCl + Aq (containing 26% of KCl)	1.168	61
Sat. CaCl <sub>2</sub> + Aq (containing 40.2% of CaCl <sub>2</sub> )	1.402	26.1
Sat. K <sub>2</sub> SO <sub>4</sub> + Aq (containing 9.42% of K <sub>2</sub> SO <sub>4</sub> )	1.077	62
Sat. Na <sub>2</sub> SO <sub>4</sub> + Aq (containing 11.14% of Na <sub>2</sub> SO <sub>4</sub> )	1.105	58
Sat. K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + Aq (containing 9.14% of K <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> + 24H <sub>2</sub> O)	1.047	70
Sat. KNO <sub>3</sub> + Aq (containing 20.6% of KNO <sub>3</sub> )	1.139	57
Sat. NaNO <sub>3</sub> + Aq (containing 26.4% of NaNO <sub>3</sub> )	1.206	45
Sat. H <sub>2</sub> C <sub>2</sub> H <sub>3</sub> O <sub>4</sub> + Aq (containing 53.37% of H <sub>2</sub> C <sub>2</sub> H <sub>3</sub> O <sub>4</sub> )	1.288	41
(de Saussure, Gilbert's Ann. Phys. 47. 167.)		

About half as sol. in NaCl + Aq (15% NaCl) as in H<sub>2</sub>O.

Much more sol. in Na<sub>2</sub>HPO<sub>4</sub> + Aq or Na<sub>2</sub>CO<sub>3</sub> + Aq than in H<sub>2</sub>O, the quantity dissolved increasing with the amount of salt in the solution. The solubility in these solutions depends on the coefficient of solubility in H<sub>2</sub>O plus the product of a constant coefficient multiplied by the amount of salt in the solution; this constant equals 0.069 for Na<sub>2</sub>HPO<sub>4</sub>, and 0.088 for Na<sub>2</sub>CO<sub>3</sub>. (Fernet, A. ch. (3) 47. 307.)

Fernet's determinations are not accurate. (L. Meyer, A. Suppl. 2. 157.)

1 mol. Na<sub>2</sub>HPO<sub>4</sub> in dil. Na<sub>2</sub>HPO<sub>4</sub> + Aq absorbs 2 mols. CO<sub>2</sub>. (Setschenow.)

Solutions of salts of similar constitution are equivalent in regard to their power of absorption of CO<sub>2</sub>, when they contain the same percentage of crystal water. Experiments were made with solutions of alum, MgSO<sub>4</sub>, 7H<sub>2</sub>O, and ZnSO<sub>4</sub>, 7H<sub>2</sub>O, containing 10% of the salts. The MgSO<sub>4</sub> solution absorbed the greatest proportional amount of CO<sub>2</sub>, and the alum the least. The further rule was deduced that with salts of similar constitution and the same amount of crystal water, the

absorptiometric equivalents are identical with the chemical equivalents. (Setschenow, B. 6. 1461.)

Salts can be divided into two classes, according as CO<sub>2</sub> has chemical action on the salt or not. In the first case, i. e., when there is chemical combination or action of CO<sub>2</sub> on the salt in solution, the amount of CO<sub>2</sub> absorbed increases with increasing concentration of the solution; in the second case, however, the amount of CO<sub>2</sub> decreases with the strength of the solution. Several salts can be arranged in a series as regards their power of absorption, beginning with that which has the greatest, as follows: Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>B<sub>4</sub>O<sub>7</sub>, Na<sub>2</sub>HPO<sub>4</sub>, NaC<sub>2</sub>H<sub>3</sub>O<sub>4</sub>, Na<sub>2</sub>C<sub>2</sub>H<sub>3</sub>O<sub>4</sub>, Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>, NaC<sub>2</sub>H<sub>3</sub>O<sub>4</sub>, MnO<sub>2</sub>, MCl, M<sub>2</sub>SO<sub>4</sub>. The division between the two classes occurs in this series at Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.

The matter is discussed at length in the original papers. (Setschenow, Mémoires Acad. St. Petersb. 22. No. 8. Also further, Setschenow, ib. 34. No. 3, and 35. No. 7. See also Ostwald, Allgemeine Chemie, 2te Aufl. vol. 1, p. 629.)

Solubility of CO<sub>2</sub> in salts + Aq at 15.2°.

CO<sub>2</sub> = cc. CO<sub>2</sub> (at 0° and 760 mm.) dissolved per cc. of salt solution.

Salt	g. salt per l.	CO <sub>2</sub>
NH <sub>4</sub> Cl	1	1.005
"	10	0.985
"	51.6	0.941
"	172	0.819
"	258	0.770
NH <sub>4</sub> NO <sub>3</sub>	2.8	1.013
"	11.2	1.002
"	55	0.989
"	101	0.962
"	202.1	0.911
"	404.3	0.807
"	810.4	0.612
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	72.2	0.712
"	144.4	0.575
Ba(NO <sub>3</sub> ) <sub>2</sub>	62.7	0.922
Ca(NO <sub>3</sub> ) <sub>2</sub>	41.	0.923
LiCl	16.72	1.035
"	50.15	0.808
"	125.4	0.596
"	250.8	0.497
"	501.5	0.120
MgSO <sub>4</sub>	26.5	0.901
"	79.5	0.669
"	159.	0.441
"	318.	0.188
KBr	83.9	0.908
"	167.7	0.819
"	251.5	0.748
"	503.1	0.579
KI	319.1	0.777
"	478.6	0.688
"	957.3	0.506
KSCN	326	0.691
"	489	0.590

Solubility of  $\text{CO}_2$  in salts + Aq at  $15.2^\circ$ —Cont.

Salt	g. salt per l.	$\text{CO}_2$
KSCN	978	0.387
$\text{KNO}_3$	58.8	0.959
"	117.5	0.890
"	235.1	0.781
$\text{NaCl}$	12.9	0.978
"	64	0.760
"	128	0.580
"	192	0.466
$\text{NaBr}$	115.1	0.775
"	460.3	0.364
"	690.4	0.221
$\text{NaNO}_3$	89.3	0.835
"	125	0.762
"	208.4	0.621
"	416.8	0.385
"	625.2	0.244
$\text{NaClO}_3$	233.3	0.625
"	349.9	0.506
"	699.8	0.257
$\text{Na}_2\text{SO}_4$	14.2	0.950
"	94.8	0.620
"	284.4	0.234
$\text{ZnSO}_4$	38.3	0.903
"	76.7	0.783
"	230.	0.474
"	460	0.209

(Setschenow, A. ch. 1892, (6) 25. 226.)

$\text{CO}_2$  is not disengaged at ordinary temp. from  $\text{H}_2\text{O}$ , in which  $\frac{1}{1000}$  pt. of  $\text{CaCO}_3$  or  $\text{MgCO}_3$  is held in solution thereby. These solutions have a great power of retaining  $\text{CO}_2$  even at a boiling temp. or with diminished pressure, and they also absorb  $\text{CO}_2$  from the air in much larger quantity than pure  $\text{H}_2\text{O}$ . (Bineau.)

$\text{BaCO}_3$  in  $\text{H}_2\text{O}$  also retains  $\text{CO}_2$  even after long boiling. (Storer.)

$\text{CO}_2$  is also absorbed from the air by  $\text{Na}_2\text{CO}_3$  or  $\text{K}_2\text{CO}_3$  + Aq, especially if dilute.

Absorption of  $\text{CO}_2$  by  $\text{NaCl}$  + Aq at  $t^\circ$ .  
 $\alpha$  = Coefficient of absorption for a 6.52%  $\text{NaCl}$  solution.

$\alpha_1$  = Coefficient of absorption for a 17.62%  $\text{NaCl}$  solution.

$t^\circ$	$\alpha$	$\alpha_1$
0	1.234	0.678
5	1.024	0.577
10	0.875	0.503
15	0.755	0.442
20	0.664	0.393
25	0.583	0.352
30	0.517	0.319
35	0.460	0.288
40	0.414	0.263
45	0.370	0.235
50	0.335	0.215
55	0.305	0.198
60	...	0.183

(Bohr, W. Ann. 1899, 68. 504.)

Absorption of  $\text{CO}_2$  by  $\text{CaCl}$  + Aq.

M = Content in g. equiv. per l.

S = Solubility. (See under Oxygen.)

M	$S_{25}^\circ$	$S_{15}^\circ$
0.552	0.7771	1.001
0.554	0.7769	0.9995

(Geffcken, Z. phys. Ch. 1904, 49. 273.)

Absorption of  $\text{CO}_2$  by  $\text{KNO}_3$  + Aq.

M	$S_{25}^\circ$	$S_{15}^\circ$
0.536	0.7832	1.002
0.537	0.7818	0.9997
1.022	0.7452	0.9439
1.033	0.7447	0.9421

(Geffcken.)

Absorption of  $\text{CO}_2$  by  $\text{KI}$  + Aq.

M	$S_{25}^\circ$	$S_{15}^\circ$
0.559	0.7678	0.9809
0.573	0.7676	0.9835
1.043	0.7236	0.9144
1.119	0.7166	0.9090

(Geffcken.)

Absorption of  $\text{CO}_2$  by  $\text{RbCl}$  + Aq.

M	$S_{25}^\circ$	$S_{15}^\circ$
0.479	0.7705	0.9908
0.481	0.7698	0.9910
1.007	0.7190	0.9210
1.012	0.7157	0.9200

(Geffcken.)

Absorption of  $\text{CO}_2$  by  $\text{KBr}$  + Aq.

M	$S_{25}^\circ$	$S_{15}^\circ$
0.550	0.7621	0.9783
0.565	0.7619	0.9766
1.056	0.7030	0.9100
1.064	0.7068	0.9065

(Geffcken.)

Absorption of  $\text{CO}_2$  by  $\text{KCl}$  + Aq.

M	$S_{25}^\circ$	$S_{15}^\circ$
0.423	0.7695	0.9892
0.432	0.7667	0.9865
1.045	0.6920	0.8875
1.058	0.6961	0.8910

(Geffcken.)

Absorption of CO<sub>2</sub> by salts + Aq.

Salt	Grams CO <sub>2</sub> absorbed by 75 cc. of salt solution at 15.5° and 720 mm.
1-N KBr	0.1280
1-N KNO <sub>3</sub>	0.1231
1-N KCl	0.1213
1-N KI	0.1204
1-N LiCl	0.1087
1-N NaCl	0.1050
1-N (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	0.1093
1-N (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> FeSO <sub>4</sub> · 24H <sub>2</sub> O	0.0991
1-N K <sub>2</sub> SO <sub>4</sub>	0.1002
1-N K <sub>2</sub> SO <sub>4</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> · 24H <sub>2</sub> O	0.1054
2-N K <sub>2</sub> SO <sub>4</sub>	0.1140
1-N MgSO <sub>4</sub>	0.1209
1-N MgSO <sub>4</sub>	0.1047
2-N MgSO <sub>4</sub>	0.0656
4-N MgSO <sub>4</sub>	0.0527
2-N CuSO <sub>4</sub>	0.0751
2-N ZnSO <sub>4</sub>	0.0720
2-N KHSC <sub>4</sub>	0.1017
2-N KHSC <sub>4</sub>	0.0999
1-N KH <sub>2</sub> AsO <sub>4</sub>	0.0808
1-N KH <sub>2</sub> PO <sub>4</sub>	0.0852
1-N K <sub>2</sub> HAsO <sub>4</sub>	0.1111
1-N K <sub>2</sub> HPO <sub>4</sub>	0.4989
1-N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.2205
1-N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.5317
1-N Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub>	0.8511
1-N NaBO <sub>2</sub>	0.8124
1-N NH <sub>4</sub> HB <sub>2</sub> O <sub>4</sub>	0.7672
N-Na <sub>2</sub> PO <sub>4</sub> · 12H <sub>2</sub> O	0.5828
N-Na <sub>2</sub> P <sub>2</sub> O <sub>7</sub> · 10H <sub>2</sub> O	0.8457
N-NaPO <sub>3</sub>	0.2081
N-KPO <sub>3</sub>	0.2618

(Christoff, Z. phys. Ch. 1905, 53. 338-340.)

Solubility of CO<sub>2</sub> in KCl + Aq at 25°.

Concentration, 7.45 g. in 100 cc. of solution, sp. gr. = 1.043.

Pressure 756 850 953 1116 1249 1362  
Solubility 0.694 0.693 0.688 0.700 0.709 0.710

Concentration, 5 g. in 100 cc. of solution, sp. gr. = 1.031.

Pressure 756 832 901 1050 1150 1223  
Solubility 0.731 0.727 0.724 0.726 0.735 0.736

Concentration, 2.56 g. in 100 cc. of solution, Sp. gr. = 1.016.

Pressure 756 852 981 1079 1190 1362  
Solubility 0.767 0.761 0.761 0.762 0.768 0.766  
(Findlay and Creighton, Chem. Soc. 1910, 97. 557.)Solubility of CO<sub>2</sub> in NH<sub>4</sub>Cl + Aq at 25°.

Concentration (C) denotes number of grams of solute in 100 cc. of solution.

Density (D) equals the specific gravity of the solution.

Solubility (S) calculated by formula given in the original article.

C	D	S
2.35	1.005	0.791
5.05	1.013	0.754
8.24	1.022	0.732
10.02	1.027	0.712
17.09	1.045	0.665

(Findlay and Shenn, Chem. Soc. 1912, 101. 1461.)

Solubility of CO<sub>2</sub> in KCl + Aq at 25°.

C	D	S
1.84	1.008	0.792
3.05	1.017	0.764
4.58	1.026	0.749
7.46	1.044	0.701

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in BaCl<sub>2</sub> + Aq at 25°.

C	D	S
2.80	1.018	0.789
5.81	1.040	0.741
8.15	1.054	0.710
9.97	1.070	0.676

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in (NH<sub>4</sub>)<sub>2</sub>Fe(SO<sub>4</sub>)<sub>2</sub> + Aq at 25°.

C	D	S
9.51	1.052	0.641
10.26	1.057	0.629
22.47	1.124	0.460

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in solutions of sucrose at 25°.

C	D	S
2.63	1.009	0.813
5.16	1.018	0.798
9.68	1.038	0.767
12.33	1.051	0.744

(Findlay and Shenn.)

Solubility of CO<sub>2</sub> in solutions of chloral hydrate at 25°.

C	D	S
5.08	1.019	0.815
10.12	1.041	0.795

(Findlay and Shenn.)



100 vols. alcohol (0.803 sp. gr.) at 18° absorb 260 vols. CO<sub>2</sub>.

100 vols. alcohol (0.840 sp. gr.) at 18° absorb 186 vols. CO<sub>2</sub>. (de Saussure, l. c.)

Solubility of CO<sub>2</sub> in alcohol. 1 vol. alcohol at t° and 760 mm. dissolves V vols. CO<sub>2</sub> gas reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4.3295	9	3.5844	18	3.0402
1	4.2368	10	3.5140	19	2.9921
2	4.1466	11	3.4461	20	2.9465
3	4.0589	12	3.3807	21	2.9034
4	3.9736	13	3.3178	22	2.8628
5	3.8908	14	3.2573	23	2.8247
6	3.8105	15	3.1993	24	2.7890
7	3.7327	16	3.1438	..	....
8	3.6573	17	3.0908	..	....

(Bunsen's Gasometry, pp. 287, 128, 153.)

Coefficient of absorption = 4.32955—  
0.09395t + 0.00124t<sup>2</sup>. (Bunsen.)

Much less sol. in 30% alcohol than in pure alcohol or pure H<sub>2</sub>O. (Müller, W. Ann. 37. 24.)

Solubility of CO<sub>2</sub> in 99% alcohol at t°.

$\alpha$  = Coefficient of absorption, i. e., the no. of ccm. of CO<sub>2</sub> measured at 0° and 760 mm. which are absorbed at the given temp. and at an absorption pressure of 760 mm. by 1 ccm. alcohol.

$\alpha_1$  = Coefficient of absorption corrected for increase in the volume of the alcohol used due to absorption of CO<sub>2</sub>.

t°	$\alpha$	$\alpha_1$
—65	38.41	35.93
—25	8.75	8.61
—20	7.51	7.41
—15	6.59	6.51
—10	5.75	5.69
—5	5.01	4.96
0	4.44	4.40
+5	3.96	3.93
10	3.57	3.55
15	3.25	3.23
20	2.98	2.96
25	2.76	2.74
30	2.57	2.56
35	2.41	2.39
40	2.20	2.19
45	2.01	2.00

(Bohr, W. Ann. 1900, (4) 1. 249.)

Solubility in 98.7% alcohol at t°.

$\alpha$  = Coefficient of absorption.

$\alpha_1$  = Coefficient of absorption corrected for increase in volume of the alcohol used due to absorption of CO<sub>2</sub>.

t°	$\alpha$	$\alpha_1$
0	4.35	4.31
—10	5.43	5.38
—20	7.25	7.16
—30	9.97	9.79
—40	14.25	13.89
—50	21.28	20.49
—60	31.25	29.59
—65	39.89	37.22
—67	44.07	40.83

(Bohr, W. Ann. 1900, (4) 1. 253.)

Solubility in alcohol + Aq at t°.

t°	% by wt. of alcohol in the solvent	Solubility of CO <sub>2</sub> in alcohol + Aq	Solubility of CO <sub>2</sub> in H <sub>2</sub> O
1.4	6.325	1.5864	1.6916
3.2	4.464	1.4878	1.5652
9.2	7.276	1.1829	1.2216
13.8	2.870	1.0268	1.0385

(Langer, C. C. 1904, I, 1583.)

Solubility of CO<sub>2</sub> in ethyl alcohol at 25°.

Concentration. 2.95 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.99308.

Pressure 737 836 929 1073 1213 1338

Solubility 0.812 0.813 0.812 0.811 0.813 0.811

Concentration. 3.01 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.99295.

Pressure 745 823 937 1083 1226 1357

Solubility 0.814 0.812 0.815 0.813 0.812 0.812

Concentration. 8.83 g. alcohol in 100 cc. of solution. Sp. gr. 25°/15° = 0.98342.

Pressure 747 846 942 1090 1231 1360

Solubility 0.786 0.786 0.784 0.785 0.786 0.788

(Findlay and Shenn, Chem. Soc. 1911, 99. 1315.)

Solubility of CO<sub>2</sub> in organic solvents at low temperatures.

Solvent. Ethyl alcohol.

t = —78°; sp. gr. = 0.872

Pressure	Coefficient of absorption	Solubility
100	111.8	68.4
200	115.7	69.5
400	123.8	71.4
700	138.6	74.7

Solubility of CO<sub>2</sub> in organic solvents at low temperatures.—*Continued*

t = -59°; sp. gr. = 0.856		
Pressure	Coefficient of absorption	Solubility
100	40.85	27.27
200	41.00	27.16
400	42.35	27.65
700	44.15	28.10

## Solvent. Methyl alcohol.

t = -78°; Sp. gr. = 0.884		
Pressure	Coefficient of absorption	Solubility
50	194.0	120.5
100	195.0	119.6
200	202.9	120.1
400	221.5	122.2
500	226.4	...
740	260.0	126.8

t° = -59°; sp. gr. = 0.886		
Pressure	Coefficient of absorption	Solubility
100	63.0	42.5
200	64.2	42.7
400	66.3	43.1
700	69.0	43.3

## Solvent. Acetone.

t = -78°; sp. gr. = 0.900		
Pressure	Coefficient of absorption	Solubility
50	311	196.6
100	322	198.1
200	344.5	201.5
400	400	208.8
640	487	215.7
700	545.5	...

t = -59°; sp. gr. = 0.879		
Pressure	Coefficient of absorption	Solubility
100	97.8	67.2
200	101.2	68.0
460	106.6	72.8
700	118.8	72.8

## Solvent.—Ethyl acetate.

t = -78°; sp. gr. = 1.017		
Pressure	Coefficient of absorption	Solubility
50	250.2	177.5
100	255.6	177.1
200	271.8	179.2
400	310.9	183.2
650	386.9	191.2

Solubility of CO<sub>2</sub> in organic solvents at low temperatures.—*Continued*

t = -59°; sp. gr. = 0.994		
Pressure	Coefficient of absorption	Solubility
100	85.3	65.6
200	86.3	65.3
400	91.6	66.7
700	101.5	69.7

## Solvent. Methyl acetate.

t = -78°; sp. gr. = 1.056		
Pressure	Coefficient of absorption	Solubility
50	304.9	224.1
100	315.0	224.3
200	337.4	223.1
400	389.3	225.6
650	498.1	231.2

t = -59°; sp. gr. = 1.032		
Pressure	Coefficient of absorption	Solubility
100	94.3	75.8
200	98.45	77.1
400	103.6	77.6
700	112.9	79.0

(Stern, Z. phys. Ch. 1912, 81. 468.)

Solubility of CO<sub>2</sub> in ether at 0° = 7.33; at 10° = 6.044; at 15° = 5.46. (Christoff, Z. phys. Ch. 1912, 79. 459.)

Coefficient of absorption in chloroform is 0.20376 at 36.57 mm., and 4.43757 at 762 mm. pressure. (Woukoloff, C. R. 109. 62.)

100 vols. of following liquids absorb vols. CO <sub>2</sub> at 18°—		
	Sp. gr.	Vols. CO <sub>2</sub>
Ether . . . . .	0.727	217
Rectified naphtha . . . . .	0.784	169
Oil of turpentine . . . . .	0.860	166
Oil of lavender (freshly distilled) . . . . .	0.880	191
Oil of thyme . . . . .	0.890	188
Linseed oil . . . . .	0.940	156
Olive oil . . . . .	0.915	151
Gum-arabic + Aq (containing 25% of the gum) . . . . .	1.092	75
Cane-sugar + Aq (containing 25% of sugar) . . . . .	1.104	72

(de Saussure, l. c.)

1 vol. oil of turpentine absorbs 1.7-1.9 vols. CO<sub>2</sub> (Saussure.)

1 vol. spirit at 10° absorbs 2 vols. CO<sub>2</sub>. (de Saussure.)

1 vol. olive oil at 10° absorbs 1+vol. CO<sub>2</sub>. (de Saussure.)

1 vol. oil of turpentine at 10° absorbs 2 vols. CO<sub>2</sub>. (Bergman.)

1 vol. caoutchine absorbs 11 vols. CO<sub>2</sub>. (Bergman.)

Coefficient of absorption for petroleum is 1.17 at 20° and 1.31 at 10°. (Gniewasz and Walfisz, Zeit. phys. Ch. 1. 70.)

100 vols. petroleum absorb 70 vols. CO<sub>2</sub> at 10°. (Robinet, C. R. 58. 608.)

Solubility of  $\text{CO}_2$  in  $\frac{N}{2}$  solutions of various organic substances at  $20^\circ$ .

Substance	Sp. gr. of $\frac{N}{2}$ solution	Coeff. of absorption	cc. $\text{CO}_2$ dissolved in 1000 g. $\text{H}_2\text{O}$
Dextrose	1.0328	0.792	841
Mannite	1.03031	0.782	833
Glycerine	1.01413	0.843	864
Pyrogallol	1.01718	0.853	894
Hydrochinon	1.00946	0.887	928
Resorcin	1.00958	0.901	945
Pyrocatechin	1.0107	0.868	908
Urethane	1.0037	0.869	907
Carbamide	1.00715	0.864	884
Thiocarbamide	1.00917	0.859	885
Antipyrine	1.01339	0.859	935
Acetamide	1.005	0.879	906
Acetic acid	1.0026	0.868	893
N. Propylic acid	0.9939	0.869	902

(Usher, Chem. Soc. 1910, 97. 73.)

Absorption of  $\text{CO}_2$  by ethyl alcohol.

Amount of alcohol used = 0.093 ccm.

V = ccm. of  $\text{CO}_2$  absorbed by the solvent at  $t^\circ$ , reduced to a pressure of 1 kg. per sq. cm.

$V_1$  = ccm. of  $\text{CO}_2$  absorbed by 1 ccm. of the solvent.

Pressure kg/sq.cm.	$t^\circ$	Gas volume ccm.	V	$V_1$
30	$20^\circ$	57.31	9.462	104.8
40			15.15	149.7
50			23.04	188.8
30	$35^\circ$	60.05	7.114	77.87
40			10.52	113.1
50			14.73	144.5
60			19.63	173.0
70			27.39	210.8
40	$60^\circ$	64.44	6.429	72.82
50			9.023	97.09
60			12.27	122.5
70			15.64	145.2
80			19.11	167.9
90			20.64	180.7
100			23.88	195.7
50	$100^\circ$	72.19	3.809	42.49
60			6.034	66.05
70			8.374	88.67
80			10.76	111.2
90			13.06	129.0
100			14.90	145.7
110			16.22	155.0
120			18.93	174.6
130			20.48	182.6
140			20.61	186.0

(Sander, Z. phys. Ch. 1912, 78. 524.)

Absorption of  $\text{CO}_2$  by propyl alcohol.

Amount of alcohol used = 0.103 ccm.

V and  $V_1$ . See under absorption of  $\text{CO}_2$  by ethyl alcohol.

Pressure kg/sq.cm.	$t^\circ$	Gas volume ccm.	V	$V_1$
20	$20^\circ$	60.59	4.867	56.16
30			8.472	86.62
40			13.46	122.1
50			21.62	174.6
20	$35^\circ$	62.96	3.493	40.00
30			6.307	64.08
40			9.296	98.16
50			13.99	122.8
60			18.90	159.9
70			35.03	228.2
80			49.23	269.6
20	$60^\circ$	68.08	2.602	24.73
30			4.722	47.68
40			6.723	64.65
50			9.810	88.54
60			13.05	111.5
70			17.15	144.4
80			19.61	159.2
90			24.75	184.3
100			30.19	213.9
40	$100^\circ$	76.27	2.592	26.50
50			5.669	54.19
60			8.025	74.51
70			10.44	92.17
80			13.13	107.7
90			15.72	132.3
100			17.10	144.7
110			20.95	163.5
120			23.55	175.4

(Sander.)

Absorption of  $\text{CO}_2$  by ether.

Amount of ether used = 0.131 ccm.

V and  $V_1$ . See under absorption of  $\text{CO}_2$  by alcohol.

Pressure kg/sq.cm.	$t^\circ$	Gas volume ccm.	V	$V_1$
45	$35^\circ$	62.06	42.62	205.6
50			46.81	217.3
60			57.83	241.6
50	$60^\circ$	67.11	28.49	171.6
60			35.24	195.4
70			42.01	210.0
80			46.64	221.4
90			50.72	235.0
100			56.63	248.7
60	$100^\circ$	71.03	12.57	101.0
70			20.00	134.6
80			26.34	142.8
90			32.16	166.4
100			35.70	175.4

(Sander.)

Absorption of CO<sub>2</sub> by benzene.

Amount of benzene used = 0.080 ccm.

V and V<sub>1</sub>. See under absorption of CO<sub>2</sub> by ethyl alcohol.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
15	20°	55.14	2.728	46.89
20			4.845	71.16
30			9.618	125.3
40			18.70	192.4
50			30.10	264.3
15	35°	58.17	2.225	39.94
20			3.373	48.65
30			6.879	94.39
40			11.56	138.3
50			17.09	186.6
60	60°	61.86	25.73	243.1
70			35.80	269.0
20			2.140	34.57
30			3.880	55.97
40			6.699	88.71
50	100°	73.75	10.28	128.5
60			13.57	156.6
70			17.71	184.6
80			22.50	215.0
90			28.09	246.6
100			33.76	284.4
40	100°	73.75	2.822	46.52
50			3.981	58.46
60			6.440	91.27
70			8.398	119.0
80			11.96	155.8
90	100°	73.75	14.57	182.5
100			17.79	212.9
110			20.60	237.7
120			23.98	258.2

(Sander.)

Absorption of CO<sub>2</sub> by chlorbenzene.

Amount of chlorbenzene used = 0.106 ccm.

V and V<sub>1</sub>. See under absorption of CO<sub>2</sub> by ethyl alcohol.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
20	20°	61.03	5.813	62.61
30			10.25	95.22
40			17.17	137.3
50			26.59	187.5
20	35°	64.16	4.650	46.66
30			7.705	72.73
40			11.81	101.5
50			16.83	137.3
60			22.82	168.3
70	60°	69.38	32.83	205.5
20			3.685	35.86
30			5.510	53.94
40			7.982	73.69

Absorption of CO<sub>2</sub> by chlorbenzene.—Cont.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
50			11.16	99.06
60			13.74	118.1
70			16.65	134.5
80			19.50	149.3
90			22.23	165.5
110	100°	77.73	31.64	204.4
30			3.562	33.65
40			5.008	48.16
50			7.106	63.78
60			8.701	77.24
70	100°	77.73	10.37	91.02
80			12.05	103.00
90			13.88	121.2
100			14.89	121.5
110			16.35	130.7
120	100°	77.73	17.77	140.7
130			18.54	146.8

(Sander.)

Absorption of CO<sub>2</sub> by brombenzene.

Amount of brombenzene used = 0.113 ccm.

V and V<sub>1</sub>. See under absorption of CO<sub>2</sub> by ethyl alcohol.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	V <sub>1</sub>
20	20°	60.84	4.531	50.83
30			7.793	82.29
40			12.22	121.1
50			17.37	160.0
20	35°	63.96	3.947	43.38
30			5.782	62.69
40			8.508	90.43
50			11.96	116.4
60			16.00	146.0
70	60°	69.16	22.56	184.1
80			41.26	233.9
20			2.650	30.58
30			3.714	46.15
40			5.971	62.64
50	100°	77.48	7.406	77.19
60			9.718	98.73
70			10.27	108.4
80			13.99	131.4
90			16.70	144.3
100	100°	77.48	20.06	169.7
110			23.13	190.6
30			2.970	30.56
40			4.032	41.49
50			5.833	59.64
60	100°	77.48	7.239	72.64
70			8.330	82.56
80			9.714	92.86
90			11.14	107.1
100			12.79	118.0
110	100°	77.48	13.80	125.3
120			15.50	140.7

(Sander.) by Google

Absorption of  $\text{CO}_2$  by nitrobenzene.

Amount of nitrobenzene used = 0.164 ccm.  
V and  $V_1$ . See under absorption of  $\text{CO}_2$   
by ethyl alcohol.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	$V_1$
15	20°	57.65	5.459	41.60
20			7.354	57.12
30			12.14	92.50
40			15.93	115.9
50			21.71	155.9
20	35°	59.86	5.644	44.48
30			8.658	68.23
40			11.98	94.39
50			15.59	113.4
60			19.94	145.1
70			25.57	179.6
80			34.95	227.0
20	60°	64.73	3.787	31.38
30			4.519	38.23
40			6.308	52.26
50			7.750	64.21
60			8.887	72.15
70			10.15	82.40
80			10.80	85.03
20	100°	75.52	2.749	24.67
30			4.162	41.00
40			5.393	50.36
50			6.832	63.80
60			7.763	70.85
70			9.048	75.75
80			10.65	86.86

(Sander.)

Absorption of  $\text{CO}_2$  by toluene.

Amount of toluene used = 0.114 ccm.  
V and  $V_1$ . See under absorption of  $\text{CO}_2$   
by ethyl alcohol.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	$V_1$
20	20°	59.97	7.420	57.91
30			13.31	103.3
40			23.25	155.9
50			45.10	235.8
20	35°	63.05	6.018	49.60
30			10.13	82.63
40			16.03	118.8
50			23.34	155.8
60			31.39	192.1
70			44.17	225.8
30	60°	68.17	6.735	54.67
40			9.885	78.67
50			13.95	104.6
60			18.00	128.1
70			22.66	150.1
80			26.60	171.9
90			31.66	191.5
100			38.86	210.0

Absorption of  $\text{CO}_2$  by toluene.—Continued

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	$V_1$
30	100°	76.37	3.356	28.68
40			5.945	49.25
50			8.703	67.93
60			11.18	85.98
70			13.72	101.7
80			16.30	117.6
90			18.88	132.6
100			21.85	149.0
110			24.86	161.9
120			26.80	171.8
130			28.21	178.7

(Sander.)

Absorption of  $\text{CO}_2$  by ethyl acetate.

Amount of ethyl acetate used = 0.155 ccm.  
V and  $V_1$ . See under absorption of  $\text{CO}_2$   
by ethyl alcohol.

Pressure kg./sq.cm.	t°	Gas volume ccm.	V	$V_1$
25	20°	60.30	29.43	158.6
30			37.91	188.2
40			51.26	227.9
30	35°	63.40	26.54	145.2
40			38.69	188.4
50			48.35	213.9
60			51.88	219.8
30	60°	68.55	18.12	108.0
40			25.67	140.5
50			33.21	165.2
60			40.12	186.7
70			45.47	201.1
80			49.16	223.4
40	100°	76.80	12.76	80.70
50			18.80	110.1
60			24.12	132.0
70			28.99	152.0
80			32.96	162.3
90			36.92	172.1
100			42.75	191.5

(Sander.)

Absorption of  $\text{CO}_2$  by  $\text{CH}_3\text{COOH} + \text{CCl}_4$ .

Solvent		cc. $\text{CO}_2$ absorbed
1 mol.	$\text{CH}_3\text{COOH}$	58.8
0.8	" $\text{CH}_3\text{COOH} +$	
0.2	" $\text{CCl}_4$	61.0
0.5	" $\text{CH}_3\text{COOH} +$	
0.5	" $\text{CCl}_4$	62.4
0.2	" $\text{CH}_3\text{COOH} +$	
0.8	" $\text{CCl}_4$	60.2
1	" $\text{CCl}_4$	57.6

(Christoff, J. phys. Ch. 1905, 53, 382.)

Absorption of CO<sub>2</sub> by C<sub>2</sub>H<sub>4</sub>Cl<sub>2</sub> + CS<sub>2</sub>.

Solvent	cc. CO <sub>2</sub> absorbed
1 mol. C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub>	209.7
0.8 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> + 0.2 " CS <sub>2</sub>	173.4
0.5 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> + 0.5 " CS <sub>2</sub>	140.0
0.2 " C <sub>2</sub> H <sub>4</sub> Cl <sub>2</sub> + 0.8 " CS <sub>2</sub>	71.9
1 " CS <sub>2</sub>	19.9

(Christoff.)

Solubility of CO<sub>2</sub> in organic solvents

$\frac{ds}{dt}$  = change of solubility for 1° increase in temp.

Solvent	Sol- ubility at 25° C.	Sol- ubility at 20° C.	Sol- ubility at 15° C.	$\frac{ds}{dt}$
Glycerine	0.0302	....	....	....
Water	0.8256	....	....	....
Carbon bisulphide	0.8699	0.8888	0.9446	-0.00747
Iodobenzene	1.301	1.371	1.440	-0.0139
Aniline	1.324	1.434	1.531	-0.0207
o-Toluidine	1.381	1.473	1.539	-0.0158
m-Toluidine	1.436	1.581	1.730	-0.0244
Eugenol	1.539	1.653	1.762	-0.0223
Benzotrichloride	1.643	....	....	....
Cumene	1.782	1.879	1.978	-0.0196
Carvone	1.802	1.921	2.034	-0.0282
Dichlorhydrin	1.810	1.917	2.020	-0.0210
Amyl alcohol	1.831	1.941	2.058	-0.0227
Bromobenzene	1.842	1.964	2.092	-0.0250
Isobutyl alcohol	1.849	1.964	2.088	-0.0239
Benzyl chloride	1.938	2.072	2.180	-0.0242
m-Xylene	2.090	2.216	2.346	-0.0256
Ethylene bromide	2.157	2.294	2.424	-0.0267
Chlorobenzene	2.265	2.420	2.581	-0.0316
Carbon tetrachloride	2.294	2.502	2.603	-0.0309
Propylene bromide	2.301	2.453	2.586	-0.0281
Toluene	2.305	2.426	2.557	-0.0256
Benzene	2.425	2.540	2.710	-0.0285
Amyl bromide	2.455	2.638	2.803	-0.0348
Nitrobenzene	2.456	2.655	2.845	-0.0389
Propyl alcohol	2.498	....	....	....
Carvol	2.498	2.690	2.914	-0.0416
Ethyl alcohol (97%)	2.706	2.923	3.130	-0.0424
Benzaldehyde	2.841	3.057	3.304	-0.0463
Amyl chloride	2.910	3.127	3.363	-0.0453
Isobutyl chloride	3.105	3.388	3.659	-0.0554
Chloroform	3.430	3.681	3.956	-0.0526
Butyric acid	3.478	3.767	4.064	-0.0606
Ethylene chloride	3.525	3.795	4.081	-0.0636
Pyridine	3.656	3.862	4.281	-0.0685
Methyl alcohol	3.837	4.205	4.606	-0.0769
Amyl formate	4.026	4.329	4.646	-0.0620
Propionic acid	4.078	4.417	4.787	-0.0709
Amyl acetate	4.119	4.411	4.850	-0.0731
Glacial acetic acid	4.079	5.129	5.614	-0.0935
Isobutyl acetate	4.091	4.968	....	-0.0654
Acetic anhydride	5.206	5.720	6.218	-0.1012
Acetone	6.285	6.921	....	-0.1252
Methyl acetate	6.494	....	....	....

(Just, Z. phys. Ch. 1901. 37. 354.)

Absorption of CO<sub>2</sub> by organic substances + Aq at 15°.

P = % of the organic substance in the solvent.

 $\beta_{15^\circ}$  = Coefficient of absorption at 15°. $S_{15^\circ}$  = Solubility at 15°.

Organic substance used	P	$\beta_{15^\circ}$	$S_{15^\circ}$
Chloral hydrate	0	0.996	....
	0	0.992	1.056
	0	1.012	....
	17.7	0.885	0.935
	21.8	0.860	0.908
	31.6	0.803	0.848
	37.0	0.790	0.834
	38.3	0.781	0.825
	49.8	0.760	0.802
	51.1	0.769	0.812
	52.6	0.764	0.807
	57.1	0.765	0.808
	61.1	0.780	0.824
	68.8	0.797	0.842
Glycerine	71.0	0.812	0.857
	74.6	0.848	0.895
	79.4	0.903	0.953
	....	....	....

Organic substance used	P	$\beta_{15^\circ}$	$S_{15^\circ}$
Glycerine	0	1.003	1.064
	0	1.013	....
	26.11	0.785	0.829
	27.69	0.800	0.845
	43.72	0.639	0.675
	46.59	0.620	0.655
	62.14	0.511	0.540
	73.36	0.449	0.474
	77.75	0.430	0.454
	87.74	0.422	0.446
	90.75	0.404	0.427
Glycerine	96.64	0.415	0.438
	99.26	0.410	0.438

(Hammel, Z. phys. Ch. 1915, 90. 123.)

## Solubility of carbon dioxide in solutions of aniline at 25°.

I. Concentration, 0.206 g. aniline in 100 c. c. of solution.

P = Pressure.

S = Solubility calc. according to formula given in original article.

P	S	P	S
748	0.865	1053	0.855
808	0.855	1159	0.862
920	0.857	1243	0.860

II. Concentration, 0.425 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.909	1150	0.897
816	0.897	1236	0.902
921	0.897	1380	0.908

Solubility of carbon dioxide in solutions of aniline at 25°.—*Continued*

III. Concentration, 0.566 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.935	1082	0.923
823	0.929	1223	0.924
941	0.925	1341	0.930

IV. Concentration, 0.743 g. aniline in 100 c. c. of solution.

P	S	P	S
760	0.953	1063	0.940
895	0.941	1223	0.940
983	0.940	1302	0.942

(Findlay and Creighton, Chem. Soc. 1910, 97. 555.)

Solubility of CO<sub>2</sub> in CS<sub>2</sub> increases approx. proportionally with the pressure. The absorption is greater at lower temp. and less at higher temp. than is required by Dalton's law. (Woukoloff, C. R. 1889, 108. 674.)

Absorption of CO<sub>2</sub> by sugar + Aq.

Sugar + Aq	Grams CO <sub>2</sub> absorbed by 75 cc. of solution at 15.5° and 720 mm.
1/10-N sugar solution	0.1225
1/5-N " "	0.1089
1-N " "	0.0931

(Christoff, Z. phys. Ch. 1905, 53. 329.)

Absorption of CO<sub>2</sub> in sugar + Aq at 20°.

Conc. of solution	Sp. gr.	Coefficient of absorption
1/5 mol. per l.	1.01518	0.846
1/4 " " "	1.03125	0.815
1/2 " " "	1.06372	0.756
1 " " "	1.12809	0.649

(Usher, Chem. Soc. 1910, 97. 72.)

*Liquid*.—Not miscible with H<sub>2</sub>O, though slightly sol. therein, or with fatty oils; miscible with alcohol, ether, CS<sub>2</sub>, and the essential oils. (Thilorier, Mitchell.)

Unacted upon by H<sub>2</sub>O; sol. in alcohol, ethers, petroleum, oil of turpentine, and CS<sub>2</sub>. (Mareska and Donny.)

Petroleum dissolves 5 to 6 vols. liquid CO<sub>2</sub>. (Cailletet, C. R. 75. 1271.)

Sl. sol. in CS<sub>2</sub>. (Cailletet.)

*Solid*.—When immersed in H<sub>2</sub>O, rapidly volatilizes and dissolves. With alcohol or ether it forms a semi-fluid mixture. (Channing, Am. J. Sci. (2) 5. 186.)

Only slightly sol. in anhydrous ether, but may be mixed therewith to a paste. (Thilorier.)

Sol. in methyl chloride below -65° to the point of sat. without decomp. (Villard, C. R. 1895, 120. 1413.)  
+6H<sub>2</sub>O. (Villard, C. R. 1894, 119. 369.)

**Carbon selenide, C<sub>2</sub>Se.**

Sol. only in hot conc. H<sub>2</sub>SO<sub>4</sub>. (v. Bartal, Ch. Z. 1906, 30. 810.)

C<sub>2</sub>Se. Insol. in H<sub>2</sub>O, CS<sub>2</sub>, and ether. Easily sol. in hot conc. H<sub>2</sub>SO<sub>4</sub>; sol. in conc. NaOH + Aq from which it is pptd. by HCl. (v. Bartal.)

**Carbon silicide CSI.**

(*Carborundum*.) Not attacked by any acids, even HF; sl. attacked by caustic alkalies or carbonates. (Acheson, C. N. 68. 179.)

Not attacked by KOH + Aq. (Schützenberger, C. R. 114. 1089.)

**Carbon monosulphide, CS.**

Insol. in H<sub>2</sub>O, alcohol, oil of turpentine, or benzene; somewhat sol. in CS<sub>2</sub> or ether; sol. in warm HNO<sub>3</sub>; sol. in conc. KOH + Aq. (Sidot, C. R. 81. 32.)

Readily absorbed by alcohol and aniline. (Deninger, J. pr. 1895, (2) 51. 349.)

**Carbon disulphide, CS<sub>2</sub>.**

Very sl. sol. in H<sub>2</sub>O.

1 l. H<sub>2</sub>O dissolves 2-3 g. CS<sub>2</sub>. (Ckandi, Bull. Soc. 43. 562); 3.5-4.52 g. (Peligot, ib. 43. 563).

30 ccn. CS<sub>2</sub> shaken with 8690 ccn. H<sub>2</sub>O at 20-23° for 18 days decreased 11 ccn. in 9 days and 1.4 ccn. in the next 3 days by diffused light, and 0.6 ccn. in the last 5 days (no light). Part of the CS<sub>2</sub> was decomp. and 7.85 ccn. were dissolved, therefore H<sub>2</sub>O dissolves 1/1000 of its weight CS<sub>2</sub>. (Sestini, Gazz. ch. it. 1. 473.)

Solubility of CS<sub>2</sub> in H<sub>2</sub>O.

100 pts. H <sub>2</sub> O dissolve 0.203 pts. CS <sub>2</sub> at 12-13°					
" " " " " "	0.191	"	"	15-16°	
" " " " " "	0.168	"	"	25-27°	
" " " " " "	0.145	"	"	30-33°	

(Page, C. N. 41. 195.)

Solubility of CS<sub>2</sub> in H<sub>2</sub>O. a = g. CS<sub>2</sub> in 1000 ccn. solution at t°.

a	t°	a	t°	a	t°
2.04	0	1.79	20	1.11	40
1.99	5	1.69	25	0.70	45
1.94	10	1.55	30	0.14	49
1.87	15	1.37	35		

(Chancel and Parmentier, C. R. 100. 773.)

100 g. H<sub>2</sub>O dissolve at t°:

t°	0	10	20	30
	0.258	0.239	0.201	0.195 g. CS <sub>2</sub> .

(Rex, Z. phys. Ch. 1906, 55. 365.)

Absorption of CS<sub>2</sub> vapor by H<sub>2</sub>O at t°.

t°	Coefficient of absorption
0	3.573
10	2.189
20	1.346
30	0.799

Calc. from data of Chancel and Parmentier, C. R. 100. 733.)

(Winkler, Z. phys. Ch. 1906, 55. 352.)

Vapors of CS<sub>2</sub> are most easily absorbed by alcoholic solution of KOH. Sl. absorbed by KOH+Aq. and very slowly by CuSO<sub>4</sub>, Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq. conc. H<sub>2</sub>SO<sub>4</sub>, or CaCl<sub>2</sub> in HCl+Aq. (Berthelot, A. ch. (3) 51. 74.)

Solubility in alcohol. S=strength of alcohol in per cent by weight; P=pts. CS<sub>2</sub> which dissolve in 10 ccm. alcohol at 17°.

S	P	S	P
100	∞	91.37	5.00
98.5	18.20	84.12	3.00
98.15	13.20	76.02	2.00
96.95	10.00	48.40	0.20
93.54	7.00	47.90	0.00

(Tuchschmidt and Follenius, B. 4. 583.)

Miscible with absolute alcohol, ether, ethereal and fatty oils, and liquid CO<sub>2</sub>.

**Tricarbon disulphide, C<sub>3</sub>S<sub>2</sub>.**

Insol. in H<sub>2</sub>O; easily sol. in alcohol, ether, chloroform, benzene, and CS<sub>2</sub>. The alcoholic and ethereal solutions decomp. on standing. (Lengyel, B. 26. 2960.)

Sol. in alcohol with decomp. Sol. in CS<sub>2</sub> and in benzene. (Stock, B. 1912, 45. 3575.)

*Solid modification.* Insol. in H<sub>2</sub>O and ordinary solvents. Sol. in KOH+Aq. (Lengyel.)

**Carbon sulphoselenide, CSSe.**

Mpt. —85°, bpt. +84°.

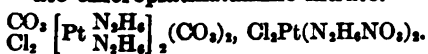
Decomp. by light. Not attacked by H<sub>2</sub>O.

Sol. in hot conc. HNO<sub>3</sub>. Decomp. by Br<sub>2</sub> to an oil. Sol. in alcohol with decomp. Miscible with CS<sub>2</sub>. (Stock, B. 1914, 47. 150.)

**Carbon sulphotelluride, CSTe.**

Mpt. —54°. Very unstable.

Miscible with CS<sub>2</sub> and benzene without decomp. (Stock, B. 1914, 47. 142.)

**Carbonatochloroplatindiamine carbonate chloroplatindiamine nitrate.**

Precipitate. (Cleve, J. B. 1867. 321.)

**Carbonatonitratoplatindiamine carbonate, (NO<sub>2</sub>)<sub>2</sub>[Pt(N<sub>2</sub>H<sub>4</sub>)<sub>2</sub>(CO<sub>2</sub>)<sub>2</sub>].**

Sol. in boiling H<sub>2</sub>O. (Cleve.)

**Carbonatotetramine cobaltic bromide, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>Br.**

Much less sol. than chloride. (Jörgensen, Z. anorg. 2. 279.)

— **carbonate**, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>CO<sub>2</sub>+3H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Jörgensen.)

— **chloraurate**, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>AuCl<sub>4</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.

Somewhat sol. in H<sub>2</sub>O; nearly absolutely insol. in alcohol. (Jörgensen.)

— **chloride**, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>Cl.

Easily sol. in H<sub>2</sub>O; insol. in alcohol. (Jörgensen.)

— **chloroplatinate**, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>PtCl<sub>4</sub>+2H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O and alcohol. (Jörgensen.)

— **chloroplatinite**, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>PtCl<sub>4</sub>.

Nearly insol. in H<sub>2</sub>O; wholly in alcohol. (Jörgensen.)

— **dithionate**, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>S<sub>2</sub>O<sub>6</sub>.

Ppt. (Jörgensen.)

— **iodide**, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>I.

Much less sol. than bromide or chloride. (Jörgensen.)

— **nitrate**, Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>NO<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.

Sol. in about 15 pts. cold H<sub>2</sub>O; insol. in alcohol. (Jörgensen.)

— **sulphate**, [Co(NH<sub>3</sub>)<sub>4</sub>CO<sub>2</sub>]<sub>2</sub>SO<sub>4</sub>+3H<sub>2</sub>O.

Considerably less sol. in H<sub>2</sub>O than the nitrate. (Jörgensen.)

**Carbonic acid, H<sub>2</sub>CO<sub>3</sub>.**

See Carbon dioxide.

**Carbonates.**

Carbonates of Na, K, Rb, and Cs are easily sol. in H<sub>2</sub>O; carbonates of Li and Tl are much less sol.; other carbonates are nearly or quite insol. All carbonates are sol. to some extent in H<sub>2</sub>O containing CO<sub>2</sub>. All carbonates, except those of NH<sub>4</sub>, Rb, and Cs, are insol. in alcohol.

Sol. in those acids which are themselves sol. in H<sub>2</sub>O, except HCN and H<sub>2</sub>BO<sub>3</sub>.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 824.)



**Aluminum carbonate, basic.**

$5\text{Al}_2\text{O}_3, 6\text{CO}_2 + 37\text{H}_2\text{O} = 3\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 14\text{H}_2\text{O}$ . (Seubert, Z. anorg. 1893, 4. 67.)

$\text{Al}_2\text{O}_3, \text{CO}_2$ . (Parkmann, Sill. Am. J. (2) 34. 324.)

$3\text{Al}_2\text{O}_3, 2\text{CO}_2 + 16\text{H}_2\text{O}$ . (Muspratt and Danson, A. 72. 120.)

$3\text{Al}_2\text{O}_3, 2\text{CO}_2 + 9\text{H}_2\text{O}$ . (Wallace, Chem. Gaz. 1858. 410.)

$5\text{Al}_2\text{O}_3, 3\text{CO}_2 + 18\text{H}_2\text{O}$ . (Bley, J. pr. 39. 11.)

$2\text{Al}_2\text{O}_3, \text{CO}_2 + 6\text{H}_2\text{O} = 10\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ . Sol. in cold dil. acids. (Schlumberger, Bull. Soc. 1895, (3) 13. 46.)

+  $8\text{H}_2\text{O}$ . (Urbain and Renoul, J. Pharm. (4) 30. 340.) =  $10\text{Al}(\text{OH})_3, \text{Al}_2(\text{CO}_3)_3 + 9\text{H}_2\text{O}$ . (Seubert, Z. anorg. 1893. 4. 67.)

$8\text{Al}_2\text{O}_3, 3\text{CO}_2 + 40\text{H}_2\text{O}$ . (Langlois, A. ch. (3) 48. 505.)

All are precipitates, insol. in  $\text{H}_2\text{O}$ , sol. in acids, and give off  $\text{CO}_2$  at slight heat.

There are no definite carbonates of aluminum. (Cameron, J. phys. Chem. 1908, 12. 572.)

**Aluminum ammonium carbonate,  $\text{Al}_2\text{O}_3, \text{CO}_2, (\text{NH}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$ .**

Precipitate. (Rose, Pogg. 91. 460.)

**Aluminum sodium carbonate,  $\text{Al}_2\text{O}_3, \text{CO}_2, 2\text{Na}_2\text{CO}_3 + 24\text{H}_2\text{O}$ .**

Precipitate. Sol. in cold dil. acids. (Bley, J. pr. 39. 22.)

**Ammonium carbonate,  $(\text{NH}_4)_2\text{CO}_3 + \text{H}_2\text{O}$ .**

Sol. at  $15^\circ$  in its own weight  $\text{H}_2\text{O}$ . Solution in  $\text{H}_2\text{O}$  gives off gas at  $70-75^\circ$  and boils at  $75-80^\circ$ . Sl. sol. in cold dil.  $\text{NH}_4\text{OH} + \text{Aq}$ , more sol. at ordinary temp. Insol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Divers, Chem. Soc. (2) 8. 171, 259, and 364.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Insol. in alcohol.

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

100 g. pure glycerine dissolve 20 g.  $(\text{NH}_4)_2\text{CO}_3$  at  $15^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

**Ammonium hydrogen carbonate,  $\text{NH}_4\text{HCO}_3$ .**

Sol. at  $15^\circ$  in about 8 pts.  $\text{H}_2\text{O}$ . (Berthollet, J. Phys. 66. 168.)

Sol. at  $12.8^\circ$  in about 6 pts.  $\text{H}_2\text{O}$ . (J. Davy, N. Edinb. J. 16. 245.)

Solution decomp. on air or by gentle heat or by addition of the solid salt. (Berthollet.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 11.9 pts.; at  $10^\circ$ , 15.85 pts.; at  $20^\circ$ , 21 pts.; at  $30^\circ$ , 27 pts.  $\text{NH}_4\text{HCO}_3$ . (Dibbitts, J. pr. (2) 10. 417.)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NH}_4\text{Cl} + \text{Aq}$ , sat. with  $\text{CO}_2$ , at  $t^\circ$ .**

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr. of sat. solution
	$\text{NH}_4\text{Cl}$	$\text{NH}_4\text{HCO}_3$	
$0^\circ$	0	11.9	1.077
	29.08	3.6	
	0	18.64	
	2.99	16.29	
	6.06	14.22	
$15^\circ$	8.51	12.69	1.064
	11.68	11.68	1.063
	18.30	9.33	1.062
	26.93	7.73	1.062
	33.25	6.64	1.069
	34.35	6.42	1.076
			1.085
$30^\circ$	0	27.0	...
	39.7	9.1	

(Fedotieff, Z. phys. Ch. 1904, 49. 168.)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NaHCO}_3 + \text{Aq}$ , sat. with  $\text{CO}_2$ , at  $t^\circ$ .**

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr. of sat. solution
	$\text{NaHCO}_3$	$\text{NH}_4\text{HCO}_3$	
$0^\circ$	0	11.90	1.072
	4.82	10.94	
$15^\circ$	0	18.64	1.064
	5.92	17.06	
$30^\circ$	0	27.0	...
	7.0	23.0	

(Fedotieff, Z. phys. Ch. 1904, 49. 168.)

**Solubility of  $\text{NH}_4\text{HCO}_3$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $t^\circ$ .**

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr. of sat. solution
	$\text{NH}_4\text{NO}_3$	$\text{NH}_4\text{HCO}_3$	
$0^\circ$	0	11.90	1.2625
	118	4.52	
$15^\circ$	0	18.64	1.064
	23.26	12.91	1.113
	49.82	10.33	1.164
	103.4	8.25	1.242
	128.9	7.79	1.269
	166.9	7.49	1.302
$30^\circ$	0	26.96	...
	231.9	12.57	

(Fedotieff and Koltunoff, Z. anorg. 1914, 85. 251.)

Insol. in alcohol. (J. Davy.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium dihydrogen carbonate,**  
 $(\text{NH}_4)_2\text{H}_2(\text{CO}_3) + \text{H}_2\text{O}.$ 

Sol. in 5 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; decomp. by more  $\text{H}_2\text{O}$  or by heat. (Divers, Chem. Soc. (2) 8. 171, 359, and 364.)

Sl. sol. in alcohol.

**Ammonium hydrogen carbonate carbamate,**  
 $2\text{NH}_4\text{HCO}_3, \text{NH}_4\text{CONH}_2.$  (*Salts of hartshorn.*)

1 pt. salt dissolves at:

$13^\circ$  in 4 pts.  $\text{H}_2\text{O}.$

$16.7^\circ$  " 3.3 "

$32.2^\circ$  " 2.7 "

$40.6^\circ$  " 2.4 "

$49^\circ$  " 2 "

(J. Davy, N. Edinb. J. 16. 245.)

Strong alcohol dissolves out carbamate, and the carbonate remains undissolved.

$\text{NH}_4\text{HCO}_3, \text{NH}_4\text{CO}_2\text{NH}_2.$  (*Commercial carbonate of ammonia.*)

Sol. at  $15^\circ$  in 4 pts.  $\text{H}_2\text{O}$ , at  $65^\circ$  in  $1\frac{1}{2}$  pts.  $\text{H}_2\text{O}.$  (Divers.)

30 pts. salt + 100 pts.  $\text{H}_2\text{O}$  lower temp. from  $15.3^\circ$  to  $3.2^\circ.$  (Rüdorff, B. 2. 68.)

Sol. in 1.667 pts. cold, and 0.833 pt. hot  $\text{H}_2\text{O}.$  (Fourcroy.)

100 pts.  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 25 pts.

"  $17^\circ$  " 30 "

"  $37^\circ$  " 37 "

"  $41^\circ$  " 40 "

"  $49^\circ$  " 50 "

(Berzelius.)

100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 33 pts.; at  $100^\circ$ , 100 pts. (Tre's Dict.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ , and in less than 1 pt. boiling  $\text{H}_2\text{O}$ ; sat. solution at  $15.5^\circ$  contains 33.3%, and sat. boiling solution 50%. (Abl.)

Sat. aqueous solution at  $10^\circ$  contains 15.7%. (Eller.)

Sat. aqueous solution at  $(t)$  contains 6.1%. (Museumbroek.)

Sat. solution in the cold contains 37.5%. (Fourcroy.)

Does not dissolve as such in  $\text{H}_2\text{O}$ ;  $(\text{NH}_4)_2\text{CO}_3$  dissolves out first, and  $\text{NH}_4\text{HCO}_3$  later. (Scanlan.)

Sp. gr. of carbonate of ammonia + Aq at  $12^\circ.$

Deg. Tw.	Sp. gr. at $12^\circ.$	% Carb. ammon.	Change of sp. gr. for $1^\circ\text{C}.$
1	1.006	1.66	0.0002
2	1.010	3.18	0.0002
3	1.015	4.66	0.0003
4	1.020	6.04	0.0003
5	1.025	7.49	0.0003
6	1.030	8.93	0.0004
7	1.035	10.35	0.0004
8	1.040	11.86	0.0004
9	1.045	13.36	0.0005
10	1.050	14.83	0.0005
11	1.055	16.16	0.0005
12	1.060	17.70	0.0005
13	1.065	19.18	0.0005
14	1.070	20.70	0.0005
15	1.075	22.25	0.0006
16	1.080	23.78	0.0006
17	1.085	25.31	0.0006

Sp. gr. of carbonate of ammonia + Aq at  $12^\circ.$ —Continued

Deg. Tw.	Sp. gr. at $12^\circ.$	% Carb. ammon.	Change of sp. gr. for $1^\circ\text{C}.$
18	1.090	26.82	0.0007
19	1.095	28.33	0.0007
20	1.100	29.93	0.0007
21	1.105	31.77	0.0007
22	1.110	33.45	0.0007
23	1.115	35.08	0.0007
24	1.120	36.88	0.0007
25	1.125	38.71	0.0007
26	1.130	40.34	0.0007
27	1.135	42.20	0.0007
28	1.140	44.29	0.0007
29	1.144	44.90	0.0007

(Lunge, Chem. Ind. 1883. 2.)

Sp. gr. of aqueous solution of salt with composition 31.3%  $\text{NH}_3$ , 56.6%  $\text{CO}_2$ , 12.1%  $\text{H}_2\text{O}.$  100 pts. of solution contain—

6.58 9.96 14.75 19.83 25.71 pts. salt  
1.0219 1.0337 1.0497 1.0672 1.0863 sp. gr.

29.74 35.85 40.23 44.90 pts. salt.

1.0995 1.1174 1.1297 1.1414 sp. gr.

(J. H. Smith, Chem. Ind. 1883. 3.)

Conc. alcohol dissolves out carbamate and leaves carbonate. (Hünefeld, J. pr. 7. 25.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Ammonium cerous carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{Ce}_2(\text{CO}_3)_3 + 6\text{H}_2\text{O}.$ 

Ppt. Very sl. sol. in conc.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  (Meyer, Z. anorg. 1904, 41. 104.)

**Ammonium chromous carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{CrCO}_3 + \text{H}_2\text{O}.$ 

Decomp. by moist air; sol. in dil.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4.$  (Baugé, C. R. 1896, 122. 476.)

**Ammonium cobaltous carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{CoCO}_3 + 4\text{H}_2\text{O}.$ 

Permanent. Sol. in  $\text{H}_2\text{O}.$  (Deville, A. ch. (3) 35. 460.)

$(\text{NH}_4)_2\text{O}, 2\text{CoO}, 4\text{CO}_2 + 9\text{H}_2\text{O}.$  Quickly decomp. on air; sol. in  $\text{H}_2\text{O}.$  (Deville.)  
+  $12\text{H}_2\text{O}.$  Sol. in  $\text{H}_2\text{O}.$

**Ammonium didymium carbonate,  $(\text{NH}_4)_2\text{CO}_3,$**   
 $\text{Di}(\text{CO}_3)_2 + 3\text{H}_2\text{O}.$ 

Insol. in  $\text{H}_2\text{O}.$  (Cleve.)

**Ammonium dysprosium carbonate,**  
 $\text{NH}_4\text{Dy}(\text{CO}_3)_2 + \text{H}_2\text{O}.$ 

Only sl. sol. in  $\text{H}_2\text{O}.$  (Jantsch, B. 1911, 44. 1277.)

**Ammonium glucinum carbonate**,  $2(\text{NH}_4)_2\text{CO}_3 \cdot 3\text{GlCO}_3(?)$ .

Very sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Nearly insol. in alcohol. (Debray.)

Composition is  $(\text{NH}_4)_2\text{CO}_3 \cdot 2\text{GlCO}_3 \cdot \text{Gl}(\text{OH})_3 + 2\text{H}_2\text{O}$ . (Humpidge, Royal Soc. Proc. 39. 1.)

**Ammonium lanthanum carbonate**,  $\text{La}_2(\text{CO}_3)_3 \cdot (\text{NH}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Meyer, Z. anorg. 1904, 41. 102.)

**Ammonium magnesium carbonate**,  $(\text{NH}_4)_2\text{Mg}(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .

Sol. in 71 pts.  $\text{H}_2\text{O}$  with decomp.; more sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Divers, Chem. Soc. 51. 196.)

$\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$  dissolves very slightly; more sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ . (Favre, A. ch. (3) 10. 473.)

**Ammonium magnesium hydrogen carbonate**,  $(\text{NH}_4)_2\text{Mg}_2\text{H}_2(\text{CO}_3)_4 + 8\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$ .

Decomp. on air. (Deville, A. ch. (3) 35. 454.)

**Ammonium neodymium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Nd}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. Sl. sol. in conc.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1904, 41. 106.)

**Ammonium nickel carbonate**,  $\text{NH}_4\text{HCO}_3 \cdot \text{NiCO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 35. 452.)

**Ammonium praseodymium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Pr}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1904, 41. 105.)

**Ammonium samarium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Sm}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt.

**Ammonium scandium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot 2\text{Sc}_2(\text{CO}_3)_3 + 6\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . Sol. in cold alkali-carbonate + Aq, less sol. in hot. (R. Meyer, Z. anorg. 1910, 67. 410.)

**Ammonium tin (stannous) carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot 2\text{SnCO}_3 + 3\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 35. 456.)

**Ammonium uranyl carbonate**,  $2(\text{NH}_4)_2\text{CO}_3 \cdot \text{UO}_2\text{CO}_3$ .

Sol. at  $15^\circ$  in 20 pts.  $\text{H}_2\text{O}$ , more abundantly in  $\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$ . (Ebelsmen.)

Insol. in pure  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{O}$  containing  $(\text{NH}_4)_2\text{CO}_3$ . Solution is decomp. by boiling. (Berzelius.)

Sol. in  $\text{SO}_2 + \text{Aq}$ . (Berthier, A. ch. (3) 7. 76.)

$3(\text{NH}_4)_2\text{CO}_3 \cdot 2(\text{UO}_2)\text{CO}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Giolitti C. C. 1906, II. 227.)

**Ammonium vanadyl carbonate**,  $3(\text{NH}_4)_2\text{O} \cdot 7\text{VO}_2 \cdot 5\text{CO}_2 + 16\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

Sol. in acids and alkalis. (Koppel, Z. anorg. 1905, 45. 350.)

**Ammonium yttrium carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{Y}_2(\text{CO}_3)_3 + 2\text{H}_2\text{O}$ .

Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Mosander.)

**Ammonium zinc carbonate, basic**,  $3\text{ZnO} \cdot \text{NH}_4\text{OH} \cdot 2\text{CO}_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Kassner, Arch. Pharm. (3) 27. 673.)

**Ammonium zinc carbonate**,  $(\text{NH}_4)_2\text{CO}_3 \cdot \text{ZnCO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Deville.)

Quite sol. in  $\text{H}_2\text{O}$ ; more sol. than  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{MgCO}_3$ . Tolerably permanent in the air. Slowly decomp. by cold, rapidly by hot  $\text{H}_2\text{O}$ .

Very sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Not attacked by alcohol. (Favre, A. ch. (3) 10. 481.)

**Barium carbonate**,  $\text{BaCO}_3$ .

Sol. in 4304 pts. cold, and 2304 pts. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)

Sol. in 47,620 pts.  $\text{H}_2\text{O}$ . (Bineau, A. ch. (3) 51. 290.)

Sol. in 14,137 pts.  $\text{H}_2\text{O}$  at  $16-20^\circ$ , and 15,421 pts. at  $100^\circ$ . (Fresenius.)

Sol. in 12,027 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, Pogg. 85. 247.)

Calculated from electrical conductivity of solution, 1 pt.  $\text{BaCO}_3$  is sol. in 64,070 pts.  $\text{H}_2\text{O}$  at  $8.8^\circ$  and 45,566 pts. at  $24.2^\circ$ . (Holleman, Z. phys. Ch. 12. 125.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. sol. in 100 g. $\text{H}_2\text{O}$
14	$4.32 \times 10^{-4}$
18	$4.57 \times 10^{-4}$
23	$4.89 \times 10^{-4}$
27	$5.22 \times 10^{-4}$
32	$5.69 \times 10^{-4}$
38	$6.27 \times 10^{-4}$

(Weissenberger, Z. phys. Ch. 1914, 88. 266.)

"Solubility product" =  $8.1 \times 10^{-2}$  mol. l. (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (See barium hydrogen carbonate.)

Easily sol. in dil. acids. Not acted upon by conc.  $\text{HNO}_3 + \text{Aq}$ .

Not decomp. by 1 pt.  $\text{H}_2\text{SO}_4 + 6$  pts. absolute alcohol. Slowly decomp. by 1 pt.

HNO<sub>3</sub>+6 pts. absolute alcohol. Slowly decomp. by 1 pt. H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>+6 pts. absolute alcohol.

Not decomp. by absolute alcoholic solutions of racemic, tartaric, citric, or glacial acetic acids. (Babington and Phillips, 1816.)

Almost completely insol. in H<sub>2</sub>O containing NH<sub>4</sub>OH and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>, when digested in such a solution and allowed to stand. 1 pt. BaCO<sub>3</sub> dissolves in 141,000 pts. of such a solution. (Fresenius.)

Not more sol. in NaCl+Aq than in H<sub>2</sub>O. (Karsten.)

Sol. in cold NH<sub>4</sub>Cl, NH<sub>4</sub>NO<sub>3</sub>, or NH<sub>4</sub> succinate+Aq. (Vogel, J. pr. 7. 453.)

2 mols. NH<sub>4</sub>Cl dissolved in H<sub>2</sub>O dissolve 1 mol. BaCO<sub>3</sub> by continued boiling. (Smith, Phil. Mag. J. 9. 540.)

Solubility in H<sub>2</sub>O increases by addition of NH<sub>4</sub>Cl, at first strongly, then less strongly and finally strongly again. (D'Agustino and Pellegrino, Gazz. ch. it. 1908, 38 (1) 532.)

Somewhat sol. in K<sub>2</sub>CO<sub>3</sub>+Aq. (Wackenroder, A. 24. 30.)

Solubility of BaCO<sub>3</sub> in KCl+Aq at bpt. of solution

g. KCl per 100 g. solution	g. BaCO <sub>3</sub> per 1000 cc. sat. solution
0.15	0.0847
1	0.1781
3	0.2687
10	0.4274
30	0.5550

(Cantoni and Goguelia, Bull. Soc. 1905, (3) 33. 13.)

Solubility of BaCO<sub>3</sub> in NaCl+Aq at bpt. of solution

g. NaCl per 100 g. solution	g. BaCO <sub>3</sub> per 1000 cc. sat. solution
0.15	0.0587
1	0.0787
3	0.1056
10	0.1575
30	0.2784

(Cantoni and Goguelia, l. c.)

Solubility of BaCO<sub>3</sub> in 10% KCl+Aq at t°.

t°	g. BaCO <sub>3</sub> per 1000 cc. sat. solution
10	0.2175
20	0.2408
40	0.2972
60	0.3491
80	0.4049

(Cantoni and Goguelia, l. c.)

Solubility of BaCO<sub>3</sub> in 10% NaCl+Aq at t°.

t°	g. BaCO <sub>3</sub> per 1000 cc. sat. solution
10	0.1085
20	0.1126
40	0.1231
60	0.1303
80	0.1418

(Cantoni and Goguelia, l. c.)

Slowly sol. in conc. Na<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, ZnSO<sub>4</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>, or CaCl<sub>2</sub>+Aq, but insol. in ZnCl<sub>2</sub>+Aq. (Karsten.)

Sl. decomp. by boiling K<sub>2</sub>SO<sub>4</sub>+Aq.

Sl. decomp. in the cold by 1 pt. K<sub>2</sub>SO<sub>4</sub>+2 pts. Na<sub>2</sub>SO<sub>4</sub>+Aq.

Decomp. by salts of Al, Mn, Cr, Fe, U, Bi, Cd, Cu, Hg, Pb, Sn<sup>II</sup>, Sn<sup>IV</sup>, Hg<sub>2</sub>, Rh, Ir, Au, with pptn. of oxide of metal. (Rose, Tr.)

Pptn. of BaCO<sub>3</sub> is hindered by presence of alkali citrates or metaphosphates.

Sol. in solutions of various salts, as in the case of calcium carbonate (see *Calcium carbonate*). The solvent power of these solutions for barium carbonate is somewhat less than for calcium carbonate.

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Min. *Witherite*.

**Barium hydrogen carbonate**, BaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>(?).

100 pts. H<sub>2</sub>O containing CO<sub>2</sub> dissolve 0.079 pt. BaCO<sub>3</sub>. (Bineau.)

100 pts. H<sub>2</sub>O containing CO<sub>2</sub> dissolve 0.17 pt. BaCO<sub>3</sub>. (Lassaigne.)

100 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> under a pressure of 4-6 atmospheres dissolve 0.725 pt. BaCO<sub>3</sub>. Upon evaporating, BaCO<sub>3</sub> is deposited. (Wagner, Z. anal. 6. 167.)

BaCO<sub>3</sub> is sol. in 833 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 10°. (Lassaigne.)

BaCO<sub>3</sub> is sol. in 830 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 10°. (Fourcroy.)

BaCO<sub>3</sub> is sol. in 1550 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 10°. (Bergman.)

100 cc. H<sub>2</sub>O sat. with CO<sub>2</sub> dissolve 0.73 g. BaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>. (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

**Barium calcium carbonate**, BaCO<sub>3</sub>, CaCO<sub>3</sub>.

Min. *Barytocalcite*, *Bromlite*. Sol. in dil. acids.

**Barium uranyl carbonate**, BaO, 2UO<sub>3</sub>, 2CO<sub>2</sub>, +5H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Blinkoff. Dissert. 1900.)

+8H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Blinkoff.)

**Bismuth carbonate, basic,  $(\text{BiO})_2\text{CO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. Insol. in  $\text{CO}_2 + \text{Aq.}$  (Bergman.)

Completely sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$ ; sl. sol. in  $\text{K}_2\text{CO}_3 + \text{Aq.}$ ; insol. in  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  (Lau-gier.)

Absolutely insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  unless  $\text{H}_3\text{PO}_4$  or  $\text{H}_2\text{AsO}_4$  are present. (Berzelius.)

Insol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  (Rose.)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder.) Insol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Sol. in  $\text{CaCl}_2 + \text{Aq.}$  (Pearson.)

Min. *Bismuthosphaerite*.

$3\text{Bi}_2\text{O}_3$ ,  $\text{CO}_2$ . Min. *Bismuthite*. Easily sol. in acids.

$4\text{Bi}_2\text{O}_3$ ,  $3\text{CO}_2 + 4\frac{1}{2}\text{H}_2\text{O}$ . Min. *Bismuth spar*. Easily sol. in acids.

**Bismuth potassium carbonate,  $\text{Bi}_2\text{OK}_4(\text{CO}_3)_4 + \text{H}_2\text{O}$ .**

Decomp. by large quantities of  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 266.)

**Cadmium carbonate,  $\text{CdCO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids; insol. in  $\text{K}_2\text{CO}_3$ , and  $\text{Na}_2\text{CO}_3 + \text{Aq.}$ ; very sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Fresenius.)

Easily sol. in  $\text{NH}_4$  sulphate, nitrate, and succinate +  $\text{Aq.}$  (Wittstein.)

Sol. in  $\text{KCN} + \text{Aq.}$ ; sol. in cold  $\text{NH}_4\text{Cl} + \text{Aq.}$ ; less sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett, 1837.)

Not prevented from pptn. by non-volatile organic substances. (Rose.)

Not pptd. from solutions containing sodium citrate. (Spiller.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate. (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . (Lefort, J. B. 1847. 346.)

(Kraut, Z. anorg. 1897, 13. 14.)

**Cadmium carbonate hydrazine,  $\text{CdCO}_3, 2\text{N}_2\text{H}_4$ .**

Easily sol. in cold  $\text{NH}_4\text{OH} + \text{Aq.}$  (Franzen, Z. anorg. 1908, 60. 281.)

**Cæsium carbonate,  $\text{Cs}_2\text{CO}_3$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

100 pts. absolute alcohol dissolve 11.1 pts.  $\text{Cs}_2\text{CO}_3$  at  $19^\circ$ ; 20.1 pts.  $\text{Cs}_2\text{CO}_3$  at boiling temp. (Bunsen.)

**Cæsium hydrogen carbonate,  $\text{CaHCO}_3$ .**

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Calcium carbonate basic,  $\text{CaO}, \text{CaCO}_3 + \text{H}_2\text{O}$ .**

Hardened by  $\text{H}_2\text{O}$ , but not dissolved. (Raoult, C. R. 92. 189.)

**Calcium carbonate,  $\text{CaCO}_3$ .**

More sol. in cold than in hot  $\text{H}_2\text{O}$ . (Gmelin.)

When recently pptd., sol. in 8834 pts. boiling, and 10,601 pts. cold  $\text{H}_2\text{O}$ ; much less sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$ , 65,246 pts. of which dissolve 1 pt.  $\text{CaCO}_3$ . (Fresenius (1846), A. 89. 122.)

Sol. in 16,000 pts. pure  $\text{H}_2\text{O}$ . (Brandes, 1835.)

Sol. in 12,858 pts. pure  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, Pogg. 88. 247.)

Sol. in 16,000–24,000 pts. pure  $\text{H}_2\text{O}$ . (Bucholz.)

1 l.  $\text{H}_2\text{O}$  dissolves 34 mg.  $\text{CaCO}_3$ . (Chevalier, Z. anal. 8. 91; Hoffmann, Z. anal. 4. 414.)

1 l.  $\text{H}_2\text{O}$  may contain 0.016 g.  $\text{CaCO}_3$ . i. e., 1 pt. is sol. in 62,500 pts.  $\text{H}_2\text{O}$ . (Bineau, A. ch. (3) 51. 290.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.02 g.  $\text{CaCO}_3$ , i. e., 1 pt.  $\text{CaCO}_3$  is sol. in 50,000 pts.  $\text{H}_2\text{O}$ . (Peligot.)

Solubility is much affected by  $\text{CO}_2$  of the air.

1 l.  $\text{H}_2\text{O}$  at  $16^\circ$  dissolves 13.1 mg.  $\text{CaCO}_3$ . (Schlössing, C. R. 74. 1552.)

Calculated from electrical conductivity of  $\text{CaCO}_3 + \text{Aq.}$  1 pt.  $\text{CaCO}_3$  is sol. in 99,500 pts.  $\text{H}_2\text{O}$  at  $8.7^\circ$ , and 80,040 pts. at  $23.8^\circ$ . (Holle-mann, Z. phys. Ch. 12. 125.)

By continued boiling  $\text{CaH}_2(\text{CO}_3)_2$ , 36 mg.  $\text{CaCO}_3$  remain in solution. (Weltzien, A. 136. 165.)

**Solubility in  $\text{H}_2\text{O}$  at different pressures.**

Pressure in atmos.	Solubility
1	1079
2	1403
4	1820
6	2109

(Engel, C. R. 101. 949.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.0005 pt. (calculated as  $\text{CaO}$ ) from pptd.  $\text{CaCO}_3$ , and 0.0027 pt. from calcspar. (Lubavin, J. russ. Soc. 24. 389.)

1 l.  $\text{H}_2\text{O}$  dissolves 13 mg.  $\text{CaCO}_3$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1893, 12. 241.)

1 l.  $\text{CO}_2$  free water dissolves 17.4 mg.  $\text{CaO}$  or 31.0 mg.  $\text{CaCO}_3$ . (Gothe, Ch. Z. 1915, 39. 305.)

$\text{CaCO}_3$  dissolves in 9662 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Pollacci, C. C. 1896, II. 946.)

1 l.  $\text{H}_2\text{O}$  free from  $\text{CO}_2$  dissolves 9.6 mg.  $\text{CaCO}_3$ . (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

Found dissolved in 10,000 pts. sea water. (Davy.)

Pptd. amorphous  $\text{CaCO}_3$  dissolves in 1600 pts. sea water. Pptd. crystalline  $\text{CaCO}_3$  dissolves in 8000 pts. sea water. (Irvine and Young, Chem. Soc. 56. 344.)

Artificial sea water sat. with  $\text{CO}_2$  dissolves  $\text{CaCO}_3$  corresponding to 57.27 mg. of combined  $\text{CO}_2$  per litre at  $15^\circ$ .

Sea water which contains 52–55 mg. neutral combined  $\text{CO}_2$  per litre must be sat. with  $\text{CaCO}_3$ . (Cohen, Chem. Soc. 1900, 78 (2) 725.)

For action of  $\text{H}_2\text{CO}_3 + \text{Aq.}$  see *Calcium hydrogen carbonate*.

Sol. in  $\text{H}_2\text{SO}_4$ , even when native. Sol. in acids generally. When treated with acids in closed vessels effervescence ceases on increase of pressure, but is renewed at once on removing it. (Link, 1814.)

Unacted upon by conc.  $\text{HNO}_3$ , even when boiling, as  $\text{Ca}(\text{NC})_2$ , is insol. in conc.  $\text{HNO}_3$ .

Not decomp. by mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 6 pts. absolute alcohol, but immediately by  $\text{HNO}_3$  + absolute alcohol.

Not decomp. by absolute alcoholic solutions of oxalic, racemic, tartaric, citric, or glacial acetic acids. (Babington and Phillips, 1816.)

Unacted upon by glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , even when boiling.

Freshly pptd.  $\text{CaCO}_3$  is sol. in cold  $\text{NH}_4\text{Cl}$  + Aq; but the solution becomes cloudy on exposure to air, a portion, however, of  $\text{CaCO}_3$  remains dissolved, which cannot be pptd. even by boiling. If ppt. is washed and allowed to stand 24 hours, it is not as sol. in  $\text{NH}_4\text{Cl}$  as at first, but natural  $\text{CaCO}_3$  is not wholly insol. in  $\text{NH}_4\text{Cl}$  + Aq; it is, however, much less sol. than  $\text{MgCO}_3$ . (Vogel, J. pr. 7. 453.)

Sol. in boiling  $\text{NH}_4\text{Cl}$  + Aq with evolution of  $\text{NH}_3$ . (Demarcay, 1834.)

When  $\text{NH}_4\text{OH}$  + Aq, incompletely sat. with  $\text{CO}_2$ , is mixed with  $\text{CaCl}_2$  + Aq, no ppt. occurs even during several days. If kept in a closed vessel; and only a slight ppt. if the mixture is exposed to the air, but  $\text{CaCO}_3$  is pptd. if the solution is boiled.

$\text{NH}_4\text{OH}$  + Aq wholly sat. with  $\text{CO}_2$  produces ppt. when mixed with  $\text{CaCl}_2$  + Aq, but pptn. is not complete until heat is applied. Also when an excess of  $\text{CaCl}_2$  + Aq is added to a solution of crystallized carbonate of ammonia, only a portion of the  $\text{CaCO}_3$  is pptd. until the solution is boiled. (Vogel, 1814.)

When  $\text{CaCl}_2$  + Aq mixed with  $\text{NH}_4\text{OH}$  + Aq is exposed to an atmos. of pure  $\text{CO}_2$ , no ppt. occurs for several hours, but  $\text{CaCO}_3$  is completely pptd. in several days. (Vogel.)

When recently pptd., readily sol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3$  + Aq. (Brett, 1837; Wackenroder, A. 41. 315.)

When recently pptd., readily sol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4$  succinate + Aq. (Wittstein.)

Sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  + Aq. (Thomson.)

More sol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$  + Aq, or in neutral potassium, or sodium salts + Aq than in  $\text{H}_2\text{O}$ . (Fresenius.)

From solutions in  $\text{NH}_4$  salts,  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3$  + Aq precipitate  $\text{CaCO}_3$  more completely than  $\text{BaCO}_3$ . (Fresenius.)

When boiled with  $\text{NH}_4\text{Cl}$  + Aq,  $\text{CaCO}_3$  is dissolved, and  $(\text{NH}_4)_2\text{CO}_3$  given off. (D. Smith.)

$\text{CaCl}_2$  + Aq prevents pptn. of  $\text{CaCO}_3$  in the cold, as do also  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , or  $\text{NaCl}$  + Aq, but it is pptd. when boiled, if the latter solutions are not too conc.  $\text{K}_2\text{SO}_4$ ,  $\text{KNO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$  + Aq have a similar effect. A large excess of  $(\text{NH}_4)_2\text{CO}_3$  + Aq when quickly added to  $\text{CaCl}_2$  + Aq produces

no ppt. in the cold.  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3$  + Aq act likewise. (Storer, Am. J. Sci. (2) 25. 41.)

1 g.  $\text{CaCO}_3$  requires 13.98 g.  $\text{NH}_4\text{Cl}$ , 8.380 g.  $(\text{NH}_4)_2\text{SO}_4$ , or 14.438 g.  $\text{NH}_4\text{NO}_3$ , to effect solution. (Bertrand, Monit. Sci. (3) 10. 477.)

Less sol. in Na than in  $\text{NH}_4$  salts, but more than in K salts. (Berthelot.)

When  $\text{NH}_4\text{OH}$  + Aq, partially neutralized by  $\text{CO}_2$ , is mixed with  $\text{CaO}_2\text{H}_2$  + Aq, no cloudiness appears until the mixture is boiled; when more  $\text{CO}_2$  has been added to  $\text{NH}_4\text{OH}$  + Aq, a ppt. appears at first, which disappears and only reappears on addition of much  $\text{CaO}_2\text{H}_2$  + Aq; but  $\text{NH}_4\text{OH}$  + Aq does not dissolve pptd.  $\text{CaCO}_3$ . (Vogel.)

#### Solubility in $\text{NH}_4$ salts + Aq at 25°.

$\text{NH}_4$ salt	Millimols $\text{NH}_4$ salt per l.	Millimols $\text{CaO}$ dissolved per l.
$\text{NH}_4\text{Cl}$	1000	6.770
	500	5.008
	250	3.724
	125	2.743
$\text{NH}_4\text{NO}_3$	500	5.267
	250	3.830
	125	2.779
	62.5	2.004
Triammonium citrate	500	66.87
	250	39.80
	125	22.64
	62.5	14.92

(Rindell, Z. phys. Ch. 1909, 70. 454.)

#### Solubility of $\text{CaCO}_3$ in $\text{NH}_4\text{Cl}$ + Aq at 12–18°.

• Time, 98 days.

g. per l. of sat. solution	
$\text{NH}_4\text{Cl}$	$\text{CaCO}_3$
53.5	0.423
100	0.609
200	0.645

(Cantoni and Goguelia, Bull. Soc. 1905, (3) 33. 27.)

#### Solubility of $\text{CaCO}_3$ in $\text{NH}_4\text{NO}_3$ + Aq at 18°.

g. per l. of sat. solution	
$\text{NH}_4\text{NO}_3$	$\text{CaCO}_3$
0	0.131
5	0.211
10	0.258
20	0.340
40	0.462
80	0.584

(Berju and Kosminiko, Landw. Vers. Sta. 1904, 60. 422.)

$\text{CaO}_2\text{H}_2 + \text{Aq}$  dissolves a little  $\text{CaCO}_3$ . (Welter and Berthollet, 1789.)

$\text{CaO}_2\text{H}_2 + \text{Aq}$  retains a little  $\text{CaCO}_3$  in solution at ordinary temperature, which is pptd. on boiling. (Eliot and Storer, Proc. Am. Acad. 1860, 5. 63.)

$\text{CaO}_2\text{H}_2 + \text{Aq}$ , mixed with dil.  $\text{NaOH}$ ,  $\text{KOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , gives no immediate ppt. when  $\text{CO}_2$  is passed through it, unless boiled. Sol. in boiling  $\text{MgCl}_2 + \text{Aq}$  even when dilute. (Cousté.)

Not decomp. when boiled with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$ , and  $\text{Na}_2\text{B}_4\text{O}_7 + \text{Aq}$ ; but partially decomp. by boiling with  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{HPO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{HAsO}_4$ ,  $\text{Na}_2\text{AsO}_4$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4 + \text{Aq}$ . With the  $\text{NH}_4$  salts the decomposition is complete. (Dulong, A. ch. 82. 286.)

Not decomp. by alkali sulphates +  $\text{Aq}$ . (Malaguti.)

Precipitation of  $\text{CaCO}_3$  is much hindered by alkali citrates or metaphosphates.

#### Solubility in $\text{KCl} + \text{Aq}$ at $25^\circ$ .

Sp. gr. $25^\circ/25^\circ$	% $\text{KCl}$	% $\text{CaCO}_3$
1.000	0.00	0.0013
1.024	3.90	0.0078
1.046	7.23	0.0078
1.072	11.10	0.0076
1.092	13.82	0.0072
1.101	15.49	0.0076
1.122	18.21	0.0070
1.133	19.84	0.0072
1.179	26.00	0.0060

(Cameron and Robinson, J. phys. Chem. 1907, 11. 578.)

Solubility in  $\text{NaCl} + \text{Aq}$  in contact with  $\text{CO}_2$  free air at  $25^\circ$ .

Sp. gr. $25^\circ/25^\circ$	g. per 100 g. $\text{H}_2\text{O}$	
	$\text{NaCl}$	$\text{CaCO}_3$
1.0079	1.60	0.0079
1.0314	5.18	0.0086
1.0466	9.25	0.0094
1.0734	11.48	0.0104
1.0949	16.66	0.0106
1.1346	22.04	0.0115
1.1794	30.50	0.0119

(Cameron, Bell and Robinson, J. phys. Ch. 1907, 11. 396.)

#### Solubility of $\text{CaCO}_3$ in $\text{NaOH} + \text{Aq}$ .

Solvent	1 litre dissolves	
	at $18^\circ$	at $95^\circ-100^\circ$
$\text{H}_2\text{O}$	12.8 mg. $\text{CaCO}_3$	20.7 mg. $\text{CaCO}_3$
ca. 0.0001 n. $\text{NaOH}$	8.7 " "	9.6 " "
ca. 0.001 n. $\text{NaOH}$	4.2 " "	6.9 " "
ca. 0.01 n. $\text{NaOH}$	4.3 " "	5.7 " "

(Le Blanc, Z. anorg. 1906, 51. 185.)

#### Solubility in $\text{K}_2\text{SO}_4 + \text{Aq}$ at $25^\circ$ .

Sp.-gr. $25^\circ/25^\circ$	% $\text{K}_2\text{SO}_4$	% $\text{CaCO}_3$
1.010	1.60	0.0104
1.021	3.15	0.0116
1.033	4.73	0.0132
1.048	6.06	0.0148
1.061	7.85	0.0168
1.069	8.88	0.0192
1.083	10.18	0.0192
1.084	10.48	0.0188

(Cameron and Robinson, J. phys. Chem. 1907, 11. 578.)

The solubility of  $\text{CaCO}_3$  in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in equilibrium with air steadily increases with increasing amounts of  $\text{CaSO}_4$  in the solution up to saturation point of the  $\text{CaSO}_4$ . In the presence of solid  $\text{CaSO}_4$  the solubility of  $\text{CaCO}_3$  is much decreased. (Cameron and Seidell, J. phys. Chem. 1902, 6. 56.)

See under  $\text{CaH}_2(\text{CO}_3)$ .

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in contact with  $\text{CO}_2$  free air at  $25^\circ$ .

g. per 100 g. $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{CaCO}_3$
0.97	0.0151
1.65	0.0180
4.90	0.0262
12.69	0.0313
14.55	0.0322
19.38	0.0346
23.90	0.0360

(Cameron, Bell and Robinson, J. phys. Ch. 1907, 11. 396.)

#### Solubility in salts + $\text{Aq}$ .

g. salt added per litre	mg. $\text{CaO}$ dissolved per litre
0.000	17.4
0.585 g. $\text{NaCl}$	20.05
1.17 g. " "	24.9
2.93 g. " "	31.1
0.85 g. $\text{NaNO}_3$	24.35
1.70 " "	27.7
4.25 " "	34.5
0.805 g. $\text{Na}_2\text{SO}_4$ , $10\text{H}_2\text{O}$	25.95
1.61 g. " "	31.15
4.03 g. " "	40.7
0.53 g. $\text{Na}_2\text{CO}_3$	8.4
1.06 g. " "	7.2
2.65 g. " "	4.4
0.55 g. $\text{CaCl}_2$ , $6\text{H}_2\text{O}$	9.0
1.10 g. " "	8.4
2.75 g. " "	8.4

The solubility of  $\text{CaCO}_3$  in  $\text{CO}_2$ -free water

is therefore increased by the addition of NaCl, NaNO<sub>3</sub> or Na<sub>2</sub>SO<sub>4</sub>, 10H<sub>2</sub>O, but decreased by the addition of Na<sub>2</sub>CO<sub>3</sub> or CaCl<sub>2</sub>, 6H<sub>2</sub>O.

(Gothe, Ch. Z. 1915, 39. 306.)

Sol. in ferric chloride or nitrate + Aq with evolution of CO<sub>2</sub> and pptn. of Fe<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>O (Fuchs, 1831); also in chlorides or nitrates of Al, Mn, Cr, or U, but not in FeCl<sub>3</sub> + Aq.

Sol. in cold SnCl<sub>4</sub> + Aq with pptn. of SnO<sub>2</sub>. Insol. in conc. Na<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, BaCl<sub>2</sub>, MgCl<sub>2</sub>, Pb(NO<sub>3</sub>)<sub>2</sub>, or AgNO<sub>3</sub> + Aq. (Karsten.)

Abundantly sol. when freshly precipitated in CaCl<sub>2</sub> + Aq, and MgSO<sub>4</sub> + Aq. (Hunt.)

Absolutely insol. at 15–19° in BaO<sub>2</sub>.H<sub>2</sub> + Aq; also on boiling.

1 l. H<sub>2</sub>O containing 3–4 g. MgSO<sub>4</sub> dissolves 1–2 g. CaCO<sub>3</sub>, and also 1 g. MgCO<sub>3</sub>. (Hunt, Am. J. Sci (2) 26. 109.)

100 pts. NaCl + Aq (2.525% NaCl) dissolve 0.0037 pt. (calculated as CaO) pptd. CaCO<sub>3</sub>, and 0.0053 pt. calcsp. (Lubavin, J. russ. Soc. 24. 389.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in liquid CO<sub>2</sub>. (Büchner, Z. phys. Ch. 1906, 54. 674.)

Alcohol dissolves traces of CaCO<sub>3</sub>. (Grishow.)

Sol. in Na citrate + Aq. (Spiller.)

Sol. in Ca succrate + Aq. (Barreswill.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

*Amorphous.* Solubility in H<sub>2</sub>O cannot be determined because of its instability. (Kendall, Phil. Mag. 1912, (6) 23. 972.)

*Min. Calcite.* In contact with air free from CO<sub>2</sub>, 1 l. H<sub>2</sub>O dissolves at:

25°	50°	100°
0.01433	0.01504	0.01779 g. calcite.

(Kendall, Phil. Mag. 1912, (6) 23. 964.)

In contact with air containing 3.7 pts. CO<sub>2</sub> per 10,000, the solubility of calcite in H<sub>2</sub>O was found to be 0.04608 g. per l. at 25° and 0.02925 g. per l. at 50°. (Kendall, Phil. Mag. 1912, (6) 23. 973.)

*Min. Aragonite.* In contact with air free from CO<sub>2</sub>, 1 l. H<sub>2</sub>O dissolves at:

25°	50°	100°
0.01528	0.01617	0.01902 g. aragonite.

(Kendall, Phil. Mag. 1912, (6) 23. 964.)

+5H<sub>2</sub>O. Efflorescent.

+6H<sub>2</sub>O. (Pelouze.)

**Calcium hydrogen carbonate, CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.**

Known only in aqueous solution.

CaCO<sub>3</sub> dissolves in CO<sub>2</sub> + Aq.

CaCO<sub>3</sub> is sol. in 1428 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 0°, and 1136 pts. at 10°. (Lassaigne, J. ch. med. 4. 312.)

Bineau could dissolve, even in large quantities of H<sub>2</sub>O sat. with CO<sub>2</sub>, only  $\frac{1}{4}$  enough CaCO<sub>3</sub> to form CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

Chalk dissolves in 994.5 pts. H<sub>2</sub>O sat. with CO<sub>2</sub>, while Iceland spar requires 3149 pts. (Bischhof.)

CaCO<sub>3</sub> is sol. in 1015 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> at 21° and 748.3 mm. (Warrington, Chem. Soc. 6. 296.)

**Solubility of CaCO<sub>3</sub> in CO<sub>2</sub> + Aq at p pressure in atmospheres. CaO + CO<sub>2</sub> = mg. CO<sub>2</sub>, and CaO dissolved, corresponding to CaCO<sub>3</sub> = mg. CaCO<sub>3</sub>.**

p	CaO + CO <sub>2</sub>	CaCO <sub>3</sub>
0.000504	60.96	74.6
0.000808	72.11	85.0
0.00333	123	137.2
0.03187	218.4	223.1
0.0282	310.4	296.5
0.05008	408.5	360
0.1422	.....	533
0.2538	1072	663.4
0.4167	1500	787.5
0.5533	1846	885.5
0.7297	2270	972
0.9841	2864	1086

(Schlössing, C. R. 74. 1522.)

With high pressure, 1 l. H<sub>2</sub>O containing CO<sub>2</sub> dissolves at most 3 g. CaCO<sub>3</sub>. This maximum is reached at 5° under 4 atmospheres' pressure; at 10–13° under 5 atmospheres; and at 20° under 7 atmospheres. (Caro, Arch. Pharm. (3) 4. 145.)

CaCO<sub>3</sub> is sol. in about 1000 pts. H<sub>2</sub>CCl<sub>3</sub> + Aq, and solubility is considerably increased by Na<sub>2</sub>SO<sub>4</sub> or MgSO<sub>4</sub>.

1000 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> dissolve pts. Carrara marble at t°, and B = height of barometer in millimetres.

t°	B	Pts. CaCO <sub>3</sub>	t°	B	Pts. CaCO <sub>3</sub>
7.5	754	1.224	22.0	746	0.920
8.5	752	1.202	26.0	740	0.875
9.5	754	1.115	26.5	743	0.860
20.5	741	0.975	27.0	741	0.885
21.5	744	0.935	28.0	737	0.770

Or, from 7.5–9.5°, 1000 pts. H<sub>2</sub>O sat. with CO<sub>2</sub> dissolve 1.181 pts. CaCO<sub>3</sub>; from 20.5–22°; 0.9487 pt. CaCO<sub>3</sub>; from 26–28°, 0.855 pt. CaCO<sub>3</sub>.



Other varieties of  $\text{CaCO}_3$  are dissolved as follows in 1000 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ .

Variety	t°	B	Pts. $\text{CaCO}_3$
Lüneburg chalk . . .	18	740	0.835
Pptd. $\text{CaCO}_3$ . . .	18	740	0.950
Iceland spar. . . .	18	735	1.970
Calcite . . . . .	12	754	1.223
Traversella . . . .	12	754	.212
Dolomite, semi-transparent . . . . .	11.5	749	0.654
Dolomite, opaque, in small crystals . . .	11.5	755	0.725
Dolomite, opaque, in large crystals . . .	11	746	.224
Dolomite, transparent, in large crystals . .	11	749	1.073
Oolitic limestone . .	15	747	.252
Dolomitic limestone .	15.5	740	.573

(Cossa, Z. anal. 8. 145.)

Solubility of  $\text{CaCO}_3$  in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  at various pressures.

$\text{CO}_2$ pressure in atm.	1	2	4	6
Solubility	1079	1403	1820	2109

(Engel, C. R. 1885, 101. 951.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.3850 g.  $\text{CaH}_2(\text{CO}_3)_2$  at 15°. (Treadwell, Z. anorg. 1898, 17. 186.)

1 l. of sat.  $\text{CaH}_2(\text{CO}_3)_2 + \text{Aq.}$  obtained from pure or impure limestone, contains 1.13-1.17 g.  $\text{CaCO}_3$  at 15°. (Treadwell, Z. anorg. 1898, 17. 189.)

Solubility of  $\text{CaH}_2(\text{CO}_3)_2$  in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  at 15°.

% carbonic acid in gas at 0° and 760 mm.	Hg. partial pressure mm.	Free carbonic acid mg.	mg. $\text{CaH}_2(\text{CO}_3)_2$ in 100 cc. of the solution	mg. Ca
8.94	67.9	157.4	187.2	46.2
6.04	45.9	86.3	175.5	43.3
5.45	41.4	52.8	159.7	39.4
2.18	16.6	48.5	154.0	38.0
1.89	14.4	34.7	149.2	36.8
1.72	13.1	24.3	133.1	32.9
0.79	6.0	14.5	124.9	30.8
0.41	3.1	4.7	82.1	20.3
0.25	1.9	2.9	59.5	14.7
0.08	0.6	...	40.2	9.9
....	....	....	38.5	9.5
....	....	....	38.5	9.5
....	....	....	38.5	9.5

(Treadwell and Reuter, Z. anorg. 1898, 17. 185.)

1 l.  $\text{H}_2\text{O}$  sat. with carbonic acid dissolves 1.30 g.  $\text{CaCO}_3$  at 13.2°; 1.45 g. at 2.8°. (Treadwell, Z. anorg. 1898, 17. 189.)

At 30° C. in equilibrium with the air, not more than 3 per cent of the calcium present is combined as  $\text{CaCO}_3$ . At lower temperatures and lesser concentrations the percentage of normal carbonate is even less, and practically all the calcium present is combined as  $\text{Ca}(\text{HCO}_3)_2$ . (Cameron and Briggs, J. phys. Chem. 1901, 5. 549.)

With pressures less than 4.5 atmospheres of  $\text{CO}_2$ , no other than normal calcium carbonate or a hydrate of the normal carbonate can exist as the solid phase at 0°. (Cameron, J. phys. Chem. 1908, 12. 566.)

Solubility in  $\text{H}_2\text{O}$  in contact with air, containing  $\text{CO}_2$  with varying partial pressures at t°.

P = partial pressure of  $\text{CO}_2$ .

t = 15°		
P	g. per l.	
	$\text{CaCO}_3$	$\text{CO}_2$
0.8	0.193	0.117
1.5	0.193	0.152
1.7	0.238	0.135
6.8	0.445	0.327
9.9	0.627	0.456
13.6	0.723	0.560
14.6	0.686	0.623
31.6	1.050	1.117

t = 25°		
P	g. per l.	
	$\text{CaCO}_3$	$\text{CO}_2$
0.7	0.159	0.091
1.6	0.177	0.111
4.6	0.341	0.208
7.8	0.446	0.301
16.5	0.539	0.522
30.1	0.743	0.715
35.5	0.755	0.803

t = 40°		
P	g. per l.	
	$\text{CaCO}_3$	$\text{CO}_2$
0.6	0.136	0.078
1.7	0.143	0.085
2.9	0.175	0.106
3.5	0.232	0.169
7	0.284	0.234
14.9	0.384	0.293
22.2	0.427	0.333
31.7	0.480	0.476

Similar results at 20°, 30°, and 35° are also given.

(Leather and Sen, Mem. Dept. Agric. (India) Chem. Ser. 1909, 1. 117; Seidell, Solubilities, 1919.)

Solubility of calcite in  $\text{H}_2\text{O}$  at  $25^\circ$ , in contact with  $\text{CO}_2$  under varying pressures.

P = approximate pressure of  $\text{CO}_2$  in atmospheres.

P	g. per l. sat. solution		Solid phase
	$\text{H}_2\text{CO}_3$	$\text{Ca}(\text{HCO}_3)_2$	
0.1	0.22	0.67	$\text{CaCO}_3$
1.1	2.3	1.58	"
9.9	20.6	3.62	"
13.2	27.5	4.04	"
16.3	34.1	4.21	$\text{Ca}(\text{HCO}_3)_2$
25.4	53.2	4.22	"

(McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 468.)

1 l.  $\text{H}_2\text{O}$  dissolves 2.3374 g.  $\text{CaCO}_3$  at  $5^\circ$  under a  $\text{CO}_2$  pressure of 2 atmos. (Ehlert, Z. Elektrochem. 1912, 18. 727.)

Solubility data for calcite in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$ , with and without the presence of salts are given by Seyler and Lloyd (Chem. Soc. 1909, 95. 346.)

A critical analysis and recalculation of results of Schloesing and others is given by Johnston (J. Am. Chem. Soc. 1915, 37. 2001).

$\text{CaCO}_3$  is not dissolved by  $\text{CO}_2$  and  $\text{H}_2\text{O}$  in presence of  $\text{MgCO}_3$ . (Leather and Sen, C. A. 1916. 181.)

1 l. of 1/10-normal  $\text{NaCl} + \text{Aq}$  dissolves 0.3320 g.  $\text{CaH}_2(\text{CO}_3)_2$  at  $15^\circ$ . (Treadwell and Reuter, Z. anorg. 1898, 17. 193.)

Solubility of  $\text{CaH}_2(\text{CO}_3)_2$  in  $\text{NaCl} + \text{Aq}$  sat. with carbonic acid at  $15^\circ$ , containing 5 g.  $\text{NaCl}$  per l. of  $\text{NaCl} + \text{Aq}$ .

% carbonic acid in gas at $0^\circ$ and 760 mm.	mm. Hg = partial pressure	mg. free $\text{CO}_2$	mg. $\text{CaH}_2(\text{CO}_3)_2$ in 100 cc. of the solution	mg. Ca
16.95	128.8	132.5	218.4	53.9
11.47	87.2	110.1	214.3	52.9
6.07	46.1	23.5	149.2	36.8
3.16	24.0	13.5	118.3	29.2
0.50	3.8	2.7	73.9	18.2
0.41	3.4	0.3	49.0	12.1
...	...	...	34.9	8.6
...	...	...	33.7	8.3
...	...	...	32.9	8.1
...	...	...	33.2	8.2

(Treadwell and Reuter, Z. anorg. 1898, 17. 193.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $25^\circ$  C. and in equilibrium with air.

$\text{Ca}(\text{HCO}_3)_2$		$\text{NaCl}$	
Grams per liter	Reacting wts. per liter	Grams per liter	Reacting wts. per litre
0.1046	0.00065	0.000	0.000
0.1770	0.00110	9.720	0.168
0.2051	0.00128	21.010	0.362
0.2152	0.00134	30.301	0.522
0.2252	0.00140	50.620	0.872
0.2212	0.00138	69.370	1.195
0.2172	0.00135	98.400	1.695
0.1971	0.00123	147.400	2.540
0.1569	0.00095	234.500	4.040
0.1227	0.00076	262.300	4.520

(Cameron and Seidell, J. phys. Chem. 1902, 6. 51.)

Solubility in various salts +  $\text{Aq}$  under a  $\text{CO}_2$  pressure of 2 atmos. at  $5^\circ$ .

Salt	g. salt per 1000 g. $\text{H}_2\text{O}$	g. $\text{CaCO}_3$ sol. in 1 l. of solvent
$\text{H}_2\text{O}$	...	2.3374
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	6.08	2.3518
	50.0	3.4045
	86.0	4.0828
	350.0	3.3009
	700.0	2.7357
	1150.0	2.2054
	1725.0	1.7058
	2300 (sat.)	1.4060
$\text{NaCl}$	27.96	3.2796
	50.0	3.7399
	86.0	3.7828
	106.9	3.6900
	175.6	3.3495
	263.4	2.8107
	351.2	2.1625 at $8^\circ$
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105.3 ( $14^\circ$ ) sat. at $14^\circ$	2.1768
		0.91356
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137.7 ( $14^\circ$ ) sat. at $14^\circ$	1.4060
		1.9199

(Ehlert and Hempel, Z. Elektrochem. 1912, 18. 727.)

Solubility of  $\text{CaCO}_3$  in  $\text{KCl} + \text{Aq}$  at  $25^\circ$  sat. with  $\text{CO}_2$  at atmospheric pressure.

% $\text{KCl}$	% $\text{CaCO}_3$
3.90	0.145
7.23	0.150
11.10	0.166
13.82	0.165
15.49	0.167
18.21	0.154
19.84	0.140
26.00	0.126

(Cameron and Robinson, J. phys. Chem. 1907, 11. 579.)

Solubility in NaCl+Aq in contact with CO<sub>2</sub> at atmospheric pressure at 25°.

g. per 100 g. H <sub>2</sub> O	
NaCl	CaCO <sub>3</sub>
1.45	0.150
5.69	0.160
11.08	0.174
15.83	0.172
19.62	0.159
29.89	0.123
35.85	0.103

(Cameron, Bell and Robinson, J. phys. Ch. 1907, 11. 396.)

Solubility in K<sub>2</sub>SO<sub>4</sub>+Aq, sat. with CO<sub>2</sub> at atmospheric pressure and 25° temp.

% SO <sub>2</sub>	% CaO
0.69	0.69
1.37	0.69
1.67	0.47 *
2.18	0.30 *
2.99	0.24 *

\* Solid phase, CaSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>.  
(Cameron and Robinson.)

Solubility in Na<sub>2</sub>SO<sub>4</sub>+Aq at 24° in equilibrium with air.

Total Ca calc. as Ca(HCO <sub>3</sub> ) <sub>2</sub> . Grams per liter	Ca actually dissolved as Ca(HCO <sub>3</sub> ) <sub>2</sub> . Grams per liter	Na <sub>2</sub> SO <sub>4</sub> . Grams per liter
0.0925	0.0925	0.000
0.1488	0.1488	2.800
0.1729	0.1729+	5.235
0.2330	0.2210	11.730
0.3240	0.3020	36.860
0.3960	0.3440	74.010
0.4580	0.3660	116.100
0.5630	0.3940	184.200
0.5910	0.4060	213.700
0.6650	0.4300	255.900

(Cameron and Seidell, J. phys. Chem. 1902, 6. 53.)

Data are also given for solubility of CaCO<sub>3</sub> in NaCl+Na<sub>2</sub>SO<sub>4</sub>+Aq, and CaCO<sub>3</sub>+CaSO<sub>4</sub> in NaCl+Na<sub>2</sub>SO<sub>4</sub>+Aq. (Cameron, Bell and Robinson.)

**Calcium copper uranium carbonate**, CaCO<sub>3</sub>, 3CuCO<sub>3</sub>, 4U(CO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O.

Sol. in acids.

**Calcium lead carbonate**, xCaCO<sub>3</sub>, yPbCO<sub>3</sub>.

Min. *Plumbocalcite*.

**Calcium magnesium carbonate**, CaCO<sub>3</sub>, MgCO<sub>3</sub>.

Min. *Dolomite*. 1 l. H<sub>2</sub>O sat. with CO<sub>2</sub> at 18° and 750 mm. dissolves 0.31 g. dolomite. (Cossa, B. 2. 697.)

Not obtained by evaporating solution, but can be crystallized from CO<sub>2</sub>+Aq between 100° and 200°. (Hoppe-Seyler.)

Dolomite is dissolved by CO<sub>2</sub> and H<sub>2</sub>O, but solution is prevented partially by CaCO<sub>3</sub>, and wholly by MgCO<sub>3</sub>. (Leather and Sen, C. A. 1915. 181.)

Insol. in cold dil. acids. (Dolomieu, J. Phys. 39. 1.)

Insol. in cold acetic acid. (Forchhammer.)

**Calcium potassium carbonate**, CaK<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

Decomp. by H<sub>2</sub>O. (Reynolds, Chem. Soc. 1898, 73. 265; Bütschli, C. A. 1907. 2223). 2CaCO<sub>3</sub>, 3K<sub>2</sub>CO<sub>3</sub>+6H<sub>2</sub>O. (Bütschli.)

**Calcium sodium carbonate**, CaNa<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

*Anhydrous*. Decomp. by H<sub>2</sub>O. +2H<sub>2</sub>O. (Butschli, C. A. 1907. 2223.) +5H<sub>2</sub>O. Min. *Gaylussite*. Sparingly sol. in H<sub>2</sub>O.

**Calcium uranyl carbonate**, CaCO<sub>3</sub>, UO<sub>2</sub>CO<sub>3</sub>+20H<sub>2</sub>O.

Min. *Liebigite*. Sol. in HCl+Aq. +xH<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Blinkoff, Dissert. 1900.)

2CaO, 4UO<sub>3</sub>, 3CO<sub>2</sub>+24H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Blinkoff, Dissert. 1900.)

**Calcium carbonate chloride**, CaCO<sub>3</sub>, CaCl<sub>2</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O with immediate decomp. (Fritzsche, J. pr. 83. 213.)

**Cerous carbonate**, Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>+5, and 9H<sub>2</sub>O.

Insol. in H<sub>2</sub>O, and solution of CO<sub>2</sub> in H<sub>2</sub>O. (Vauquelin.)

Somewhat sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. (Jolin.)

Insol. in neutral salt solutions and neutral alkali carbonates+Aq; easily sol. in SO<sub>2</sub>+Aq. (Berthier, A. ch. (3) 7. 77.)

**Ceric carbonate**, Ce(CO<sub>3</sub>)<sub>2</sub>+½H<sub>2</sub>O.

Precipitate. (Hisinger, A. ch. 94. 108.)

Insol. in H<sub>2</sub>O. Sol. in slight traces in Na<sub>2</sub>CO<sub>3</sub>+Aq; sl. sol. in NaHCO<sub>3</sub>+Aq, and in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. (Rose.)

**Cerous lanthanum carbonate fluoride**.

Min. *Bainavite*, *Hamartite*, *Hydrofluocerite*. Slowly decomp. by HCl+Aq, easily by H<sub>2</sub>SO<sub>4</sub>.

**Cerous potassium carbonate**, Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>+3H<sub>2</sub>O.

Ppt. (Jolin.)

Ce<sub>2</sub>(CO<sub>3</sub>)<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>+12H<sub>2</sub>O. Ppt.

Sol. in 30% K<sub>2</sub>CO<sub>3</sub>+Aq. (Meyer, Z. anorg. 1904, 41. 103.)

**Perceic potassium carbonate**,  $\text{Ce}_2\text{O}_3(\text{CO}_3)_2$ ,  $4\text{K}_2\text{CO}_3 + 12\text{H}_2\text{O}$ .

*Crystalline*. Sl. sol. in  $\text{H}_2\text{O}$  containing  $\text{K}_2\text{CO}_3$ ; sol. in dil.  $\text{H}_2\text{SO}_4$  with decomp. (Job, C. R. 1899, 123. 1098.)

**Cerous sodium carbonate**,  $\text{Ce}_2(\text{CO}_3)_3$ ,  $2\text{Na}_2\text{CO}_3 + 2\text{H}_2\text{O}$ .

Ppt. (Jolin.)  
 $2\text{Ce}_2(\text{CO}_3)_3$ ,  $3\text{Na}_2\text{CO}_3 + 24\text{H}_2\text{O}(?)$ . Ppt.  
Easily decomp. (Meyer, Z. anorg. 1904, 41. 103.)

**Chromous carbonate**,  $\text{CrCO}_3$ .

Sol. in much  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{KHCO}_3 + \text{Aq}$ . (Moberg, J. pr. 44. 328; Moissan, A. ch. (5) 21. 199.)

**Chromic carbonate, basic**,  $\text{Cr}_2\text{O}_3, 2\text{CO}_2$ .

Precipitate. (Parkmann, Sill. Am. J. (2) 34. 321.)

$\text{Cr}_2\text{O}_3, \text{CO}_2 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids; when freshly pptd. is sol. in  $\text{K}_2\text{CO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and still more sol. in  $\text{KOH} + \text{Aq}$ . (Meissner.)

Insol. in ethyl acetate (Naumann, B. 1910, 43. 314); methyl acetate. (Naumann, B. 1909, 42. 3790.)

$2\text{Cr}_2\text{O}_3, \text{CO}_2 + 6\text{H}_2\text{O}$ . Precipitate. (Langlois, A. ch. (3) 43. 502.)

**Chromous potassium carbonate**,

$\text{CrCO}_3, \text{K}_2\text{CO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  when freshly prepared; slowly polymerizes; stable in dry air, decomp. in moist air; sol. in acids with decomp. (Baugé, C. R. 1898, 126. 1568.)

**Chromous sodium carbonate**,  $\text{CrNa}_2(\text{CO}_3)_2 + \text{H}_2\text{O}$ .

Decomp. when heated. In Aq. solution, passes into the hydrate containing 10 mols.  $\text{H}_2\text{O}$ . (Baugé, C. R. 1897, 125. 1179.)

+ 10  $\text{H}_2\text{O}$ . Very sol. in cold  $\text{H}_2\text{O}$ ; Aq. solution decomp. below  $100^\circ$ ; effloresces in the air; sol. in  $\text{HCl} + \text{Aq}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Baugé, C. R. 1897, 125. 1178.)

**Cobaltous carbonate, basic**,  $5\text{CoO}, 2\text{CO}_2 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Sol. in cold  $\text{NH}_4\text{NO}_3$ , and  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Brett, 1837.)

Sol. in  $\text{CO}_2 + \text{Aq}$ , and acid alkali carbonates + Aq, from which it is pptd. on boiling. Very sl. sol. in conc.  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ ; largely sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and partly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius.)

Not pptd. from solutions containing Na citrate. (Spiller.)

$4\text{CoO}, \text{CO}_2 + 4\text{H}_2\text{O}$ . Ppt. (Beetz.)  
+  $3\text{H}_2\text{O}$ . (Meigen, C. C. 1905, I. 1363.)

**Cobaltous carbonate, basic**,  $3\text{CoO}, \text{CO}_2 + 2\text{H}_2\text{O}$ .

(Meigen, C. C. 1905, I. 1363.)

$3\text{H}_2\text{O}$ . (Rose, Pogg. 84. 551.)

$3\text{CoO}, 2\text{CO}_2 + 4\text{H}_2\text{O}$ . (Bratin, Z. anal. 6. 76.)

$2\text{CoO}, \text{CO}_2 + 3\frac{1}{2}\text{H}_2\text{O}$ . Converted into  $5\text{CoO}, 2\text{CO}_2 + 4\text{H}_2\text{O}$  by  $\text{H}_2\text{O}$ . (Beetz.)

**Cobaltous carbonate**,  $\text{CoCO}_3$ .

*Anhydrous*. Not attacked by cold conc.  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Senarmont, A. ch. (3) 30. 129.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

Min. *Sphaerocobaltite*. Sl. attacked by cold  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ .

+  $\frac{1}{2}\text{H}_2\text{O}$ . Sol. in acids. (Deville, A. ch. (3) 33. 95.)

+  $6\text{H}_2\text{O}$ . (Deville.)

Decomp. by  $\text{H}_2\text{O}$  with formation of a basic carbonate. (Berzelius.)

**Cobaltous potassium carbonate**,  $\text{CoCO}_3, \text{K}_2\text{CO}_3 + 4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 90.)

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 264.)

$\text{CoCO}_3, \text{KHCO}_2 + 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Deville.)

**Cobaltous sodium carbonate**,  $\text{CoCO}_3, \text{Na}_2\text{CO}_3 + 4\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 75.)

**Cupric carbonate, basic**.

The compounds produced by pptn. of copper solutions by carbonates are unstable and possess varying solubilities in solutions of  $\text{CO}_2$ . On treatment with solutions of  $\text{CO}_2$ , these substances pass over into an apparently stable compound possessing a definite solubility in solutions of  $\text{CO}_2$  of definite concentration, which solubility increases with the concentration of  $\text{CO}_2$ . Solubility of this compound in various salts + Aq is recorded. (Free, J. Am. Chem. Soc. 1908, 30. 1374.)

$8\text{CuO}, \text{CO}_2 + 5\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 75.)

$6\text{CuO}, \text{CO}_2$ . (Field, Chem. Soc. 14. 70.)

$3\text{CuO}, \text{CO}_2 + 2\text{H}_2\text{O}$ . (Favre, A. ch. (3) 10. 119.)

$5\text{CuO}, 2\text{CO}_2 + 6\text{H}_2\text{O}$ . (Struve.)

$2\text{CuO}, \text{CO}_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids, even  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sl. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , 30,720 pts. of the solution containing 1 pt.  $\text{CuO}$ . (Jahn.) Sol. in 4690 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat. at 4-6 atmos. pressure. (Wagner.) Sol. in 3833 pts. sat.  $\text{H}_2\text{CCl}_2 + \text{Aq}$ . (Lassaigne, J. ch. méd. 4. 312.)

Sol. in  $\text{NH}_4$  salts + Aq. Partially sol. in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ , and more sol. in

**NaHCO<sub>3</sub>**, or **KHCO<sub>3</sub>** + Aq; sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Favre, A. ch. (3) 10. 18.)

Less sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq than CuO in NH<sub>4</sub>OH + Aq. (Thomson, 1831.) Sol. in KCN + Aq. (Berzelius.) Sol. in NH<sub>4</sub>Cl, or NH<sub>4</sub>NO<sub>3</sub> + Aq. (Brett.)

Sol. in ferric salts with pptn. of Fe<sub>2</sub>O<sub>3</sub>H<sub>2</sub>.

Insol. in liq. NH<sub>3</sub>. (Franklin and Kraus, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Sol. in ethyl amine carbonate + Aq. (Wurtz.)

Sol. in cane sugar + Aq. (Peschier, Repert. 1820, 6. 85.)

Not pptd. from solutions containing sodium citrate. (Spiller.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

Min. *Malachite*. Sol. in acids, and NH<sub>4</sub>OH + Aq.

+ 2H<sub>2</sub>O. (Favre.)

8CuO, 5CO<sub>2</sub> + 7H<sub>2</sub>O. (Gröger, Z. anorg. 1900, 24. 137.)

3CuO, 2CO<sub>2</sub> + H<sub>2</sub>O. Insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH + Aq, also in hot conc. NaHCO<sub>3</sub> + Aq.

Min. *Azurite*.

**Copper potassium carbonate, basic**, 8CuO, 2K<sub>2</sub>CO<sub>3</sub>, 7CO<sub>2</sub> + 17H<sub>2</sub>O.

Ppt.; decomp. by H<sub>2</sub>O. (Gröger, B. 1901, 34. 430.)

Mixture. (Wood and Jones, C. A. 1907. 2867.)

5CuO, 4CO<sub>2</sub>, K<sub>2</sub>CO<sub>3</sub> + 10H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Deville, A. ch. (3) 33. 102.)

**Cupric potassium carbonate**, CuCO<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub>.

Decomp. by H<sub>2</sub>O. (Wood and Jones, C. A. 1907. 2667.)

+ H<sub>2</sub>O. (Wood and Jones.)

+ 4H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Reynolds, Chem. Soc. 1898, 73. 263.)

Could not be obtained. (Wood and Jones.)

2CuCO<sub>3</sub>, K<sub>2</sub>CO<sub>3</sub> + 4H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Wood and Jones.)

**Cupric sodium carbonate**, CuCO<sub>3</sub>, Na<sub>2</sub>CO<sub>3</sub>.

Not decomp. by cold H<sub>2</sub>O. (Debray, C. R. 49. 218.)

+ 3H<sub>2</sub>O.

**Cupric zinc carbonate**, 2CuO, 3ZnO, 2CO<sub>2</sub> + 3H<sub>2</sub>O, or 3CuO, 9ZnO, 4CO<sub>2</sub> + 8H<sub>2</sub>O.

Min. *Aurichalcite*. Easily sol. in HCl + Aq.

**Cupric carbonate ammonia (cuprammonium carbonate)**, CuCO<sub>3</sub>, 2NH<sub>3</sub>.

Decomp. by H<sub>2</sub>O. Insol. in alcohol and ether. Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Favre, A. ch. (3) 10. 116.)

**Didymium carbonate**, Di<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub> + H<sub>2</sub>O, or 6H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. Only traces dissolve in CO<sub>2</sub> + Aq. Insol. in solutions of alkali carbonates or bicarbonates + Aq. (Marignac, A. ch. (3) 38. 166.) Very sl. sol. in conc. NH<sub>4</sub>Cl + Aq. (Rose.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+ 8H<sub>2</sub>O. (Cleve, Bull. Soc. (2) 43. 363.)

**Didymium potassium carbonate**, Di<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>, K<sub>2</sub>CO<sub>3</sub> + 4H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Cleve, Bull. Soc. (2) 43. 363.)

+ 12H<sub>2</sub>O. (Cleve.)

**Didymium sodium carbonate**, 2Di<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>, 3Na<sub>2</sub>CO<sub>3</sub> + 9H<sub>2</sub>O.

Ppt. (Cleve.)

Di<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>, 2Na<sub>2</sub>CO<sub>3</sub> + 8H<sub>2</sub>O. Ppt. (Cleve.)

**Dysprosium carbonate**, Dy<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Jantach, B. 1911, 44. 1277.)

**Erbium carbonate**, Er<sub>2</sub>O<sub>3</sub>, 2CO<sub>2</sub> + 2H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Höglund.)

**Erbium sodium carbonate**, Er<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>, 5Na<sub>2</sub>CO<sub>3</sub> + 36H<sub>2</sub>O.

Efflorescent. Decomp. by H<sub>2</sub>O.

**Gadolinium carbonate, basic**, Gd(OH)CO<sub>3</sub> + H<sub>2</sub>O.

Ppt. (Benedicks, Z. anorg. 1900, 22. 417.)

**Glucinum carbonate, basic**, 3GdO, CO<sub>2</sub>; 4GdO, CO<sub>2</sub>; 5GdO, CO<sub>2</sub> + 5H<sub>2</sub>O, etc.

Not perceptibly sol. in H<sub>2</sub>O or H<sub>2</sub>CO<sub>3</sub> + Aq. Decomp. by boiling H<sub>2</sub>O. Easily sol. in acids. Sol. in NH<sub>4</sub> salts, and KOH, or NaOH + Aq. Sol. in alkali carbonates, especially (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Vauquelin.) Sl. sol. in K<sub>2</sub>CO<sub>3</sub> + Aq. When solution in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> is boiled, a more basic carbonate is pptd. (Rose.)

**Glucinum carbonate**, GdCO<sub>3</sub> + 4H<sub>2</sub>O.

Efflorescent. Sol. in 278 pts. H<sub>2</sub>O. (Klatso, J. pr. 106. 242.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 828.)

No definite carbonate of glucinum exists. (Cameron, J. phys. Chem. 1906, 12. 572.)

**Glucinum potassium carbonate**,  $3\text{GIClO}_3$ ,  $2\text{K}_2\text{CO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (Debray.) Less easily sol. in alcohol.

**Indium carbonate**,  $\text{In}_2(\text{CO}_3)_3$ .

Ppt. Insol. in  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Winkler, J. pr. 94. 1.)

**Iron (ferric) carbonate, basic.**

$9\text{Fe}_2\text{O}_3$ ,  $\text{CO}_2 + 12\text{H}_2\text{O}$ . (Wallace, Chem. Gaz. 1858. 410.)

$3\text{Fe}_2\text{O}_3$ ,  $\text{CO}_2 + 4\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$ . (Barrat, C. N. 1. 110.)

$+6\text{H}_2\text{O}$ . (Wallace.)

$2\text{Fe}_2\text{O}_3$ ,  $\text{CO}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ . (Rother, Pharm. J. Trans. (3) 4. 576.)

$\text{Fe}_2\text{O}_3$ ,  $\text{CO}_2$ . (Parkmann, Sill. Am. J. (2) 34. 321.)

These and other similar basic salts are ppts., easily decomp. on standing into  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

**Iron (ferrous) carbonate**,  $\text{FeCO}_3$ .

Insol. in  $\text{H}_2\text{O}$ .

Sol. in acids, even in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

See Carbonate, ferrous hydrogen.

Min. *Siderite*, *Spathic ore*. Sl. attacked by dil. acids. Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$  under pressure.

Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

$+ \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids;

sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in ferric salts  $+ \text{Aq}$  with evolution of  $\text{CO}_2$  and pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

Soluble in an aqueous solution of cane sugar.

Solubility in salts  $+ \text{Aq}$  free from  $\text{CO}_2$ .

Salt	g. salt per 1000 g. $\text{H}_2\text{O}$	1 l. of solvent dissolves g. $\text{FeCO}_3$
$\text{NaCl}$	351.2	0.35042
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	2300.0	4.2049
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137.7 sat. at $+14^\circ$	0.70085 0.93444
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105.3 sat. at $+18^\circ$	1.4667 2.9334

(Ehlert, Z. Elektrochem. 1912, 18. 728.)

**Iron (ferrous) hydrogen carbonate**,  $\text{FeH}_2(\text{CO}_3)_2(?)$ .

Known only in aqueous solution.

By conducting  $\text{CO}_2$  at ordinary pressure through  $\text{H}_2\text{O}$ , in which Fe is suspended, a solution containing 9.1 pts.  $\text{FeCO}_3$  to 10,000 pts.  $\text{H}_2\text{O}$  is obtained. (v. Hauer, J. pr. 81. 391.)

100 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  dissolve 0.72 pt.  $\text{FeCO}_3$ . (Wagner.)

$\text{FeCO}_3$  dissolves in 1381 pts.  $\text{H}_2\text{O}$  saturated with  $\text{CO}_2$ , under a pressure of 4-6 atmospheres. (Wagner, J. B. 1867. 135.)

1 l.  $\text{H}_2\text{O}$  dissolves 6.1907 g.  $\text{FeCO}_3$  (pure) under a  $\text{CO}_2$  pressure of 2 atmos. (Ehlert, Z. Elektrochem. 1912, 18. 728.)

Solubility in various salts  $+ \text{Aq}$  in presence of  $\text{CO}_2$  under pressure of 2 atmos.

Salt	With $\text{CO}_2$ of 2 atmos. pressure	
	g. salt per 1000 g. $\text{H}_2\text{O}$	1 l. of solvent dissolves g. $\text{FeCO}_3$
$\text{H}_2\text{O}$	....	6.1907
$\text{NaCl}$	50	....
	106.9	....
	175.6	....
	263.4	....
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	351.2	....
	86.9	5.8403
	700.0	4.5553
	1150.0	4.4587
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	1437.5	4.6934
	1725.0	5.3975
	2300.0	9.0524
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137.7 sat. at $+14^\circ$	7.9428 9.5780
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105.3 sat. at $+18^\circ$	6.2423 7.3922

(Ehlert, Z. Elektrochem. 1912, 18. 728.)

A bicarbonate of ferrous iron is not formed under pressures of  $\text{CO}_2$  up to 5 atmospheres at  $0^\circ$ . (Cameron, J. phys. Chem. 1908, 12. 571.)

**Iron (ferrous) magnesium carbonate**,  $\text{FeCO}_3$ ,  $\text{MgCO}_3$ .

Min. *Pistomesite*.

$\text{FeCO}_3$ ,  $2\text{MgCO}_3$ . Min. *Mesitile*.

**Iron (ferrous) potassium carbonate**,

$\text{FeK}_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 265.)

**Lanthanum carbonate**,  $\text{La}_2(\text{CO}_3)_3 + \text{H}_2\text{O}$ ,  $3\text{H}_2\text{O}$ , and  $8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .  $\text{CO}_2 + \text{Aq}$  dissolves traces.

Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Min. *Lanthanite*.

**Lanthanum potassium carbonate**,  $\text{La}_2(\text{CO}_3)_3 \cdot \text{K}_2\text{CO}_3 \cdot 12\text{H}_2\text{O}$ .

Sol. in 30%  $\text{K}_2\text{CO}_3 + \text{Aq.}$  (Meyer, Z. anorg. 1904, 41. 101.)

**Lanthanum sodium carbonate**,  $2\text{La}_2(\text{CO}_3)_3 \cdot 3\text{Na}_2\text{CO}_3 \cdot 20\text{H}_2\text{O} (?)$ .

Ppt. Easily decomp. (Meyer, Z. anorg. 1904, 41. 102.)

**Lead carbonate, basic**,  $2\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ ;  $5\text{PbCO}_3 \cdot 3\text{PbO} \cdot \text{H}_2\text{O}$ ;  $3\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ ;  $5\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ .

*White Lead.* Insol. in  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{CO}_3 + \text{Aq.}$ , even under pressure. Sol. in dil., insol. in conc.  $\text{KOH} + \text{Aq.}$  Insol. in normal, or acid alkali carbonates  $+ \text{Aq.}$  (Böttger.)

Sol. in cold dil.  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Brett.)  $\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Yorke.)

$2\text{PbCO}_3 \cdot \text{PbO} \cdot \text{H}_2\text{O}$ .

Solubility is less than 0.0002 millimol Pb in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II. 1056.)

When not exposed to air, sol. in 32,000 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  (0.2 g. per l.); 26,900 pts.  $\text{KNO}_3 + \text{Aq.}$  (0.2 g. per l.); 23,000 pts.  $\text{CaCl}_2 + \text{Aq.}$  (0.2 g. per l.); 4600 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (0.2 g. per l.); 4300 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ .

When exposed to air in beakers, sol. in 43,000 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  (0.2 g. per l.); 43,000 pts.  $\text{KNO}_3 + \text{Aq.}$  (0.2 g. per l.); 26,000 pts.  $\text{CaCl}_2 + \text{Aq.}$  (0.2 g. per l.); 26,000 pts.  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (0.2 g. per l.); 4300 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  (0.2 g. per l.). (Muir, Chem. Soc. 31. 664.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

$3\text{PbO} \cdot 4\text{PbCO}_3 \cdot 2\text{H}_2\text{O}$ . Ppt. (Strömholm, Z. anorg. 1904, 33. 446.)

**Lead carbonate,  $\text{PbCO}_3$ .**

Sol. in 50,551 pts.  $\text{H}_2\text{O}$  at ordinary temp.

Sol. in 23,450 pts.  $\text{H}_2\text{O}$  with little ammonium acetate, carbonate, and free ammonia; and in somewhat less  $\text{H}_2\text{O}$ , containing much ammonium nitrate with carbonate and free ammonia. (Fresenius, A. 59. 124.)

Calculated from electrical conductivity of  $\text{PbCO}_3 + \text{Aq.}$  1 l.  $\text{H}_2\text{O}$  dissolves 3 mg.  $\text{PbCO}_3$  at  $10^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Solubility is 0.0002 millimol. Pb in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II. 1056.)

Sl. sol. in  $\text{H}_2\text{O}$ .  $1.5 \times 10^{-3}$  g. are contained in 1 l. of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 604.)

Easily sol. in acids, even  $\text{HC}_2\text{H}_3\text{O}_2$ ; but not decomp. by conc.  $\text{HNO}_3 + \text{Aq.}$  on account of insolubility of  $\text{Pb}(\text{NO}_3)_2$  in  $\text{HNO}_3 + \text{Aq.}$  Insol. in a mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 6 pts. absolute alcohol, or in an alcoholic solution of racemic or tartaric acids.

Insol. in  $\text{H}_2\text{CO}_3 + \text{Aq.}$  (Jahn, A. 23. 117.) Very sl. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq.}$ , but solution is prevented by traces of various salts. (Tünnerman.) Sol. in 7144 pts. sat.  $\text{H}_2\text{CO}_3 + \text{Aq.}$  (Lassaigne, J. ch. méd. 4. 312.)  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  under 4-6 atmos. pressure dissolves only traces of Pb; 1000 pts. of solution containing 0.5 pt.  $\text{PbCO}_3$ . (Wagner, Z. anal. 6. 167.)

Solubility of  $\text{PbCO}_3$  in  $\text{H}_2\text{CO}_3 + \text{Aq.}$  at  $18^\circ$ .

mg. per l.	
$\text{CO}_2$	$\text{PbCO}_3$
0	1.75
2.8	6
5.4	7
14.4	8.2
26	9.9
43.5	10.9
106	15.4

(Pleissner, C. C. 1907, II. 1056.)

Sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$  and  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Weppen, 1837.) Sol. in  $\text{KOH} + \text{Aq.}$ ; not absolutely insol. at ord. temp. in an excess of  $\text{K}_2\text{CO}_3$ , or  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  and still more sol. at  $100^\circ$ ; but absolutely insol. in  $\text{NaHCO}_3$ ,  $\text{KHCO}_3$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Rose.) Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$ ; sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$ ; decomp. by boiling  $\text{Ca}(\text{NO}_3)_2 + \text{Aq.}$  (Berzelius.)

Sl. decomp. (Persoz), not at all decomp. (Malaguti) by alkali sulphates  $+ \text{Aq.}$

Partially decomp. by boiling with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $\text{MgSO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{NaNH}_4\text{HPO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{K}_2\text{AsO}_4$ ,  $\text{Na}_2\text{AsO}_4$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4 + \text{Aq.}$  With the  $\text{NH}_4$  salts, the decomp. is complete. (Dulong, A. ch. 82. 290.)

Easily sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Brett; Rose.)

When 1 mol.  $\text{PbCO}_3$  is boiled with 1 mol.  $\text{K}_2\text{C}_2\text{O}_4$ , 15% of the  $\text{PbCO}_3$  is decomp.; with 1 mol.  $\text{K}_2\text{CO}_3$ , 93.28% is decomp. (Malaguti.)

Not decomp. by  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Rose.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in an aqueous solution of acetates. (Mercer, 1844.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Not pptd. in presence of Na citrate. (Spiller.)

Min. *Cerussite*.

**Lead sodium carbonate**,  $4\text{PbCO}_3 \cdot \text{Na}_2\text{CO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 47. 199.)

**Lead carbonate bromide**,  $\text{PbCO}_3 \cdot \text{PbBr}_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Storer's Diet.)

**Lead carbonate chloride,  $\text{PbCO}_3$ ,  $\text{PbCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Miller, Chem. Soc. (2) 8. 37.)

Min. *Phosgenite*. Easily sol. in acids.

**Lead carbonate iodide,  $\text{PbCO}_3$ ,  $\text{PbI}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Poggiale.)

**Lead carbonate sulphate,  $\text{PbCO}_3$ ,  $\text{PbSO}_4$ .**

Min. *Lanarkite*. Sol. in  $\text{HNO}_3$  + Aq with residue of  $\text{PbSO}_4$ .

$3\text{PbCO}_3$ ,  $\text{PbSO}_4$ . Min. *Leadhillite*. As above.

**Lithium carbonate,  $\text{Li}_2\text{CO}_3$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 1 pt.  $\text{Li}_2\text{CO}_3$ . (Vauquelin, A. ch. 7. 284.)

100 pts.  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 0.769 pt.  $\text{Li}_2\text{CO}_3$ ; at  $102^\circ$ , 0.778 pt.  $\text{Li}_2\text{CO}_3$ . (Kremers, Pogg. 99. 48.)

100 pts.  $\text{H}_2\text{O}$ , cold or hot, dissolve 1.2 pts.  $\text{Li}_2\text{CO}_3$ . (Troost, A. ch. (3) 51. 103.)

100 pts.  $\text{H}_2\text{O}$  dissolve 1.4787 pts. at  $15^\circ$ , 0.7162 pt. at  $100^\circ$ . (Draper, C. N. 55. 169.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Li}_2\text{CO}_3$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Li}_2\text{CO}_3$	$t^\circ$	Pts. $\text{Li}_2\text{CO}_3$
0	1.539	75	0.866
10	1.406	100	0.728
20	1.329	102	0.796
50	1.181	...	...

0.796 pt. is dissolved at  $102^\circ$  in less than  $\frac{1}{4}$  hour, and 0.955 in 1 hour. (Beketow, J. russ. Soc. 1884. 591.)

Sat. solution at  $15^\circ$  has sp. gr. 1.014, and contains 1 g.  $\text{Li}_2\text{CO}_3$  to 70 g.  $\text{H}_2\text{O}$ , while solution sat. at  $0^\circ$  has sp. gr. 1.0168 and contains 1 g.  $\text{Li}_2\text{CO}_3$  in 64.6 g.  $\text{H}_2\text{O}$ . By long spontaneous evaporation at  $15^\circ$  a solution can be obtained of 1.0278 sp. gr. containing 1 g.  $\text{Li}_2\text{CO}_3$  in 45.57 g.  $\text{H}_2\text{O}$ . (Flückiger, Arch. Pharm. (3) 25. 549.)

By boiling for an instant with  $\text{H}_2\text{O}$  a solution is obtained, which has sp. gr. 1.0074 and contains 1 g.  $\text{Li}_2\text{CO}_3$  to 139 g.  $\text{H}_2\text{O}$ . (Flückiger, Arch. Pharm. (3) 26. 543.)

0.1687 mol. is sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Rothmund, Z. phys. Ch. 1909, 69. 531.)

Sat.  $\text{Li}_2\text{CO}_3$  + Aq contains at:

95°      75°  
0.723      0.833% by wt.  $\text{Li}_2\text{CO}_3$ .

(Tschugzeff, Z. anorg. 1914, 86. 159.)

Sat. solution boils at  $102^\circ$ . (Kremers.)

More sol. in  $\text{CO}_2$  + Aq than in  $\text{H}_2\text{O}$ . 100

pts. sat.  $\text{CO}_2$  + Aq dissolve 5.25 pts.  $\text{Li}_2\text{CO}_3$ . (Troost.) See  $\text{LiHCO}_3$ .

Sol. in  $\text{NH}_4$  salts + Aq.

Solubility in salts + Aq at  $25^\circ$ .

C = concentration of salt solution in g.-equiv. per l.

S = solubility of  $\text{Li}_2\text{CO}_3$  in g.-equiv. per l.

Salt	C	S
$\text{KNO}_3$	0.25	0.3647
	0.50	0.3688
	0.75	0.3676
	1.00	0.3656
	1.50	0.3490
	2.00	0.3268
$\text{KCl}$	0.10	0.3553
	0.25	0.3590
	0.50	0.3782
	0.75	0.3832
	1.00	0.3835
	1.50	0.3731
$\text{NaCl}$	2.00	0.3558
	0.10	0.3569
	0.25	0.3691
	0.50	0.3867
	0.75	0.3956
	1.00	0.3946
$\text{K}_2\text{SO}_4$ 2	1.50	0.3901
	2.00	0.3776
	0.25	0.4028
$\text{Na}_2\text{SO}_4$ 2	0.50	0.4356
	1.00	0.4860
	2.00	0.5534
$\text{NH}_4\text{Cl}$	0.50	0.4411
	1.00	0.4926
	2.00	0.5534
	0.10	0.3902
	0.25	0.4677
	0.50	0.5659
	0.75	0.6270
	1.00	0.6810
$(\text{NH}_4)_2\text{SO}_4$ 2	1.50	0.7463
	2.00	0.7739
	4.00	0.7881
	0.25	0.5059
	0.50	0.7863
$\text{KClO}_4$	1.00	0.9804
	1.50	1.109
	2.00	1.174
	0.1	0.3500
	0.2	0.3570
	0.4	0.3616

(Geffcken, Z. anorg. 1905, 43. 198.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)



Solubility in organic compds. + Aq. at 25°.  
Solubility in H<sub>2</sub>O at 25° = 0.1687 mols. litre.

Organic compd.	Normality of the solution	Mol. Li <sub>2</sub> CO <sub>3</sub> sol. in 1 l.
Methyl alcohol	0.250	0.1604
	0.5	0.1529
	1.0	0.1394
Ethyl alcohol	0.125	0.1614
	0.250	0.1555
	0.5	0.1417
	1.0	0.1203
Propyl alcohol	0.125	0.1604
	0.250	0.1524
	0.5	0.1380
	1.0	0.1097
Tertiary amyl alcohol	0.125	0.1564
	0.250	0.1442
	0.5	0.1224
	1.0	0.0699
Acetone	0.125	0.1600
	0.250	0.1515
	0.5	0.1366
	1.0	0.1104
Ether	0.125	0.1580
	0.250	0.1476
	0.5	0.1300
Formaldehyde	0.125	0.1668
	0.250	0.1653
	0.5	0.1606
	1.0	0.1531
Glycol	0.125	0.1660
	0.250	0.1629
	0.5	0.1565
	1.0	0.1472
Glycerine	0.125	0.1670
	0.250	0.1647
	0.5	0.1613
	1.0	0.1532
Mannitol	0.125	0.1705
	0.250	0.1737
	0.5	0.1778
Glucose	0.125	0.1702
	0.250	0.1728
	0.5	0.1752
	1.0	0.1778
Sucrose	0.125	0.1693
	0.250	0.1689
	0.5	0.1661
	1.0	0.1557
Urea	0.125	0.1686
	0.250	0.1673
	0.5	0.1643
	1.0	0.1605

Solubility in organic compds. + Aq.  
at 25°—Continued.

Organic compd.	Normality of the solution	Mol. Li <sub>2</sub> CO <sub>3</sub> sol. in 1 l.
Thio-urea	0.125	0.1667
	0.250	0.1643
	0.5	0.1600
	1.0	0.1523
Dimethyl-pyrone	0.125	0.1562
	0.250	0.1460
	0.5	0.1284
	1.0	0.0992
Ammonia	0.125	0.1653
	0.250	0.1630
	0.5	0.1577
	1.0	0.1466
Diethylamine	0.125	0.1589
	0.250	0.1481
	0.5	0.1283
	1.0	0.0937
Pyridine	0.125	0.1592
	0.250	0.1503
	0.5	0.1347
	1.0	0.1091
Piperidine	0.125	0.1584
	0.250	0.1488
	0.5	0.1320
	1.0	0.1009
Urethane	0.125	0.1604
	0.250	0.1525
	0.5	0.1377
	1.0	0.1113
Acetamide	0.250	0.1614
	0.5	0.1520
	1.0	0.1358
Acetonitrile	0.125	0.1618
	0.250	0.1556
	0.5	0.1429
	1.0	0.1178
Mercuric cyanide	0.125	0.1697
	0.250	0.1704

(Rothmund, Z. phys. Ch. 1909, 69. 531.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Lithium hydrogen carbonate, LiHCO<sub>3</sub>.

100 pts. H<sub>2</sub>O dissolve 5.501 pts. at 13°. (Bewad, B. 17. 406 R.)

**Magnesium carbonate, basic,**  $\text{Mg}_3\text{C}_2\text{O}_7 + 3\text{H}_2\text{O} = 3\text{MgO}, 2\text{CO}_2 + 3\text{H}_2\text{O}$  or  $2\text{MgCO}_3, \text{MgO}, \text{H}_2\text{O}$ . (Fritzsche, Pogg. 37. 310.)

**Magnesia alba,**  $3\text{MgCO}_3, \text{Mg}(\text{OH})_2 + 4\text{H}_2\text{O}, 4\text{MgCO}_3, \text{Mg}(\text{OH})_2 + 5\text{H}_2\text{O}$ , or  $5\text{MgCO}_3, 2\text{Mg}(\text{OH})_2 + 7\text{H}_2\text{O}$ .

Very al. sol. in  $\text{H}_2\text{O}$ . Sol. in 10,000 pts. hot or cold  $\text{H}_2\text{O}$ . (Bineau.)

Sol. in 2500 pts. cold, and 9000 pts. hot  $\text{H}_2\text{O}$ . (Fyfe.)

Sol. in  $\text{H}_2\text{O}$  containing  $\text{CO}_2$ .

Very easily sol. in acids.

Easily sol. in dil.  $\text{HCl} + \text{Aq}$ .

Easily sol. in  $\text{NH}_4$  sulphate, nitrate, or succinate +  $\text{Aq}$ , also in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Wittstein.) Sol. in cold  $\text{Na}_2\text{CO}_3, \text{K}_2\text{CO}_3, \text{K}_2\text{SO}_4, \text{KCl}$ , or  $\text{KNO}_3 + \text{Aq}$  (Longchamp); also in  $\text{H}_2\text{NCl} + \text{Aq}$ , separating out on heating. (Vogel, J. pr. 7. 455.) Slowly sol. in conc.  $\text{BaCl}_2, \text{CaCl}_2$ , or  $\text{ZnSO}_4 + \text{Aq}$ . (Karsten.)

Sol. in  $\text{MgSO}_4 + \text{Aq}$ . (Dulong.)

Sol. in ferric salts +  $\text{Aq}$  with evolution of  $\text{CO}_2$  and pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . (Fuchs.)

Sol. in boiling  $\text{Co}, \text{Ni}, \text{Zn}, \text{Mn}$ , or  $\text{Cu}$  nitrates or chlorides +  $\text{Aq}$ .

Min. *Hydromagnesite*,  $4\text{MgO}, 3\text{CO}_2 + 4\text{H}_2\text{O}$ .

+  $10\text{H}_2\text{O}$ . Sol. in considerable amount in  $\text{H}_2\text{CO}_3 + \text{Aq}$  as  $\text{MgH}_2(\text{CO}_3)_2 + \text{Aq}$ . (Engel, C. R. 100. 911.)

#### Magnesium carbonate, $\text{MgCO}_3$ .

*A. hydrous.* Insol. in  $\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolves 106 mg.  $\text{MgCO}_3$ . (Chevalet, Z. anal. 8. 91.) Sol. in 5071 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers.)  $\text{MgCO}_3$  combines with  $\text{H}_2\text{O}$  to form  $\text{MgCO}_3 + 3\text{H}_2\text{O}$ , and +  $5\text{H}_2\text{O}$ , which are less sol. in  $\text{H}_2\text{O}$  than anhydrous salt. (Engel, C. R. 101. 814.)

Very hygroscopic. About 20 g. are sol. in 1 l.  $\text{H}_2\text{O}$ . (Engel, C. R. 1899, 129. 598.)

0.7156 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ .

0.627 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$  with vapour pressure of  $\text{CO}_2$  equal to zero.

6.977 grams are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$  with vapour pressure  $\text{CO}_2$  equal to 1 atmos. (Treadwell and Reuter, Z. anorg. 1898, 17. 202.)

94.4 mg. are sol. in 1 l. of  $\text{CO}_2$ -free water. (Gothe, Ch. Z. 1915, 39. 306.)

Solubility in  $\text{H}_2\text{O}$  in equilibrium with  $\text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$ .

System:  $\text{MgCO}_3, \text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$  at  $30^\circ \text{C}$ .

Total Mg (grams per liter)	Mg as $\text{MgCO}_3$ (grams per liter)	Mg as $\text{Mg}(\text{HCO}_3)_2$ (grams per liter)
0.02410	0.01205	0.01205
0.13135	0.06820	0.06314
0.16087	0.08676	0.07411

Solubility in  $\text{H}_2\text{O}$  in equilibrium with  $\text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$ —Continued.

System:  $\text{MgCO}_3, \text{Mg}(\text{HCO}_3)_2$  and  $\text{CO}_2$  at  $30^\circ \text{C}$ .

Total Mg (gram-atoms per liter)	Mg as $\text{MgCO}_3$ Per cent	Mg as $\text{Mg}(\text{HCO}_3)_2$ Per cent
0.00100	50.00	50.00
0.00545	51.92	48.08
0.00667	53.93	46.07

Total salts in solution. Grams per liter	$\text{MgCO}_3$		$\text{Mg}(\text{HCO}_3)_2$	
	Grams per liter	Per cent	Grams per liter	Per cent
0.1144	0.0418	36.5	0.0726	63.5
0.6174	0.2368	38.2	0.3806	61.7
0.7479	0.3012	40.3	0.4467	59.7

In a solution near the saturation point and in equilibrium with atmospheric air upwards of 50 per cent of the magnesium is in the form of the normal carbonate. When the solution is brought in contact with the solid phase, the proportion of the base combined as normal carbonate falls to about 34 per cent, or lower. (Cameron and Briggs, J. phys. Chem. 1901, 5. 552-3.)

For solubility in  $\text{H}_2\text{CO}_3 + \text{Aq}$ , see *Magnesium hydrogen carbonate*.

Scarcely acted upon by  $\text{HCl} + \text{Aq}$ . (Senarmont.)

The solubility of  $\text{MgCO}_3$  in  $\text{NaCl} + \text{Aq}$  when in contact with ordinary air increases with increasing concentration of  $\text{NaCl}$  up to a maximum, and then decreases. (Cameron and Seidell, J. phys. Chem. 1903, 7. 579.)

Solubility of  $\text{MgCO}_3$  in salts +  $\text{Aq}$  in equilibrium with an atmosphere free from  $\text{CO}_2$ .

$\text{NaCl} + \text{Aq}; t = 23^\circ$ .

Weight of liter of solution	Grams $\text{NaCl}$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{NaCl}$ per liter	Reacting weights $\text{MgCO}_3$ per liter
996.92	0.0	0.176	0.000	0.00210
1016.82	28.0	0.418	0.482	0.00500
1041.09	59.5	0.527	1.025	0.00630
1070.50	106.3	0.585	1.831	0.00699
1094.53	147.4	0.544	2.539	0.00650
1142.48	231.1	0.460	3.981	0.00550
1170.14	272.9	0.393	4.701	0.00470
1199.28	331.4	0.293	5.709	0.00350

(Cameron and Seidell, J. phys. Chem. 1903, 7. 585.)

Solubility of  $\text{MgCO}_3$  in salts + Aq.—*Continued*  
 $\text{Na}_2\text{SO}_4 + \text{Aq}$ ;  $t = 24^\circ$ .

Weight of liter of solution	Grams $\text{Na}_2\text{SO}_4$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting wts. $\text{Na}_2\text{SO}_4$ per liter	Reacting wts. $\text{MgCO}_3$ per liter
997.52	0.00	0.216	0.000	0.00258
1021.24	25.12	0.586	0.178	0.00700
1047.60	54.76	0.828	0.388	0.00990
1080.95	95.68	1.020	0.678	0.01219
1133.85	160.80	1.230	1.140	0.01470
1157.34	191.90	1.280	1.360	0.01530
1206.03	254.60	1.338	1.804	0.01600
1223.91	278.50	1.338	1.973	0.01600
1241.99	305.10	1.388	2.162	0.01660

$t = 35.5^\circ$ .

Weight of liter of solution	Grams $\text{Na}_2\text{SO}_4$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{SO}_4$ per liter	Reacting weights $\text{MgCO}_3$ per liter
995.15	0.32	0.131	...	0.00156
1032.89	41.84	0.577	0.296	0.00689
1067.23	81.84	0.753	0.579	0.00900
1094.77	116.56	0.904	0.826	0.01080
1120.38	148.56	0.962	1.052	0.01149
1151.70	186.70	1.047	1.323	0.01251
1179.82	224.00	1.088	1.587	0.01300
1196.32	247.20	1.100	1.751	0.01314
1236.52	199.20	1.130	2.120	0.01350

(Cameron and Seidell.)

$\text{Na}_2\text{CO}_3 + \text{Aq}$ ;  $t = 25^\circ$ .

Weight of liter of solution	Grams $\text{Na}_2\text{CO}_3$ per liter	Grams $\text{MgCO}_3$ per liter	Reacting weights $\text{Na}_2\text{CO}_3$ per liter	Reacting weights $\text{MgCO}_3$ per liter
996.84	0.00	0.223	0.000	0.00266
1019.89	23.12	0.288	0.220	0.00344
1047.72	50.75	0.510	0.482	0.00620
1062.47	86.42	0.879	0.820	0.01027
1118.91	127.30	1.314	1.209	0.01570
1147.66	160.80	1.636	1.526	0.01955
1166.05	181.90	1.972	1.727	0.02357
1189.38	213.20	2.317	2.024	0.02770

(Cameron and Seidell.)

Solubility in salts + Aq.

g. salt added per litre	mg. $\text{MgCO}_3$ dissolved per litre
0.0	94.4
0.585 g. $\text{NaCl}$	128.3
1.17 g. "	134.4
2.93 g. "	120.95
0.85 g. $\text{NaNO}_3$	122.85
1.70 g. "	138.80
4.25 g. "	137.20

Solubility in salts + Aq.—*Continued*

g. salt added per litre	mg. $\text{MgCO}_3$ dissolved per litre
0.805 g. $\text{Na}_2\text{SO}_4$ , $10\text{H}_2\text{O}$	145.05
1.61 g. "	162.05
4.03 g. "	150.75
0.53 g. $\text{Na}_2\text{CO}_3$	98.6
1.06 g. "	53.5
2.65 g. "	15.7
0.51 g. $\text{MgCl}_2$ , $6\text{H}_2\text{O}$	47.0
1.02 g. "	39.5
2.55 g. "	35.3

The solubility of  $\text{MgCO}_3$  in  $\text{CO}_2$ -free water is increased by the addition of  $\text{NaCl}$ ,  $\text{NaNO}_3$ , or  $\text{Na}_2\text{SO}_4$ ,  $10\text{H}_2\text{O}$  but decreased by the addition of  $\text{Na}_2\text{CO}_3$  or  $\text{MgCl}_2$ ,  $6\text{H}_2\text{O}$ .

(Gothé, Ch. Z. 1915, 39. 306.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Min. *Magnésite*. Very sl. attacked by warm conc.  $\text{HCl} + \text{Aq}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 0.0027 pt., calculated as  $\text{MgO}$ . (Lubavin.)

Solution in  $\text{H}_2\text{O}$  contains 0.018 g.  $\text{Mg}$  and 0.065 g.  $\text{CO}_2$  per l. at  $20^\circ$ . (Wells, J. Am. Chem. Soc. 1915, 37. 1705.)

Solution in  $\text{H}_2\text{O}$  containing 27.2 g.  $\text{NaCl}$  per l. contains 0.028 g.  $\text{Mg}$  and 0.086 g.  $\text{CO}_2$  per l. at  $20^\circ$ . (Wells, J. Am. Chem. Soc. 1915, 37. 1705.)

+  $\text{H}_2\text{O}$ .  
 +  $2\text{H}_2\text{O}$ . Decomp. by suspension in  $\text{H}_2\text{O}$  into basic salt. (Engel, C. R. 100. 911.)

+  $3\text{H}_2\text{O}$ . Small quantities of this salt are wholly dissolved by much  $\text{H}_2\text{O}$ . (Bineau.)

The solution contains in 100 pts. at—

$0^\circ$  6.5° 8° 16°  
 0.15 0.153 0.155 0.179 pts.  $\text{MgCO}_3 + 3\text{H}_2\text{O}$ .  
 (Norgaard, 1850.)

Decomp. by boiling  $\text{H}_2\text{O}$  into a basic insol. salt and  $\text{CO}_2$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 0.1518 pt. at  $19^\circ$ . (Fritzsche, Pogg. 37. 304.)

Sol. in 48 pts.  $\text{H}_2\text{O}$ , and decomp. by large amt. (Fourcroy.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.1518 pt. at  $19^\circ$ , or sol. in 658 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ . (Beckurts, J. B. 1881. 212.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.0812 pt., calculated as  $\text{MgO}$ . (Lubavin, J. russ. Soc. 24. 389.)

Solution in  $\text{H}_2\text{O}$  contains 0.36 g.  $\text{Mg}$  and 1.01 g.  $\text{CO}_2$  per l. at  $20^\circ$ . (Wells, J. Am. Chem. Soc. 1915, 37. 1707.)

Solubility in  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  has been determined at  $20^\circ$ ,  $25^\circ$ ,  $30^\circ$ ,  $34^\circ$  and  $39^\circ$  and

at  $\text{CO}_2$  pressures corresponding with 0.5 to 30.3%  $\text{CO}_2$  in the gas phase. (Leather and Sen, Chem. Soc. 1915, 108 (2) 13.)

Easily sol. in acids, even when dil.

Not decomp. by 1 pt.  $\text{H}_2\text{SO}_4$  + 6 pts. alcohol, or by alcoholic solutions of glacial acetic, racemic, or tartaric acids, but is slowly decomp. by alcoholic solution of citric acid, or  $\text{HNO}_3$  + abs. alcohol. (Butini, 1827.)

100 pts.  $\text{NaCl}$  + Aq (2.525%) dissolve 0.1250 pt., calculated as  $\text{MgO}$ . (Lubavin.)

1%  $\text{Na}_2\text{CO}_3$  + Aq, when mixed with 1%  $\text{MgSO}_4$  + Aq, cause no ppt., but 1.5-2% solutions ppt. this salt. (Brandes, 1825.)

More sol. in  $\text{NH}_4\text{Cl}$  + Aq than  $\text{CaCO}_3$ . Sol. in  $\text{NH}_4\text{NO}_3$  + Aq, but less easily than in  $\text{NH}_4\text{Cl}$  + Aq.

Solubility in  $\text{KHCO}_3$  + Aq at  $t^\circ$ .

Values are given in mol./litre.

$t^\circ$	K	Mg	Solid phase
15°	0.0	0.0095	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0.0992	0.0131	"
	0.1943	0.0167	"
	0.3992	0.0211	" labile
	0.2681	0.0192	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$
			$\text{KHCO}_3 + 4\text{H}_2\text{O}$
	0.5243	0.0097	$\text{MgCO}_3, \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0.6792	0.0074	"
	0.9810	0.0028	"
			"
25°	0.0	0.0087	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0.0985	0.0115	"
	0.2210	0.0149	"
	0.3188	0.0175	"
	0.3434	0.0181	"
	0.4216	0.0205	" labile
	0.4985	0.0207	"
	0.3906	0.0196	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$
			$\text{KHCO}_3 + 4\text{H}_2\text{O}$
	0.5893	0.0128	$\text{MgCO}_3, \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0.6406	0.0117	"
	0.788	0.0089	"
	1.125	0.0061	"
35°	0.0	0.0071	$\text{MgCO}_3 + 3\text{H}_2\text{O}$
	0.1092	0.0098	"
	0.2001	0.0132(?)	"
	0.2811	0.0142	"
	0.3704	0.0163	"
	0.4847	0.0177	"
	0.5807	0.0198	"
	0.5068	0.0184	$\text{MgCO}_3 + 3\text{H}_2\text{O} + \text{MgCO}_3$
			$\text{KHCO}_3 + 4\text{H}_2\text{O}$
	0.6231	0.0153	$\text{MgCO}_3, \text{KHCO}_3 + 4\text{H}_2\text{O}$
	0.8435	0.0119	"
			"

The experiments were performed in such a way as to prevent, as far as possible, loss of  $\text{CO}_2$  from the solutions.

(Auerbach, Z. Elektrochem. 1904, 10. 164.)

1 l.  $\text{H}_2\text{O}$ , containing 6%  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  and

a little  $\text{NaCl}$ , dissolves 5 g.  $\text{MgCO}_3$ . (Hunt, Sil. Am. J. (2) 42. 49.)

More sol. in cold alkali borates + Aq than in hot. (Wittstein.)

Sol. in  $\text{Na citrate}$  + Aq.

+  $4\text{H}_2\text{O}$ . Efflorescent.

+  $5\text{H}_2\text{O}$ . Two modifications.

$\alpha$ . Plates. Sol. in 600 pts.  $\text{H}_2\text{O}$  at  $0-7^\circ$ ; solution gradually separates out  $\text{MgCO}_3 + 2\text{H}_2\text{O}$ .  $\text{H}_2\text{CO}_3$  + Aq sat. at 3-4 atmos. pressure dissolves 9% at  $0-4^\circ$ .  $\text{MgSO}_4$  + Aq dissolves 4% moist salt at  $3-4^\circ$ , and it is easily sol. in  $\text{Na}_2\text{CO}_3$ , or  $\text{NaHCO}_3$  + Aq. (Norgaard.)

$\beta$ . Prisms. More efflorescent than  $\alpha$ . Sol. in 600 pts.  $\text{H}_2\text{O}$  but not in  $\text{MgSO}_4$ , or  $\text{Na}_2\text{CO}_3$  + Aq. Both forms are decomp. by boiling  $\text{H}_2\text{O}$ . (Norgaard.)

**Magnesium hydrogen carbonate,**  
 $\text{MgH}_2(\text{CO}_3)_2(?)$ .

Known only in solution.

1 l.  $\text{H}_2\text{CO}_3$  + Aq sat. at 1 atmos. pressure dissolves 23.5 g.  $\text{MgCO}_3$ . (Bineau.)

1 l. carbonic acid water dissolves 0.115 g. magnesite at  $18^\circ$  and 0.75 m. pressure. (Cossa, B. 2. 697.)

1 pt.  $\text{MgCO}_3$  dissolves in  $\text{H}_2\text{O}$  saturated with  $\text{CO}_2$  at  $5^\circ$  and a pressure of—

1	2	3	4	5	6 atmospheres
in 161	144	134	100.7	110	76 pts. $\text{H}_2\text{O}$

(Merkel, Techn. J. B. 1867. 213.)

$\text{H}_2\text{CO}_3$  + Aq sat. at 3-4 atmos. pressure and  $0-4^\circ$  dissolved 9%  $\text{MgCO}_3 + 5\text{H}_2\text{O}$ . (Norgaard.)

$\text{MgCO}_3 + 3\text{H}_2\text{O}$  is sol. in 72.4 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at  $20^\circ$  and ord. pressure; 30.5 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 2 atmos. pressure; 26.0 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 3 atmos. pressure; 21.1 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 4 atmos. pressure; 17.09 pts.  $\text{H}_2\text{CO}_3$  + Aq sat. at 5 atmos. pressure. (Beckurts, J. B. 1881. 212.)

1.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  at p pressure and  $t^\circ$  dissolves g.  $\text{MgCO}_3$ .

p atmos.	$t^\circ$	$\text{MgCO}_3$	p mm.	$t^\circ$	$\text{MgCO}_3$
1.0	19.5	27.79	751	13.4	28.45
2.1	19.5	33.11	760	19.5	25.79
3.2	19.7	37.3	762	29.3	21.95
4.7	19.0	43.5	764	46	15.7
5.6	19.2	46.2	764	62	10.4
6.2	19.2	48.51	765	70	8.1
7.5	19.5	51.2	765	82	4.9
9.0	18.7	56.59	765	91	2.4
...	...	...	765	100	0.0

(Engel and Ville, C. R. 93. 34.)

The low figures of other observers are due to their using basic carbonates. By very careful experiments it was found that 1 l.  $\text{H}_2\text{O}$

sat. with  $\text{CO}_2$  at 1 atmos. pressure and  $t^\circ$  dissolved the following amts. of  $\text{MgCO}_3$ :

$t^\circ$	$\text{MgCO}_3$	$t^\circ$	$\text{MgCO}_3$	$t^\circ$	$\text{MgCO}_3$
3.5	35.6	18	22.1	40	22.1
12	26.5	30	15.8	50	9.5

(Engel, C. R. 100. 444.)

1.9540 g. are sol. 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Treadwell and Reuter, Z. anorg. 1898, 17. 202.)

$\text{MgH}_2(\text{CO}_3)_2$  is not stable except in the presence of free  $\text{CO}_2$ .

At  $15^\circ$  and 760 mm., a solution having the partial pressure of  $\text{CO}_2 = 0$ , contains 1.9540 g.  $\text{MgH}_2(\text{CO}_3)_2$  and 0.7156 g.  $\text{MgCO}_3$  per liter. (Treadwell and Reuter, Z. anorg. 1898, 17. 204.)

Solubility of  $\text{MgH}_2(\text{CO}_3)_2$  in  $\text{H}_2\text{O}$  containing carbonic acid, at  $15^\circ$ .

% carbonic acid in the gas at $0^\circ$ and 760 mm.	partial pressure mm. Hg	mg. free $\text{CO}_2$	mg. $\text{MgH}_2(\text{CO}_3)_2$ in 100 cc. of the solution	mg. $\text{MgCO}_3$ in 100 cc. of the solution	mg. Mg
18.86	143.3	119.0	1210.5	....	201.6
5.47	41.6	86.6	1210.5	....	201.6
4.45	33.8	223.5	1210.5	....	201.6
1.54	11.7	...	1076.6	77.3	201.6
1.35	10.3	...	762.9	76.5	149.2
1.07	8.2	...	595.2	80.7	122.4
0.62	4.7	...	366.3	70.1	86.5
0.60	4.6	...	341.7	75.8	78.8
0.33	2.5	...	263.2	74.8	65.5
0.21	1.6	...	222.9	77.1	59.4
0.14	1.1	...	216.9	71.0	56.6
0.03	0.3	...	203.6	71.1	54.5
...	...	...	203.3	68.5	53.6
...	...	...	196.0	70.2	52.9
...	...	...	203.6	62.5	52.0
...	...	...	195.4	61.6	51.1
...	...	...	195.4	64.1	51.8

(Treadwell and Reuter, Z. anorg. 1898, 17. 200.)

No bicarbonate of magnesium is formed under pressures of  $\text{CO}_2$  up to five atmospheres at  $0^\circ$ . (Cameron, J. phys. Chem. 1908, 12. 570.)

A critical analysis and recalculation of results of Engel and others is given by Johnston (J. Am. Chem. Soc. 1915, 37. 2001.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $23^\circ\text{C}$ . in equilibrium with an atmosphere of  $\text{CO}_2$ .

g. $\text{NaCl}$ per liter	g. $\text{Mg}(\text{HCO}_3)_2$ per liter
7.0	30.64
56.5	30.18
119.7	27.88
163.9	24.96
224.8	20.78
306.6	10.75

(Cameron and Seidell, J. phys. Chem. 1903, 7. 582.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $23^\circ\text{C}$ . in equilibrium with an atmosphere of  $\text{CO}_2$ .

Strength of $\text{Na}_2\text{SO}_4 + \text{Aq}$	g. $\text{Mg}(\text{HCO}_3)_2$ in 100 ccm.
0.0	1.463
12%	1.916
saturated	1.612

(Cameron and Seidell.)

**Magnesium potassium carbonate,**  
 $\text{MgK}_2(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .

Quickly decomp. by cold  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 87.)

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Reynolds, Chem. Soc. 1898, 73. 264.)

$\text{MgKH}(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby into an insol. basic Mg carbonate, and  $\text{MgH}_2(\text{CO}_3)_2$  and  $\text{KHCO}_3$ , which dissolve. (Berzelius.)

**Magnesium rubidium hydrogen carbonate,**  
 $\text{MgRbH}(\text{CO}_3)_2 + 4\text{H}_2\text{O}$ .

Decomp. in the air. (Erdmann, A. 1897, 294. 75.)

**Magnesium sodium carbonate,  $\text{MgCO}_3$ ,**  
 $\text{Na}_2\text{CO}_3$ .

Quickly decomp. with  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 33. 89.)  
 $+ 15\text{H}_2\text{O}$ . (Norgaard.)

**Magnesium sodium carbonate sodium chloride,  $\text{MgCO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (de Schulten, C. R. 1896, 123. 1427.)

**Manganous carbonate,  $\text{MnCO}_3$ .**

Permanent. Practically insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$  and in acids generally.

1 l.  $\text{H}_2\text{O}$  dissolves 0.065 g. at  $25^\circ$ . (Ageno and Valla, Att. Accad. Linc. 1911, 20. II. 706.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Min. *Rhodochrosite*.

$+ \frac{1}{2}$ , or  $1\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ . 1 pt.  $\text{MnCO}_3$  requires 2000 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  for solution.

(Lassaigne.) Sol. in 7680 pts.  $H_2O$ , and 3840 pts.  $H_2O$  containing  $CO_2$ . (Jahn.) When freshly precipitated is sol. in  $NH_4$  salts + Aq. (Wittstein.) Not more sol. in  $H_2O$  containing  $Na_2CO_3$  or  $K_2CO_3$  than in pure  $H_2O$ . (Ebelmen.) Insol. in  $NH_4Cl$  or  $NH_4NO_3$  + Aq. (Brett.)

Sol. in ferric salts + Aq, with evolution of  $CO_2$  and pptn. of  $Fe_2C_2H_6$ . (Fuchs.)

Not pptd. in presence of Na citrate. (Spiller.)

**Manganous potassium carbonate,**  
 $MnK_2(CO_3)_2 + 4H_2O$ .

Ppt. Decomp. by  $H_2O$  alone.

Sl. sol. in  $Mn(C_2H_3O_2)_2$  + Aq or  $K_2CO_3$  + Aq. (Reynolds, Chem. Soc. 1898, 73. 264.)

**Manganous carbonate hydroxylamine,**  
 $4MnCO_3, 3NH_2OH + 2H_2O$ .

Ppt. Sol. in acids. (Goldschmidt and Syngros, Z. anorg. 5. 138.)

**Mercurous carbonate,  $Hg_2CO_3$ :**

Ppt. Decomp. by hot  $H_2O$ . Sol. in hot or warm  $NH_4Cl$  + Aq, but less easily than mercuric carbonate; less sol. in  $NH_4NO_3$  + Aq. (Brett, 1837.)

Sl. sol. in  $K_2CO_3$  + Aq; partially sol. with decomp. in  $NH_4OH$  + Aq. (Wittstein.)

**Mercuric carbonate, basic,  $4HgO, CO_2$ .**

Can be washed with cold  $H_2O$  without decomp. (Millon, A. ch. (3) 19. 368.)

$3HgO, CO_2$ . Insol. in cold  $H_2O$ . Sol. in  $CO_2$  + Aq; sl. sol. in  $K_2CO_3$  + Aq. Easily sol. in  $NH_4Cl$  + Aq. (Berzelius.)

**Neodymium potassium carbonate,  $Nd_2(CO_3)_3, K_2CO_3 + 12H_2O$ .**

Ppt. Sol. in 30%  $K_2CO_3$  + Aq. (Meyer, Z. anorg. 1904, 41. 105.)

**Neodymium sodium carbonate,  $2Nd_2(CO_3)_3, 3Na_2CO_3 + 22H_2O(?)$ .**

Ppt. Easily decomp.

Sl. sol. in conc.  $Na_2CO_3$  + Aq. (Meyer, Z. anorg. 1904, 41. 106.)

**Nickel carbonate, basic,  $3NiO, CO_2 + 5H_2O$ .**

Min. *Zaratite*. Easily sol. in  $HCl$  + Aq.

Pptd. nickel carbonate is a basic salt of varying composition. Insol. in  $H_2O$  or  $H_2CO_3$  + Ao. Sol. in acids. Sol. in  $(NH_4)_2CO_3$  + Aq;

very sl. sol. in  $Na_2CO_3$  + Aq; sol. in warm  $NH_4Cl$  + Aq, and  $KCN$  + Aq. (Rose.)

Not pptd. in presence of Na citrate. (Spiller.)

**Nickel carbonate,  $NiCO_3$ .**

1 l.  $H_2O$  dissolves 0.0925 g at 25%. (Ageno and Valla, Att. Accad. Linc. 1911, 20, II. 706.)

Not attacked by cold conc.  $HCl$  or  $HNO_3$  + Aq. (Senarmont, A. ch. (3) 30. 138.)

+  $6H_2O$ . Sol. in acids. (Deville, A. ch. (3) 35. 446.)

See also Carbonate, nickel, basic.

**Nickel potassium carbonate,  $NiCO_3, K_2CO_3 + 4H_2O$ .**

Ppt. (Deville, A. ch. (3) 33. 96.)

$NiCO_3, KHCO_3 + 4H_2O$ . Decomp. by  $H_2O$ , but may be washed by  $KHCO_3$  + Aq without decomp. (Rose, Pogg. 84. 566.)

**Nickel sodium carbonate,  $NiCO_3, Na_2CO_3 + 10H_2O$ .**

Ppt. (Deville.)

**Nickel carbonate hydroxylamine,  $2Ni(OH)_2, 4NiCO_3, 5NH_2OH + 7H_2O$ .**

Ppt. (Goldschmidt and Syngros, Z. anorg. 1894, 5. 143.)

$2Ni(OH)_2, 4NiCO_3, 6NH_2OH + 6H_2O$ .

Ppt. (Goldschmidt and Syngros.)

**Palladious carbonate,  $PdCO_3, 9PdO + 10H_2O$ .**

Insol. in  $H_2O$ ; partly sol. in  $NH_4OH$  + Aq; sl. sol. in  $Na_2CO_3$  + Aq; sol. in acids. (Kane, 1842.)

**Potassium carbonate,  $K_2CO_3$ .**

Deliquescent. Very sol. in  $H_2O$  with evolution of heat.

Sol. in 1.05 pts.  $H_2O$  at 3°; 0.962 pt. at 6°; 0.900 pt. at 12.6°; 0.747 pt. at 26°; and 0.190 pt. at 70°. (Osann.)

Sol. in 0.92 pt.  $H_2O$ . (M. R. and P.)

Sol. in 0.922 pt.  $H_2O$  at 15°. (Gerlach.)

Sol. in 1 pt.  $H_2O$ . (Abl.)

100 pts.  $H_2O$  at 15.5° dissolve 100 pts.  $K_2CO_3$ . (Ure's Diet.)

**Solubility in 100 pts.  $H_2O$  at t°.**

t°	Pts. $K_2CO_3$	t°	Pts. $K_2CO_3$	t°	Pts. $K_2CO_3$
0	83.12	40	106.20	80	134.25
10	88.72	50	112.90	90	143.18
20	94.06	60	119.24	100	153.66
30	100.09	70	127.10	135	205.11

(Poggiale, A. ch. (3) 8. 468.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $K_2CO_3$	$t^\circ$	Pts. $K_2CO_3$	$t^\circ$	Pts. $K_2CO_3$
0	89.4	46	119	91	148
1	94	47	120	92	149
2	97	48	120	93	150
3	100	49	121	94	151
4	102	50	121	95	151
5	104	51	122	96	152
6	105	52	122	97	153
7	106	53	123	98	154
8	107	54	124	99	155
9	108	55	124	100	156
10	109	56	125	101	157
11	109	57	125	102	158
12	109	58	126	103	159
13	110	59	127	104	160
14	110	60	127	105	161
15	110	61	128	106	162
16	111	62	128	107	163
17	111	63	129	108	164
18	111	64	130	109	166
19	111	65	130	110	167
20	112	66	131	111	168
21	112	67	132	112	169
22	112	68	132	113	171
23	112	69	133	114	172
24	112	70	133	115	173
25	113	71	134	116	175
26	113	72	135	117	176
27	113	73	135	118	178
28	113	74	136	119	179
29	114	75	137	120	181
30	114	76	137	121	182
31	114	77	138	122	184
32	114	78	139	123	185
33	115	79	139	124	187
34	115	80	140	125	188
35	115	81	141	126	190
36	115	82	141	127	191
37	116	83	142	128	193
38	116	84	143	129	195
39	116	85	144	130	196
40	117	86	144	131	198
41	117	87	145	132	200
42	117	88	146	133	201
43	118	89	147	134	203
44	118	90	147	135	205
45	119	..	...	...	...

(Mulder, Scheik. Verhandel. 1864. 97.)

112 g. are sol. in 100 g.  $H_2O$  at  $20^\circ$ . (Frankforter, J. Am. Chem. Soc. 1914, 36. 1106.)Sp. gr. of  $K_2CO_3$  + Aq at  $15^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
0.489	1.0048	11.748	1.1282
0.979	1.0098	12.727	1.1400
1.958	1.0108	13.706	1.1520
2.934	1.0299	14.685	1.1642
3.916	1.0401	15.664	1.1766
4.895	1.0505	16.643	1.1892
5.874	1.0611	17.622	1.2020
6.853	1.0719	18.601	1.2150
7.832	1.0829	19.580	1.2282
8.811	1.0940	20.559	1.2417
9.790	1.1052	21.538	1.2554
10.769	1.1166	22.517	1.2694

Sp. gr. of  $K_2CO_3$  + Aq at  $15^\circ$ —Continued.

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
23.496	1.2836	33.286	1.3915
24.475	1.2980	34.265	1.4030
25.454	1.3078	35.244	1.4147
26.432	1.3177	36.223	1.4265
27.412	1.3277	37.202	1.4384
28.391	1.3378	38.181	1.4504
29.360	1.3480	39.160	1.4626
30.349	1.3585	40.139	1.4750
31.328	1.3692	40.504	1.4812
32.807	1.3803	....	...

(Tünnerman.)

Sp. gr. and boiling-point of  $K_2CO_3$  + Aq.

% $K_2CO_3$	Sp. gr.	B.-pt.	% $K_2CO_3$	Sp. gr.	B.-pt.
4.7	1.06	100.56°	43.3	1.46	109.44°
9.0	1.11	100.56	45.8	1.50	111.11
13.2	1.15	101.11	48.8	1.54	112.78
16.8	1.19	101.11	52.1	1.58	114.44
20.5	1.22	101.66	56.0	1.63	116.11
24.0	1.25	102.22	60.4	1.70	117.78
27.3	1.28	102.78	65.5	1.80	119.44
30.5	1.31	103.33	71.8	1.95	122.22
33.6	1.34	104.44	79.2	2.15	125.56
36.2	1.38	105.56	88.4	2.40	129.44
39.0	1.41	107.22	100.0	2.60	137.78
41.7	1.44	108.33	....	....	....

(Dalton.)

Sp. gr. of  $K_2CO_3$  + Aq at  $17.5^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
1	1.009	19	1.182	36	1.368
2	1.018	20	1.192	37	1.380
3	1.027	21	1.203	38	1.392
4	1.036	22	1.213	39	1.404
5	1.045	23	1.224	40	1.416
6	1.054	24	1.235	41	1.429
7	1.064	25	1.245	42	1.441
8	1.073	26	1.256	43	1.453
9	1.082	27	1.267	44	1.466
10	1.092	28	1.278	45	1.478
11	1.102	29	1.289	46	1.489
12	1.112	30	1.300	47	1.503
13	1.122	31	1.312	48	1.516
14	1.132	32	1.323	49	0.529
15	1.141	33	1.334	50	1.542
16	1.151	34	1.345	51	1.555
17	1.161	35	1.357	52	1.569
18	1.172	..	...	..	...

(Hager, Comm. 1883.)

The sp. gr. increases or diminishes between  $8^\circ$  and  $20^\circ$  by a decrease or increase of temp. of  $1^\circ$  by the following amounts:—

% $K_2CO_3$	Corr.
40-50	0.0007
30-40	0.0005
20-30	0.0003
10-20	0.0002

(Hager.)

Sp. gr. of  $K_2CO_3 + Aq$  at  $15^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
1	1.00914	28	1.27893
2	1.01829	29	1.28999
3	1.02743	30	1.30105
4	1.03658	31	1.31261
5	1.04572	32	1.32417
6	1.05513	33	1.33573
7	1.06354	34	1.34729
8	1.07396	35	1.35885
9	1.08337	36	1.37082
10	1.09278	37	1.38279
11	1.10258	38	1.39476
12	1.11238	39	1.40673
13	1.12219	40	1.41870
14	1.13199	41	1.43104
15	1.14179	42	1.44388
16	1.15200	43	1.44573
17	1.16222	44	1.46807
18	1.17243	45	1.48041
19	1.18265	46	1.49314
20	1.19286	47	1.50588
21	1.20344	48	1.51861
22	1.21402	49	1.53135
23	1.22459	50	1.54408
24	1.23517	51	1.55728
25	1.24575	52	1.57048
26	1.25681	52.024	1.57079
27	1.26787	...	...

(Gerlach, Z. anal. 8. 279.)

Sp. gr. of  $K_2CO_3 + Aq$  at  $15^\circ$ .

% $K_2CO_3$	Sp. gr.	% $K_2CO_3$	Sp. gr.
5	1.0449	30	1.3002
10	1.0919	40	1.4170
20	1.1920	50	1.5428

(Kohlrausch, W. Ann. 1879. 1.)

 $K_2CO_3 + Aq$  containing 10%  $K_2CO_3$  boils at  $100.8^\circ$  $K_2CO_3 + Aq$  containing 20%  $K_2CO_3$  boils at  $102.2^\circ$  $K_2CO_3 + Aq$  containing 30%  $K_2CO_3$  boils at  $104.5^\circ$  $K_2CO_3 + Aq$  containing 40%  $K_2CO_3$  boils at  $108.6^\circ$  $K_2CO_3 + Aq$  containing 50%  $K_2CO_3$  boils at  $115.2^\circ$ 

(Gerlach.)

Sat.  $K_2CO_3 + Aq$  containing 158 pts.  $K_2CO_3$  to 100 pts.  $H_2O$  forms a crust at  $126^\circ$ ; highest temp. observed  $134.9^\circ$ . (Gerlach, Z. anal. 26. 427.)

B.-pt. of  $K_2CO_3 + Aq$  containing pts.  $K_2CO_3$  to 100 pts.  $H_2O$ . G=according to Gerlach (Z. anal. 26. 459); L=according to Legrand (A. ch. (2) 59. 438).

B.-pt	G	L
101°	11.5	13
102	22.5	22.5
103	32	31
104	40	38.8
105	47.5	46.1
106	54.5	53.1
107	61	59.6
108	67	65.9
109	73	71.9
110	78.5	77.6
111	83.5	83.0
112	88.5	88.2
113	93.5	93.2
114	98.5	98.0
115	103.5	102.8
116	108.5	107.5
117	113.5	112.3
118	117.5	117.1
119	122.5	122.0
120	127.5	127.0
121	132.5	132.0
122	137.5	137.0
123	142.5	142.0
124	147.5	147.1
125	152.5	152.2
126	158	157.3
127	163.5	162.5
128	169.5	167.7
129	175.5	172.9
130	181.5	178.1
131	187.5	183.4
132	193.5	188.8
133	199.5	194.2
133.3	202.5	...
134	....	199.6
135	....	205.0

When  $K_2CO_3 + Aq$  is sat. with  $NH_3$ , two layers form. When  $K_2CO_3$  is added to  $NH_4OH + Aq$ , it dissolves with formation of two layers and evolution of  $NH_3$ . The same takes place also when sat.  $K_2CO_3 + Aq$  and  $NH_4OH + Aq$  are brought together. (Girard, Bull. Soc. (2) 43. 552.)

Solubility of  $K_2CO_3 + KHCO_3$  in  $H_2O$  at  $0^\circ$ .

g. per 100 cc. solution		Sp. gr.
$K_2CO_3$	$KHCO_3$	
0.0	21.2	1.133
11.8	15.3	1.182
16.7	12.6	1.200
23.8	10.3	1.241
34.0	7.6	1.298
43.0	5.9	1.350
51.6	4.9	1.398
60.5	3.8	1.448
81.4	0.0	1.542

(Engel, A. ch. 1888, (6) 13. 348.)



Equilibrium between  $K_2CO_3$  and  $KHCO_3$  in  $H_2O$  and in contact with the air. System:  $K_2CO_3$ ,  $KHCO_3$ , and  $CO_2$  at  $25^\circ C$ .

Grams atoms K per liter	Amount of solution used for titration cc.	Amount K combined as $K_2CO_3$ Per cent	Amount K combined as $KHCO_3$ Per cent
0.393	5	77.5	22.5
0.553	2	83.9	16.1
1.025	2	86.8	13.2
1.865	2	91.4	8.6
2.820	2	89.0	11.0
3.710	2	88.6	11.4
4.310	1	89.6	10.4
5.695	1	88.7	11.3

(Cameron and Briggs, J. phys. Chem. 1901, 5, 546.)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $25^\circ$ .

g. per 100 g. solution		g. per 100 g. $H_2O$		Solid phase
$K_2CO_3$	$Na_2CO_3$	$K_2CO_3$	$Na_2CO_3$	
52.82	0	112	0	$K_2CO_3 \cdot 2H_2O$
52.0	1.0	110.7	2.2	"
50.7	2.6	108.7	5.7	"
49.0	4.6	105.5	10.0	$K_2CO_3 \cdot 2H_2O + Na_2CO_3$
46.5	4.3	94.6	8.8	$K_2CO_3 \cdot 12H_2O$
46.2	5.2	94.8	10.6	$Na_2CO_3 \cdot K_2CO_3 \cdot 12H_2O$
41.0	6.3	77.6	11.8	"
37.7	7.0	68.3	12.6	"
31.8	10.5	53.0	17.9	"
29.8	11.3	50.5	19.1	"
25.2	14.1	41.4	23.2	"
22.4	16.6	36.8	27.3	"
19.8	18.7	32.1	30.3	"
19.1	19.7	31.2	32.1	"
15.1	23.2	24.5	37.6	$Na_2CO_3 \cdot K_2CO_3 \cdot 12H_2O$
14.5	22.8	23.1	36.4	$+ Na_2CO_3 \cdot 10H_2O$
10.8	22.7	16.2	34.0	$Na_2CO_3 \cdot 10H_2O$
10.7	22.4	16.0	33.5	"
4.7	21.9	6.4	29.8	"
0	22.71	0	29.37	"

(Osaka, J. Tok. Chem. Soc. 1911, 32, 870.)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $24.2^\circ$ .

In 1000 ccm. $H_2O$		Solid phase
$Na_2CO_3$	$K_2CO_3$	
28.35	.....	$Na_2CO_3$
354.2	150.03	"
369.7	226.6	"
363.0	243.5	$Na_2CO_3 \cdot K_2CO_3 \cdot 6H_2O$
330.8	282.7	"
273.8	344.9	"
187.2	483.9	"
130.0	921.5	"
137.9	982.6	"
112.3	1074.0	$Na_2CO_3 \cdot K_2CO_3 \cdot 6H_2O + Na_2CO_3$
95.2	1085.1	"
25.5	1108.6	$K_2CO_3$
....	1125.7	"

(Kremann and Zitek, M. 1909, 30, 317.)

Solubility of  $K_2CO_3 + Na_2CO_3$  in  $H_2O$  at  $10^\circ$ .

In 1000 ccm. $H_2O$		Solid phase
$Na_2CO_3$	$K_2CO_3$	
119.8	.....	$Na_2CO_3$
176.4	354.1	"
108.	500.1	"
61.19	0052.9	$Na_2CO_3 \cdot K_2CO_3$
....	1084.0	$K_2CO_3$

(Kremann and Zitek, M. 1909, 30, 324.)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $25.2^\circ$ .

1 l. of the solution contains	
Mol. $K_2CO_3$	Mol. $KNO_3$
0.00	3.217
0.59	2.62
1.35	1.97
2.10	1.46
2.70	1.14
3.58	0.79

(Touren, C. R. 1900, 131, 259.)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $10^\circ$ .

In 1000 ccm. $H_2O$		Solid phase
$KNO_3$	$K_2CO_3$	
208.9	....	$KNO_3$
26.62	1076.0	$KNO_3 \cdot K_2CO_3$
....	1084.0	$K_2CO_3$

(Kremann and Zitek, M. 1909, 30, 325.)

Solubility of  $K_2CO_3 + KNO_3$  in  $H_2O$  at  $24.2^\circ$ .

In 1000 ccm. $H_2O$		Solid phase
$KNO_3$	$K_2CO_3$	
376.85	.....	$KNO_3$
285.00	130.3	"
161.67	348.4	"
141.80	371.9	"
73.04	688.1	"
38.78	878.3	"
31.11	1112.2	$KNO_3, K_2CO_3$

(Kremann and Zitek, M. 1909, 30. 316.)

Solubility of  $K_2CO_3 + KCl$  in  $H_2O$  at  $30^\circ$ .

$\% K_2CO_3$	$\% KCl$	Solid phase
$\% K_2CO_3$	$\% KCl$	
53.27	0	$K_2CO_3, 1\frac{1}{2}H_2O$
52.22	1.03	$K_2CO_3, 1\frac{1}{2}H_2O + KCl$
51.66	1.07	$KCl$
1.64	26.22	$KCl$
0	28.01	"

\* Author gives intermediary data.

(de Waal, Dissert. 1910.)

Solubility of  $K_2CO_3 + KOH$  in  $H_2O$  at  $20^\circ$ .

$\% KOH$	$\% K_2CO_3$	Solid phase
$\% KOH$	$\% K_2CO_3$	
55.75	0	$KOH, 2H_2O$
55.14	2.05	$KOH, 2H_2O + K_2CO_3, 1\frac{1}{2}H_2O$
53.77	2.50	$K_2CO_3, 1\frac{1}{2}H_2O$
0	53.27	$K_2CO_3, 1\frac{1}{2}H_2O$

\* Author gives intermediary data.

(de Waal, Dissert. 1910.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)Sol. in 9 pts. alcohol of  $17^\circ B$ . Insol. in absolute alcohol.

Not decomp. by 1 pt.  $H_2SO_4 + 6$  pts. absolute alcohol. Not decomp. by 1 pt.  $HNO_3 + 6$  pts. absolute alcohol. Not decomp. by an alcoholic solution of  $HCl$ , oxalic, racemic, tartaric, or glacial acetic acids, but is decomp. by alcoholic solution of citric acid.

Solubility in methyl alcohol. Composition of liquids in equilibrium with solid  $K_2CO_3$  at  $t^\circ$ .

$t^\circ$	Upper layer			Lower layer		
	$\% K_2CO_3$	$\% CH_3OH$	$\% H_2O$	$\% K_2CO_3$	$\% CH_3OH$	$\% H_2O$
-30	21.7	42.2	36.1	.....	.....	.....
-20	13.8	52.1	34.1	.....	.....	.....
-20	12.4	.....	.....	44.2	8.2	47.6
0	7.6	66.3	26.1	46.3	6.7	47
0	7.4	.....	.....	46.6	6.6	46.8
+17	6.2	69.6	24.2	48.3	5.7	46
35	5.0	72.9	22.1	.....	4.3	44.7

(de Bruyn, Z. phys. Ch. 1900, 32. 63 and ff.)

Solubility in ethyl alcohol. Composition of liquids in equilibrium with solid  $K_2CO_3$  at  $t^\circ$ .

$t^\circ$	Upper layer			Lower layer		
	$\% K_2CO_3$	$\% C_2H_5OH$	$\% H_2O$	$\% K_2CO_3$	$\% C_2H_5OH$	$\% H_2O$
-18	0.03	90.3	9.7	51.2	0.2	48.6
0	0.04	91.9	8.1	51.3	0.2	48.5
+17	0.06	91.5	8.4	52.1	0.2	47.7
35	0.07	90.9	9	53.4	0.2	46.4
50	0.09	91.8	8.1	55.3	0.2	44.5
75	0.12	91.4	8.5	57.9	2.0	40.9

(de Bruyn.)

Solubility in ethyl alcohol + Aq at  $25^\circ$ .

When  $K_2CO_3$  is dissolved in ethyl alcohol + Aq two layers are formed, the compositions of which are as follows:

Upper layer			Lower layer		
$\% alcohol$	$\% H_2O$	$\% K_2CO_3$	$\% alcohol$	$\% H_2O$	$\% K_2CO_3$
81.25	18.61	0.14	0.82	55.42	43.76
71.67	27.91	0.42	1.79	61.61	36.60
56.98	41.55	1.47	4.02	65.73	30.25
53.92	44.13	2.05	4.88	66.87	28.25
50.21	47.24	2.55	5.54	67.06	27.41
43.93	52.04	3.92	7.71	67.56	24.74
37.64	56.45	5.90	10.54	67.40	22.06
28.43	61.57	10.00	15.73	66.38	17.90

(Cuno, W. Ann. 1909, (4) 28. 664.)

Solubility of  $K_2CO_3$  in alcohol + Aq at  $30^\circ$ .

$\% K_2CO_3$	$\% Alcohol$	$\% H_2O$	Solid phase
$\% K_2CO_3$	$\% Alcohol$	$\% H_2O$	
53.27	0	46.73	$K_2CO_3, 1\frac{1}{2}H_2O$
53.09	0.1	46.81	"
.....	.....	.....*	"
.....	.....	.....	"
.....	.....	.....	"
0.13	90.49	9.38	$K_2CO_3, 1\frac{1}{2}H_2O$
.....	.....	.....	"
.....	.....	.....	"
0.04	99.92	0.04	$K_2CO_3 + K_2CO_3, 1\frac{1}{2}H_2O$

\* Solution separates into two layers.

(de Waal, Dissert. Leiden, 1910.)

A full discussion of the solubility of  $K_2CO_3$  in methyl, ethyl, propyl, isopropyl, and allyl alcohols is given by Frankforter and Frary (J. phys. Ch. 1913, 17. 402), and Frankforter and Temple (J. Am. Chem. Soc. 1915, 37. 2697).

$K_2CO_3$  will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of  $K_2CO_3$ , acetone and  $H_2O$  just become homogeneous at 20°. 100 g. of the solution contain:

$K_2CO_3$	$H_2O$	acetone	$K_2CO_3$	$H_2O$	acetone
18.84	73.22	7.94	2.43	55.36	42.21
13.32	71.38	15.30	22.29	72.81	4.90
11.83	70.34	17.83	17.86	73.12	9.02
10.13	69.03	20.84	15.81	72.53	11.66
8.24	67.31	24.45	14.39	71.89	13.72
7.22	65.99	26.79	10.29	69.46	20.25
6.04	64.39	29.57	1.91	54.05	44.04
28.87	69.08	2.05	1.76	52.86	45.38
23.94	71.98	4.08	1.60	51.60	46.80
21.52	72.75	5.33	1.29	49.57	49.14
19.60	73.10	7.70	1.08	47.86	51.06
6.46	65.34	28.20	0.94	46.73	52.33
5.91	64.65	29.44	0.75	44.72	54.53
5.60	63.93	30.47	0.66	43.31	56.03
5.04	62.80	32.16	0.60	42.49	56.91
4.50	61.48	34.02	0.54	41.73	57.73
3.80	59.79	36.41	0.50	40.69	58.81
3.18	57.95	38.87	0.46	40.48	60.06
2.73	56.50	40.77	...	...	...

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, **36**, 1121.)

Insol. in benzonitrile. (Naumann, B. 1914, **47**, 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42**, 3790); ethyl acetate. (Naumann, B. 1910, **34**, 314.)

Sol. in phenol.

Sol. in 13.5 pts. glycerine of 1.225 sp. gr. (Vogel, N. Repert. **16**, 557.)

100 g. sat.  $K_2CO_3$ +sugar+Aq contains 22.44 g.  $K_2CO_3$  and 56 g. sugar at 31.25° (Köhler, Z. Ver. Zuckerind. 1897, **47**, 447.)

+ $H_2O$ .

+ $1\frac{1}{2}H_2O$ . Very deliquescent. (Pohl.)

Deliquescent only in very moist air. (Städeler.)

Sol. in  $H_2O$  with evolution of heat. (Pohl.)

Sol. at 17.6° with absorption of heat, at 32° with evolution of heat, and at 25° with neither absorption nor evolution of heat. (Berthelot, C. R. **78**, 1722.)

Sat. solution of  $K_2CO_3$ + $1\frac{1}{2}H_2O$  in  $H_2O$  contains 53.27 g. anhydrous  $K_2CO_3$  in 100 g. solution at 30°. (de Waal, Dissert. 1910.)

+ $2H_2O$ . Salt usually given as containing  $1\frac{1}{2}H_2O$  contains  $2H_2O$ . (Gerlach, Z. anal. **26**, 460.)

Sat. solution of  $K_2CO_3$ + $2H_2O$  contains 112 g. anhydrous  $K_2CO_3$  in 100 g.  $H_2O$  at 25°. (Osaka, J. Tok. Ch. Soc. 1911, **32**, 870.)

+ $4H_2O$ . Not deliquescent in closed vessels. (Gerlach, l. c.)

Potassium hydrogen carbonate,  $KHCO_3$ .

Not deliquescent.

Sol. in 3.5 pts.  $H_2O$  at 15°. (Redwood.) Sol. in 4 pts.  $H_2O$  at moderate temperatures. (Bergmann.) Sol. in 0.8333 pt. boiling  $H_2O$  (Pelletier); in 4 pts. cold, and 1.2 pts. boiling  $H_2O$  (M. R. and P.'s Pharm.). Sol. in 4 pts.  $H_2O$  at 18.75°. (Abt.) 100 pts.  $H_2O$  at 15.5° dissolve 30 pts. and at 100°, 83 pts. (Tre's Diet.) 100 pts.  $H_2O$  at 10–11.2° dissolve 26.1 pts.  $KHCO_3$  and the sp. gr. of solution is 1.1536. (Anthon, Dingl. **161**, 216.)

100 pts.  $H_2O$  dissolve at—

0°	10°	20°	30°
19.61	23.23	26.91	30.57 pts. $KHCO_3$ ,
40°	50°	60°	70°
34.15	37.92	41.35	45.24 pts. $KHCO_3$ .

(Poggiale, A. ch. (3) **8**, 468.)

100 pts.  $H_2O$  dissolve pts.  $KHCO_3$  at t°.

t°	Pts. $KHCO_3$	t°	Pts. $KHCO_3$
0	22.4	40	45.2
20	33.2	60	46.4

(Dibbits, J. pr. (2) **10**, 417.)

Sp. gr. of  $KHCO_3$ +Aq at 15° containing 5%  $KHCO_3$ =1.0328; containing 10%  $KHCO_3$ =1.0674. (Kohlrausch, Z. anal. **28**, 472.)

Sol. in 1200 pts. boiling alcohol. (Berthelot.) Insol. in alcohol. (Dumas.)

100 pts.  $H_2O$  dissolve 19.3 pts.  $KHCO_3$  and 8.3 pts.  $NaHCO_3$ , if the sat. solution of latter is sat. with former; and 26.1 pts.  $KHCO_3$  and 6.0 pts.  $NaHCO_3$ , if the sat. solution of the former is sat. with the latter, all at 10°. (Mulder, J. B. **1866**, 67.)

Insol. in sat.  $K_2CO_3$ +Aq. (Engel, C. R. **102**, 365.)

Solubility of  $KHCO_3$ + $KNO_3$  in  $H_2O$  in an atmosphere of  $CO_2$ .

1 litre of the solution contains

at 14.5°		at 25.2°	
Mol. $KHCO_3$	Mol. $KNO_3$	Mol. $KHCO_3$	Mol. $KNO_3$
0.00	2.33	0.00	3.28
0.39	2.17	0.89	2.84
0.76	2.03	1.33	2.65
1.16	1.92	1.91	2.45
1.55	1.81	...	...

This case is complicated by the fact that  $KNO_3$  is more sol. in  $H_2O$  sat. with  $CO_2$  than in pure  $H_2O$ .

(Touren, C. R. 1900, **131**, 261.)

Insol. in benzonitrile (Naumann, B. 1914, **47**, 1370.)

Insol. in methyl acetate (Naumann, B. 1909, **42**, 3790); ethyl acetate (Naumann, B. 1910, **43**, 314.)

Potassium praseodymium carbonate,  $K_2CO_3$ ,  $Pr_2(CO_3)_3$ + $12H_2O$ .

Ppt. Sol. in 20%  $K_2CO_3$ +Aq. (Meyer, Z. anorg. 1904, **41**, 104.)

**Potassium samarium carbonate**,  $K_2CO_3$ ,  $Sm_2(CO_3)_3 + 12H_2O$ .  
(Cleve.)

**Potassium silver carbonate**,  $KAgCO_3$ .

Decomp. by  $H_2O$ . (de Schulten, C. R. 106. 811.)

Ppt. Decomp. by  $H_2O$ . (Reynolds, Chem. Soc. 1898, 73. 265.)

**Potassium sodium carbonate**,  $KNaCO_3 + 6H_2O$ .

Slightly efflorescent. Sol. in 0.75 pt.  $H_2O$  at  $12.5^\circ$ ; in 0.54 pt.  $H_2O$  at  $15^\circ$ .

Sat. solution at  $15^\circ$  has sp. gr. = 1.366. (Stolba, J. pr. 94. 406.)

Decomp. by recrystallising from  $H_2O$ , but crystallizes undecomposed from sat.  $K_2CO_3 + Aq$ .

Sol. in  $H_2O$ . (Osaka, C. A. 1911. 2601.)

See  $K_2CO_3 + Na_2CO_3$  under  $Na_2CO_3 + 3H_2O$ . (Kremann and Zitek, M. 1909. 30. 317.) Does not exist. (Osaka.)

$K_2CO_3, 2Na_2CO_3 + 18H_2O$ . Sl. efflorescent. Very sol. in  $H_2O$ . (Marignac.)

**Potassium stannous carbonate**,  $K_2CO_3, 2SnCO_3 + 2H_2O$ .

Decomp. by  $H_2O$ . (Deville.)

**Potassium uranyl carbonate**,  $2K_2CO_3, (UO_2)_2CO_3$ .

Sol. without decomp. in 13.5 pts.  $H_2O$  at  $15^\circ$ , and in somewhat less warm  $H_2O$ . Sol. in boiling  $H_2O$  with decomp.

More sol. in  $K_2CO_3$ , or  $KHCO_3 + Aq$  than in  $H_2O$ . (Rose.)

Insol. in alcohol. (Ebelmen, A. ch. (3) 5. 189.)

**Potassium zinc carbonate**,  $4K_2O, 6ZnO, 11CO_3 + 8H_2O$ .

Can be washed with cold  $H_2O$  without decomp. (Deville, A. ch. (3) 33. 99.)

**Praseodymium carbonate**,  $Pr_2(CO_3)_3 + 8H_2O$ .

Sol. in  $H_2O$ . (von Schule, Z. anorg. 1898, 18. 362.)

**Praseodymium sodium carbonate**,  $2Pr_2(CO_3)_3, 3Na_2CO_3 + 22H_2O(?)$ .

Ppt. Easily decomp. (Meyer, Z. anorg. 1904, 41. 105.)

**Radium carbonate**.

Less sol. in  $H_2O$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Rubidium carbonate**,  $Rb_2CO_3$ .

Very deliquescent, and sol. in  $H_2O$ . 100 pts. absolute alcohol dissolve 0.74 pt.  $Rb_2CO_3$ . (Bunsen.)

**Rubidium hydrogen carbonate**,  $RbHCO_3$ .

Not deliquescent. Easily sol. in  $H_2O$ . (Bunsen.)

**Samarium carbonate**,  $Sm_2(CO_3)_3 + 3H_2O$ .

Insol. in  $H_2O$ . (Cleve, Bull. Soc. (2) 43. 168.)

**Samarium sodium carbonate**,  $Sm_2(CO_3)_3, Na_2CO_3 + 16H_2O$ .

Ppt. (Cleve.)

**Scandium carbonate**,  $Sc_2(CO_3)_3 + 12H_2O$ .

(Crookes, Roy. Soc. Proc. 1908, 80, A. 518.)

**Scandium sodium carbonate**,  $Sc_2(CO_3)_3, 4Na_2CO_3 + 6H_2O$ .

Difficultly sol. in  $H_2O$ .

Sol. in cold, less sol. in hot alkali carbonates + Aq. (R. Meyer, Z. anorg. 1910, 67. 410.)

**Silver carbonate**,  $Ag_2CO_3$ .

Somewhat sol. in  $H_2O$ . Sol. in 31,978 pts.  $H_2O$  at  $15^\circ$ . (Kremers, Pogg. 85. 248.) 1 g.  $Ag_2CO_3$  dissolves in 2 l. boiling  $H_2O$ . (Joulin, A. ch. (4) 30. 260.)

Solubility in  $H_2O$  at  $25^\circ = 1.16 \times 10^{-4}$  mol./l. (Spencer and Le Pla, Z. anorg. 1910, 65. 14.)

1 l.  $H_2O$  at  $25^\circ$  dissolves  $1.2 \times 10^{-4}$  gram atoms of silver. (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Insol. in  $H_2CO_3 + Aq$ . (Bergman.) Sol. in 961 pts.  $H_2CO_3 + Aq$ . (Lassaigne.) 1 l. sat.  $H_2CO_3 + Aq$  dissolves 0.846 g.  $Ag_2CO_3$  at  $15^\circ$ . (Johnson, C. N. 54. 75.)

Sol. in  $(NH_4)_2CO_3 + Aq$  or  $NH_4OH + Aq$ ; sl. sol. in  $K_2CO_3 + Aq$ . (Wittstein.) Easily sol. in  $Na_2S_2O_3 + Aq$ . (Herschel, 1819.) Sol. in hot  $NH_4Cl + Aq$ , and sl. sol. in  $NH_4NO_3 + Aq$ . (Brett, 1837.) Not pptd. in presence of Na citrate. (Spiller.) Decomp. by  $HCl + Aq$ , and chlorides + Aq.

Somewhat sol. in conc.  $NaNO_3 + Aq$ . (de Coninck, Belg. Acad. Bull. 1909, 333.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol.

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

**Silver carbonate ammonia**.

Easily sol. in  $H_2O$ . Sol. in  $NH_4OH + Aq$ , from which it is precipitated by absolute alcohol. (Berzelius.)

$Ag_2CO_3, 4NH_3$ . Ppt. Insol. in alcohol. (Keen, C. N. 31. 231.)

**Sodium carbonate**,  $Na_2CO_3$ .

*Anhydrous*. Sol. in  $H_2O$  with evolution of heat.

Sol. in 5.967 pts.  $H_2O$  at  $15^\circ$ . (Fresenius.) 100 pts.  $H_2O$  at  $14.6^\circ$  dissolve 7.74 pts.  $Na_2CO_3$  or 20.64 pts.  $Na_2CO_3, 10H_2O$  is sol. in rather less than 1 pt. boiling  $H_2O$ . (Thomson, 1831.)

Sol. in 2 pts.  $H_2O$ . (Bergman.)

Sol. in 2 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. Na <sub>2</sub> CO <sub>3</sub>	Pts. Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O	t°	Pts. Na <sub>2</sub> CO <sub>3</sub>	Pts. Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O
0	7.08	21.52	25	35.90	171.33
10	16.66	61.98	30	35.90	241.57
20	30.83	123.12	104.6	48.50	420.68

(Poggiale, A. ch. (3) 8. 468.)

Possesses four different degrees of solubility, according to different states of molecular constitution and degrees of hydration. (Löwel, A. ch. (3) 44. 330.)

Little more sol. at 34–38° than at 104°, but maximum of solubility is probably at 15°. (Löwel.)

Solubility of Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O, Na<sub>2</sub>CO<sub>3</sub>+7H<sub>2</sub>O (a), and Na<sub>2</sub>CO<sub>3</sub>+7H<sub>2</sub>O (b) in H<sub>2</sub>O.

t°	Sat. solution of Na <sub>2</sub> CO <sub>3</sub> +10H <sub>2</sub> O contains—		Sat. solution of Na <sub>2</sub> CO <sub>3</sub> +7H <sub>2</sub> O (b) contains—			Sat. solution of Na <sub>2</sub> CO <sub>3</sub> +7H <sub>2</sub> O (a) contains—		
	Pts. Na <sub>2</sub> CO <sub>3</sub> in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> + 10H <sub>2</sub> O in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> + 7H <sub>2</sub> O (b) in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> + 10H <sub>2</sub> O in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> + 7H <sub>2</sub> O (a) in 100 pts. H <sub>2</sub> O	Pts. Na <sub>2</sub> CO <sub>3</sub> + 10H <sub>2</sub> O in 100 pts. H <sub>2</sub> O
0	6.97	21.33	20.39	58.93	84.28	31.93	112.94	188.37
10	12.06	40.94	26.33	83.94	128.57	37.85	150.77	286.13
15	16.20	63.20	29.58	100.00	160.51	41.55	179.90	381.29
20	21.71	92.82	38.55	122.25	210.58	45.79	220.20	556.71
25	28.50	149.13	38.07	152.36	290.91	...	...	...
30	37.24	273.64	43.45	196.93	447.93	...	...	...
38	51.67	1142.17	...	...	...	...	...	...
104	45.47	539.63	...	...	...	...	...	...

(Löwel, A. ch. (3) 33. 382.)

100 pts. H<sub>2</sub>O at 14° dissolve 60.4 pts. Na<sub>2</sub>CO<sub>3</sub>+10H<sub>2</sub>O; at 36°, 833 pts.; at 104°, 445 pts. Solubility increases to 36°, then diminishes. (Payen, A. ch. (3) 43. 233.)

There are apparently two maxima of solubility; the one occurring at 15°, or even lower, as warm solutions cool; the other at 34–38°, when cold solutions are warmed. (Payen, A. ch. (3) 44. 330.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. Na <sub>2</sub> CO <sub>3</sub>	t°	Pts. Na <sub>2</sub> CO <sub>3</sub>	t°	Pts. Na <sub>2</sub> CO <sub>3</sub>
0	7.1	22	23.8	43	46.2
1	7.5	23	25.1	44	46.2
2	7.8	24	26.5	45	46.2
3	8.4	25	28.0	46	46.2
4	8.9	26	29.7	47	46.2
5	9.5	27	31.6	48	46.2
6	10.0	28	33.6	49	46.2
7	10.6	29	35.8	50	46.2
8	11.2	30	38.1	51	46.2
9	11.9	31	41.4	52	46.2
10	12.6	32	46.2	53	46.2
11	13.3	32.5	59.0	54	46.2
12	14.0	33	46.2	55	46.2
13	14.8	34	46.2	56	46.2
14	15.6	35	46.2	57	46.2
15	16.5	36	46.2	58	46.2
16	17.4	37	46.2	59	46.2
17	18.3	38	46.2	60	46.2
18	19.3	39	46.2	61	46.2
19	20.3	40	46.2	62	46.2
20	21.4	41	46.2	63	46.2
21	22.6	42	46.2	64	46.2

Solubility in 100 pts. H<sub>2</sub>O at t°—Continued

t°	Pts. Na <sub>2</sub> CO <sub>3</sub>	t°	Pts. Na <sub>2</sub> CO <sub>3</sub>	t°	Pts. Na <sub>2</sub> CO <sub>3</sub>
65	46.2	79	46.2	93	45.6
66	46.2	80	46.1	94	45.6
67	46.2	81	46.1	95	45.6
68	46.2	82	46.1	96	45.6
69	46.2	83	46.0	97	45.5
70	46.2	84	46.0	98	45.5
71	46.2	85	45.9	99	45.5
72	46.2	86	45.9	100	45.4
73	46.2	87	45.8	101	45.4
74	46.2	88	45.8	102	45.3
75	46.2	89	45.8	103	45.3
76	46.2	90	45.7	104	45.2
77	46.2	91	45.7	105	45.1
78	46.2	92	45.7	...	....

(Mulder, Scheik. Verhandel. 1864. 129.)

Liable to form supersaturated solutions.

Supersat. Na<sub>2</sub>CO<sub>3</sub>+Aq (2 pts. Na<sub>2</sub>CO<sub>3</sub>, 10H<sub>2</sub>O: 1 pt. H<sub>2</sub>O) may be kept in a flask closed with cotton wool. (Schröder.)

When supersat. Na<sub>2</sub>CO<sub>3</sub>+Aq is exposed to low temperatures, the 10H<sub>2</sub>O salt crystallises out; but under other circumstances two other salts are formed, each containing 7H<sub>2</sub>O; one is four times as sol. at 10° as the 10H<sub>2</sub>O salt, and the other twice as sol. See above. (Löwel, A. ch. (3) 33. 337.)

See also Na<sub>2</sub>CO<sub>3</sub>+H<sub>2</sub>O, 7H<sub>2</sub>O, and 10H<sub>2</sub>O.

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $15^\circ$ .

% $\text{Na}_2\text{CO}_3$	Sp. gr.	% $\text{Na}_2\text{CO}_3$	Sp. gr.
0.372	1.0040	7.812	1.0892
0.744	1.0081	8.184	1.0937
1.116	1.0121	8.556	1.0982
1.488	1.0163	8.928	1.1028
1.850	1.0204	9.300	1.1074
2.232	1.0245	9.672	1.1120
2.504	1.0286	10.044	1.1167
2.976	1.0327	10.416	1.1214
3.348	1.0368	10.788	1.1261
3.720	1.0410	11.160	1.1308
4.090	1.0452	11.532	1.1356
4.464	1.0494	11.904	1.1404
4.836	1.0537	12.276	1.1452
5.208	1.0576	12.648	1.1500
5.580	1.0625	13.020	1.1549
5.972	1.0669	13.392	1.1598
6.324	1.0713	13.764	1.1648
6.396	1.0757	14.136	1.1698
6.768	1.0802	14.508	1.1748
7.440	1.0847	14.880	1.1816

(Tünnerman.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $15^\circ$ .

%	Sp. gr. if % is $\text{Na}_2\text{CO}_3$	Sp. gr. if % is $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$
1	1.0105	1.004
2	1.0210	1.008
3	1.0315	1.012
4	1.0420	1.016
5	1.0525	1.020
6	1.0631	1.023
7	1.0737	1.027
8	1.0843	1.031
9	1.0950	1.035
10	1.1057	1.039
11	1.1165	1.043
12	1.1274	1.047
13	1.1384	1.050
14	1.1495	1.054
15	.....	1.058
16	.....	1.062
17	.....	1.066
18	.....	1.070
19	.....	1.074
20	.....	1.078
21	.....	1.082
22	.....	1.086
23	.....	1.090
24	.....	1.094
25	.....	1.099
26	.....	1.103
27	.....	1.106
28	.....	1.110
29	.....	1.114
30	.....	1.119
31	.....	1.123
32	.....	1.126
33	.....	1.130
34	.....	1.135
35	.....	1.139
36	.....	1.143
37	.....	1.147
38	.....	1.150

(Gerlach, Z. anal. 8. 279.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	Sp. gr.
1	2.70	1.010	9	24.30	1.095
2	5.40	1.020	10	27.00	1.105
3	8.10	1.031	11	29.70	1.116
4	10.18	1.041	12	32.40	1.127
5	13.50	1.052	13	35.10	1.137
6	16.20	1.063	14	37.80	1.148
7	18.90	1.073	15	40.50	1.157
8	21.60	1.084	..	...	...

(Hager.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  increases or diminishes by a change of temperature of  $1^\circ$  by the following amounts—

Corr.	% $\text{Na}_2\text{CO}_3$
0.0004	13-15
0.00033	8-12
0.00026	3-7

(Hager, Comm. 1883.)

Sp. gr. of conc.  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $30^\circ$ .

Sp. gr.	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3$ in 1 l.	Sp. gr.	% $\text{Na}_2\text{CO}_3$	% $\text{Na}_2\text{CO}_3$ in 1 l.
1.310	28.13	368.5	1.220	20.47	249.7
1.300	27.30	354.9	1.210	19.61	237.3
1.290	26.46	341.3	1.200	18.76	225.1
1.280	25.62	327.9	1.190	17.90	214.0
1.270	24.78	314.7	1.180	17.04	201.1
1.260	23.93	301.5	1.170	16.18	189.3
1.250	23.08	288.5	1.160	15.32	177.7
1.240	22.21	275.4	1.150	14.47	166.4
1.230	21.33	262.3	1.140	13.62	155.3

(Lunge, Chem. Ind. 1882. 320.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$ .

% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	% $\text{Na}_2\text{CO}_3$	Sp. gr.	% $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	% $\text{Na}_2\text{CO}_3$	Sp. gr.
1	0.370	1.0038	16	5.929	1.0628
2	0.741	1.0076	17	6.299	1.0668
3	1.112	1.0114	18	6.670	1.0706
4	1.482	1.0153	19	7.041	1.0748
5	1.853	1.0192	20	7.412	1.0789
6	2.223	1.0231	21	7.782	1.0836
7	2.594	1.0271	22	8.153	1.0871
8	2.965	1.0309	23	8.523	1.0912
9	3.335	1.0348	24	8.894	1.0953
10	3.706	1.0388	25	9.264	1.0994
11	4.076	1.0428	26	9.635	1.1035
12	4.447	1.0468	27	10.005	1.1076
13	4.817	1.0508	28	10.376	1.1117
14	5.188	1.0548	29	10.746	1.1158
15	5.558	1.0588	30	11.118	1.1200

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23^\circ$ —Continued.

$\% \text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	$\% \text{Na}_2\text{CO}_3$	Sp. gr.	$\% \text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O}$	$\% \text{Na}_2\text{CO}_3$	Sp. gr.
31	11.488	1.1242	41	15.195	1.1662
32	11.859	1.1284	42	15.556	1.1704
33	12.230	1.1326	43	15.936	1.1746
34	12.600	1.1368	44	16.307	1.1788
35	12.971	1.1410	45	16.677	1.1830
36	13.341	1.1452	46	17.048	1.1873
37	13.712	1.1494	47	17.418	1.1916
38	14.082	1.1536	48	17.789	1.1959
39	14.530	1.1578	49	18.159	1.2002
40	14.824	1.1620	50	18.530	1.2045

(Schiff, A. 113. 186.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $23.3^\circ$ .  $a$  = number of grms.  $\times \frac{1}{2}$  mol. wt., dissolved in 1000 grms.  $\text{H}_2\text{O}$ ;  $b$  = sp. gr. if  $a = \text{Na}_2\text{CO}_3$ ,  $10\text{H}_2\text{O}$  ( $\frac{1}{2}$  mol. wt. = 143);  $c$  = sp. gr. if  $a = \text{Na}_2\text{CO}_3$  ( $\frac{1}{2}$  mol. wt. = 53).

$a$	$b$	$c$	$a$	$b$	$c$
1	1.048	1.052	5	1.163	1.226
2	1.086	1.100	6	1.182	...
3	1.117	1.145	7	1.198	...
4	1.142	1.187	..	...	...

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $18^\circ$ .

$\% \text{Na}_2\text{CO}_3$	Sp. gr.	$\% \text{Na}_2\text{CO}_3$	Sp. gr.
5	1.0511	15	1.1590
10	1.1044	..	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$ .

g.-equivalents $\text{Na}_2\text{CO}_3$ per l.	$t^\circ$	Sp. gr. $t^\circ/t^\circ$
0.002524	16.004	1.0001418
0.005041	16.026	1.0002844
0.01006	16.049	1.000568
0.02501	16.028	1.001413
0.04954	16.050	1.002789
0.10188	16.030	1.005699
0.24646	16.041	1.013598
0.002628	16.051	1.0001473
0.003948	16.088	1.0002216
0.009182	16.061	1.0005181
0.01830	16.089	1.001033
0.10842	16.042	1.006048
0.21570	16.055	1.011910
0.4297	15.14	1.02346
2.5015	16.05	1.12533

(Kohlrausch, W. Ann. 1894, 53. 26.)

Sp. gr. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $t^\circ$ .  $\text{H}_2\text{O}$  at  $4^\circ = 1$ .

$t^\circ$	$\% \text{Na}_2\text{CO}_3$	Sp. gr.
$60^\circ$	28.74	1.2971
	25.20	1.2546
	22.25	1.2191
	18.23	1.1746
	14.06	1.1277
$80^\circ$	28.59	1.2807
	18.26	1.1607

(Wegscheider, M. 1905, 28. 690.)

Sp. gr. of dil  $\text{Na}_2\text{CO}_3 + \text{Aq}$  at  $20.004^\circ$ .  
Conc. = g. equiv.  $\text{Na}_2\text{CO}_3$  per l. at  $20.004^\circ$  and 730 mm.

Sp. gr. compared with  $\text{H}_2\text{O}$  at  $20.004^\circ = 1$ .

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,006,6
0.0002	1.000,011,2
0.0004	1.000,022,5
0.0005	1.000,028,1
0.0010	1.000,056,3
0.0020	1.000,112,7
0.0040	1.000,225,8
0.0050	1.000,282,4
0.0100	1.000,564,8

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35. 1685.)

$\text{Na}_2\text{CO}_3 + \text{Aq}$  containing 5%  $\text{Na}_2\text{CO}_3$  boils at  $100.5^\circ$ ; 10%  $\text{Na}_2\text{CO}_3$  at  $101.1^\circ$ ; 15%  $\text{Na}_2\text{CO}_3$  at  $101.8^\circ$ . (Gerlach.)

Sat. solution boils at  $104.4^\circ$  (Griffiths, 1835);  $106^\circ$  (Kremers);  $104^\circ$ . (Payen.)

Sat. solution forms a crust at  $104.1^\circ$ , and contains 42.2 pts.  $\text{Na}_2\text{CO}_3$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temperature observed,  $105^\circ$ . (Gerlach, Z. anal. 26. 427.)

B.-pt. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$  containing pts.  $\text{Na}_2\text{CO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. 26. 458); L = according to Legrand (A. ch. (2) 59. 426).

B.-pt.	G	L	B.-pt.	G	L
100.5°	5.2	7.5	103.5°	36.2	41.0
101.0	10.4	14.4	104.0	41.2	44.7
101.5	15.6	20.8	104.5	46.2	47.9
102.0	20.8	26.7	104.63	...	48.5
102.5	26.0	32.0	105.0	51.2	...
103.0	31.1	36.8	....	....	....

Less sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Fresenius.)

See also under **Ammonia**.

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NH}_4\text{Cl}$ . See under **Ammonium Chloride**.

Solubility of  $\text{Na}_2\text{CO}_3 + \text{K}_2\text{CO}_3$ . See under **Carbonate, potassium**.

The reciprocal solubility of sodium carbonate and sodium hydrogen carbonate in  $H_2O$  has been determined. (de Paepe, C. A. 1911, 2603, and 1912, 2723.)

Solubility of  $Na_2CO_3 + NaHCO_3$  in  $H_2O$  at  $25^\circ$ .

g. per 100 g. $H_2O$		Solid phase
$NaHCO_3$	$Na_2CO_3$	
0	28.3	$Na_2CO_3 \cdot 10H_2O$
2.1	27.3	"
4.2	26.5	$Na_2CO_3 \cdot 10H_2O + NaHCO_3$
5.7	19.2	$NaHCO_3$
7.3	12.4	"
9.0	6.2	"
10.1	1.0	"

(de Paepe, Bull. Soc. Chim. Belg. 1911, 25. 174.)

Solubility of  $Na_2CO_3 + NaHCO_3$  in  $H_2O$  at  $25^\circ$ .

g. per l.		Solid phase
$NaHCO_3$	$Na_2CO_3$	
98.7	0.0	$NaHCO_3$
50.8	216.6	$NaHCO_3 + Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$
27.6	276.3	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O + Na_2CO_3 \cdot 10H_2O$
0.0	276.4	$Na_2CO_3 \cdot 10H_2O$

(McCoy and Test, J. Am. Chem. Soc. 1911, 33. 474.)

Equilibrium between  $Na_2CO_3$ ,  $NaHCO_3$ , and  $CO_2$ . See under Carbonate, sodium hydrogen.

Solubility of  $NaNO_3$  in  $Na_2CO_3 + Aq$  at  $10^\circ$ .

In 1000 ccm. $H_2O$		Solid phase
$NaNO_3$	$Na_2CO_3$	
305.0	...	$NaNO_3$
704.8	87.5	$NaNO_3, Na_2CO_3$
...	119.8	$Na_2CO_3$

(Kremann, M. 1909, 30. 325.)

Solubility of  $NaNO_3$  in  $Na_2CO_3 + Aq$  at  $24.2^\circ$ .

In 1000 ccm. $H_2O$		Solid phase
$NaNO_3$	$Na_2CO_3$	
913.58	...	$NaNO_3$
844.50	59.61	"
627.75	217.85	$NaNO_3 + Na_2CO_3 \cdot 7H_2O$
544.3	246.30	.....
459.6	263.30	$Na_2CO_3 \cdot 7H_2O$
....	28.55	$Na_2CO_3 \cdot 10H_2O$
....	28.55	$Na_2CO_3 \cdot 10H_2O$

(Kremann.)

Solubility of  $Na_2CO_3 + NaBr$  in  $H_2O$  at  $30^\circ$ .

% $Na_2CO_3$	% $NaBr$	Solid phase
27.98	0	$Na_2CO_3 \cdot 10H_2O$
27.54	2.41	"
26.72	4.06	"
26.23	6.26	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
23.40	11.00	$Na_2CO_3 \cdot 7H_2O$
22.68	12.22	"
19.86	16.88	"
19.57	16.95	$Na_2CO_3 \cdot 7H_2O + Na_2CO_3 \cdot H_2O$
18.11	19.32	$Na_2CO_3 \cdot H_2O$
8.45	33.39	"
6.90	36.13	"
3.04	44.75	"
2.99	45.31	$NaBr \cdot 2H_2O + Na_2CO_3 \cdot H_2O$
2.60	45.68	$NaBr \cdot 2H_2O$
0	49.40	"

(Cocheret, Dissert. 1911.)

Solubility in  $NaCl + Aq$ . 100 pts.  $H_2O$  dissolve pts.  $NaCl$  and pts.  $Na_2CO_3 + 10H_2O$ , when that salt is in excess at  $15^\circ$ .

Pts. $NaCl$	Pts. $Na_2CO_3 + 10H_2O$	Pts. $NaCl$	Pts. $Na_2CO_3 + 10H_2O$
0.00	61.42	23.70	39.06
4.03	53.86	27.93	39.78
8.02	48.00	31.65	41.44
12.02	43.78	35.46	43.77
16.05	40.96	sat.	
19.82	39.46	37.27	45.32

Solubility of anhydrous  $Na_2CO_3$  in 100 pts.  $NaCl + Aq$  containing %  $NaCl$  at  $15^\circ$ .

% $NaCl$	Pts. $Na_2CO_3$	% $NaCl$	Pts. $Na_2CO_3$
0	16.408	12	10.488
1	15.717	13	10.244
2	15.060	14	10.041
3	14.438	15	9.880
4	13.851	16	9.762
5	13.299	17	9.686
6	12.783	18	9.655
7	12.305	19	9.667
8	11.864	20	9.725
9	11.461	21	9.828
10	11.097	22	9.997
11	10.773	..	....

(Reich, W. A. B. 99, 2b. 433.)

Solubility of  $Na_2CO_3 + NaCl$  in  $H_2O$  at  $30^\circ$ .

% $Na_2CO_3$	% $NaCl$	Solid phase
27.98	0	$Na_2CO_3 \cdot 10H_2O$
27.48	0.9	"
27.12	3.33	"
26.82	4.15	$Na_2CO_3 \cdot 10H_2O + Na_2CO_3 \cdot 7H_2O$
25.59	5.17	$Na_2CO_3 \cdot 7H_2O$
24.26	5.93	"



Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $30^\circ$ —Continued.

% $\text{Na}_2\text{CO}_3$	% $\text{NaCl}$	Solid phase
22.75	10.24	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
20.72	11.49	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
18.00	14.12	$\text{NaCl} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
14.81	16.26	$\text{NaCl}$
9.71	18.76	"
5.05	21.94	"
0	26.47	"

(Cocheret, Dissert. 1911.)

Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaI}$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

% $\text{Na}_2\text{CO}_3$	% $\text{NaI}$	Solid phase
27.4	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
26.5	2.4	"
25.5	4.7	"
25.2	5.2	"
24.4	8.6	"
24.3	9.5	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
23.0	11.2	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
20.8	14.0	"
20.0	15.7	"
18.7	18.4	"
15.3	25.4	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
13.1	29.1	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
10.4	33.3	"
6.4	40.4	"
4.2	46.0	"
3.1	49.5	"
2.7	51.0	"
1.5	54.6	"
0.9	57.6	"
0.6	61.2	"
0.3	65.6	$\text{NaI} \cdot 2\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
0.0	65.5	$\text{NaI} \cdot 2\text{H}_2\text{O}$

(Cocheret, Dissert. 1911.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol. (Fresenius.)

Sl. sol. in absolute alcohol; apparently insol. in an alcoholic solution of soap. (Duffy, Chem. Soc. 5. 305.)

Solubility of  $\text{Na}_2\text{CO}_3$  in ethyl alcohol at  $20^\circ$ .

Alcohol, wt. per cent	g. $\text{Na}_2\text{CO}_3$ per 100 g. solution
44	1.7
46	1.13
48	0.9
50	0.84
54	0.80

(Linebarger, A. Ch. J. 1892, 14. 380.)

Solubility of  $\text{Na}_2\text{CO}_3$  in alcohol +  $\text{H}_2\text{O}$  at  $30^\circ$ .

% $\text{Na}_2\text{CO}_3$	% alcohol	Solid phase
27.4	0	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
26.61	2.64	"
26.14*	3.41	"
1.38	44.81	"
0.62	52.99	"
0.61	53.26	"
0.53	55.70	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
0.51	56.56	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O}$
0.47	62.61	"
0.40	63.20	"
0.15	72.80	"
0.11	73.06	$\text{Na}_2\text{CO}_3 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
0.07	78.19	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$
0.07	82.26	"
0.06	86.76	"
0.06	90.95	"
0.04	93.09	"
0.03	95.06	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O} + \text{Na}_2\text{CO}_3$
...	95.65	$\text{Na}_2\text{CO}_3$
...	98.46	"

\* Conjugated liquid phases.

(Cocheret, Dissert. 1911.)

See also under  $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ ,  $+7\text{H}_2\text{O}$  and  $+10\text{H}_2\text{O}$ .Not decomp. by 1 pt.  $\text{H}_2\text{SO}_4 + 6$  pts. absolute alcohol.Not decomp. by alcoholic solutions of racemic, tartaric, or glacial acetic acids; slowly decomp. by  $\text{HNO}_3 +$  absolute alcohol.Solubility of  $\text{Na}_2\text{CO}_3 + \text{NaBr}$ ,  $\text{NaCl}$  and  $\text{NaI}$  in alcohol. Numerical data given by Cocheret (Dissert. 1911), reported in Tables annuelles internationales des Constantes, etc. for 1911.Solubility of  $\text{Na}_2\text{CO}_3$  in propyl alcohol at  $20^\circ$ .

Alcohol, wt. per cent	g. $\text{Na}_2\text{CO}_3$ per 100 g. solution
28	4.4
38	2.7
44	1.7
46	1.5
48	1.3
50	1.2
54	0.9
62	0.4

(Linebarger, A. Ch. J. 1892, 14. 380.)

A full discussion of the solubility of  $\text{Na}_2\text{CO}_3$  in propyl, and allyl alcohol is given by Frankforter and Temple (J. Am. Ch. Soc. 1915, 37. 2697).Insol. in  $\text{CS}_2$ . (Arcetowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Solubility in mixtures of pyridine and  $\text{H}_2\text{O}$  from  $-65^\circ$  to  $+200^\circ$ . Solubility curves are given. (Limboesch, Chem. Soc. 1909, 96 (2), 472.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

100 g. glycerine (sp. gr. = 1.262) dissolve 98.3 g.  $\text{Na}_2\text{CO}_3$  at  $15-16^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

100 g. sat. solution in glycol contain 3.28-3.4 g.  $\text{Na}_2\text{CO}_3$ . (de Coninck, Bull. Soc. Belg. 1907, 21. 141.)

100 g. sat.  $\text{Na}_2\text{CO}_3$  + sugar + Aq contain 6.89 g.  $\text{Na}_2\text{CO}_3$  + 64.73 g. sugar at  $31.25^\circ$ . (Kohler, Z. Ver. Zuckerind. 1897, 47. 447.)

+  $\text{H}_2\text{O}$ . Takes up  $\text{H}_2\text{O}$  from the air. Less sol. in  $\text{H}_2\text{O}$  at  $104^\circ$  than at  $38^\circ$ ; at  $15-20^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolve 52.4 pts. of this salt, calculated as  $\text{Na}_2\text{CO}_3$ . Insol. in alcohol. (Löwel.)

#### Solubility in 100 pts. $\text{H}_2\text{O}$ at $t^\circ$ .

Corrected $t^\circ$ (Hydrogen scale)	Pts. anhydrous salt
29.86	50.53
29.89	50.75
31.80	50.31
35.17	49.63
35.37	49.67
35.66	49.37
35.86	49.44
36.45	49.36
36.90	49.29
37.91	49.11
38.92	49.09
40.94	48.51
40.93	48.52
43.94	47.98

(Wells and McAdam, J. Am. Chem. Soc. 1907, 29. 726.)

#### Solubility in alcohol + Aq.

Composition of the alcohol and water layers in contact with the solid phase  $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$ .

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
68	55.8	0.9	43.3	2.3	28.8	68.9
49	61.0	0.4	38.6	1.2	31.5	67.3
40	61.0	0.4	38.6	1.2	31.9	66.9
36	62.0	0.3	37.7	1.1	32.1	66.8
35	62.9	0.3	36.8	1.0	32.4	66.6

(Ketner, Z. phys. Ch. 1902, 39. 651.)

+  $3\text{H}_2\text{O}$ . (Schickendants, A. 155. 359.)

+  $5\text{H}_2\text{O}$ . (Persoz, Pogg. 32. 303.)

Not efflorescent. Sol. in  $\text{H}_2\text{O}$ .

+  $6\text{H}_2\text{O}$ . (Mitscherlich, Pogg. 8. 441.)

+  $7\text{H}_2\text{O}$ . Efflorescent. Two salts,  $7\text{H}_2\text{O}$

(b) (= +  $8\text{H}_2\text{O}$  of Thomson), and  $7\text{H}_2\text{O}$

(a). See also under  $\text{Na}_2\text{CO}_3$ .

#### Solubility in 100 pts. $\text{H}_2\text{O}$ at $t^\circ$ .

Corrected $t^\circ$ (Hydrogen scale)	Pts. anhydrous salt
30.35	43.50
31.82	45.16
32.86	46.28
34.37	48.22
34.76	48.98
35.15	49.23
35.17	49.34
35.62	50.08

(Wells and McAdam, J. Am. Chem. Soc. 1907, 29. 726.)

Composition of the solutions which can be in equilibrium with  $\text{Na}_2\text{CO}_3 + 7\text{H}_2\text{O}$  at different temperatures.

$t^\circ$	% $\text{Na}_2\text{CO}_3$
32.1	31.8
32.5	32.1
33.3	32.7
33.9	33.0
34.5	33.9

(Ketner, Z. phys. Ch. 1902, 39. 646.)

Composition of the alcohol and water layers in contact with the solid phase,  $\text{Na}_2\text{CO}_3 + 7\text{H}_2\text{O}$ , at different temperatures.

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
33.2	58.1	0.5	42.4	1.4	31.0	67.6
32.3	56.1	0.6	43.3	1.5	30.2	68.3
31.9	54.8	0.7	44.5	1.7	29.8	68.5
31.45	53.5	0.7	45.8	...	29.3	...
31.2	52.4	0.8	46.8	...	29.3	...

(Ketner.)

Composition of the two liquid layers which at different temperatures can be in metastable equilibrium with  $\text{Na}_2\text{CO}_3 + 7\text{H}_2\text{O}$ .

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
28.9	46.9	1.3	51.8	2.3	26.3	71.4
26.6	39.1	1.3	59.6	3.3	25.4	71.3
23.0	24.5	6.7	68.8	7.0	20.2	72.8

(Ketner.)

+  $10\text{H}_2\text{O}$ . Efflorescent. Sol. in 1.05 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ , and sat. solution has sp. gr. 1.1995. (Schiff, A. 109. 326.)

Melts in crystal  $\text{H}_2\text{O}$  at  $34^\circ$ . (Tilden, Chem. Soc. 45. 409.)

See above under  $\text{Na}_2\text{CO}_3$  for further data.

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

Corrected $t^\circ$ (Hydrogen scale)	Pts. anhydrous salt
27.84	34.20
29.33	37.40
29.85	38.89
30.35	40.12
31.45	43.25
31.66	43.95
31.72	44.21
32.06	45.64

(Wells and McAdam, J. Am. Chem. Soc. 1907, 29. 726.)

Sat. solution at  $25^\circ$  contains 29.37 g. anhyd.  $Na_2CO_3$  in 100 g.  $H_2O$ . (Osaka, J. Tok. Ch. Soc. 1911, 32. 870.)

Sat. solution at  $25^\circ$  contains 28.3 g. anhyd.  $Na_2CO_3$  in 100 g.  $H_2O$ . (de Paepe, Bull. Soc. Chim. Belg. 1911, 25. 174.)

Sat. solution at  $30^\circ$  contains 27.4–27.98 g. anhyd.  $Na_2CO_3$  in 100 g. of the solution. (Cocheret, Dissert. 1911.)

Sat. solution at  $25^\circ$  contains 27.64 g. anhyd.  $Na_2CO_3$  in 100 cc. of the solution. (McCoy and Test, J. Am. Chem. Soc. 1911, 33. 474.)

## Solubility in alcohol.

Composition of the alcohol and water layers in contact with the solid phase,  $Na_2CO_3 + 10H_2O$ , at different temperatures.

$t^\circ$	Alcohol layer			Water layer		
	% alcohol	% salt	% water	% alcohol	% salt	% water
30.6	47.8	1.2	51.0	2.3	27.8	69.9
29.7	40.0	2.1	57.9	2.9	25.5	71.6
29.0	32.7	3.8	63.5	4.3	22.7	73.0
28.2	23.5	7.3	69.2	7.9	18.6	73.5

(Ketner, Z. phys. Ch. 1902, 39. 651.)

## Solubility in alcohol + Aq.

Liquids which can be in equilibrium with  $Na_2CO_3 + 10H_2O$  at  $21^\circ$ .

% alcohol	% salt	% water
0	18.5	81.5
6.2	12.7	81.1
15.3	6.9	77.8
26.1	3.2	70.7
39.2	1.2	59.6
58.2	0.2	41.6
67.1	0.1	32.8
73.3	0.06	26.64

(Ketner.)

Composition of the alcohol liquids which can be in equilibrium with  $Na_2CO_3 + 10H_2O$  and  $Na_2CO_3 + 7H_2O$  at different temperatures.

$t^\circ$	% alcohol	% salt	% water
$20^\circ$	62.3	0.3	37.4
$26^\circ$	67.8	0.1	32.1
$21^\circ$	73.3	0.06	26.6

(Ketner.)

See also under  $Na_2CO_3$ .

+  $15H_2O$ . (Jacquelin, A. 80. 241.)

Sodium hydrogen carbonate,  $NaHCO_3$ .

100 pts. cold  $H_2O$  dissolve 7.7 pts.  $NaHCO_3$ . (Rose, Schw. J. 6. 52.)

100 pts.  $H_2O$  at  $11.25^\circ$  dissolve 8.27 pts.  $NaHCO_3$  to form solution of 1.0613 sp. gr. (Anthon, Dingl. 161. 216.)

100 pts.  $H_2O$  dissolve at—

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
8.95	10.04	11.15	12.24
40°	50°	60°	70°
13.35	14.45	15.57	16.69

(Poggiale, A. ch. (3) 8. 468.)

100 pts.  $H_2O$  dissolve pts.  $NaHCO_3$  at  $t^\circ$ .

$t^\circ$	Pts. $NaHCO_3$	$t^\circ$	Pts. $NaHCO_3$	$t^\circ$	Pts. $NaHCO_3$
0	6.90	21	9.75	42	13.05
1	7.00	22	9.90	43	13.20
2	7.10	23	10.05	44	13.40
3	7.20	24	10.20	45	13.55
4	7.35	25	10.35	46	13.75
5	7.45	26	10.50	47	13.90
6	7.60	27	10.65	48	14.10
7	7.70	28	10.80	49	14.30
8	7.85	29	10.95	50	14.45
9	8.00	30	11.10	51	14.65
10	8.15	31	11.25	52	14.85
11	8.25	32	11.40	53	15.00
12	8.40	33	11.55	54	15.20
13	8.55	34	11.70	55	15.40
14	8.70	35	11.90	56	15.60
15	8.85	36	12.05	57	15.80
16	9.00	37	12.20	58	16.00
17	9.15	38	12.35	59	16.20
18	9.30	39	12.50	60	16.40
19	9.40	40	12.70	..	...
20	9.60	41	12.90	..	...

(Dibbitts, J. pr. (2) 10. 417.)

Experiments with solutions of sodium hydrogen carbonate show that they gradually decompose after a time. (Treadwell, Z. anorg. 1898, 17. 204.)

The source of error of many solubility determinations of this substance is due to loss of  $CO_2$ . Solutions exposed to the air lose  $CO_2$ . (McCoy, Am. Ch. J. 1903, 29. 438.)

1 l. sat. solution at  $25^\circ$  contains 98.4 g.  $NaHCO_3$ . (McCoy and Test, J. Am. Chem. Soc. 1911, 33. 474.)

$\text{NaHCO}_3 + \text{Aq}$  sat. at  $16^\circ$  has sp. gr. = 1.06904. (Stolba.)

Nearly insol. in sat.  $\text{NaCl}$ , or  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Balmain, B. 5. 121.)

Equilibrium between  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  in  $\text{H}_2\text{O}$  and in contact with the air.  
System:  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ , and  $\text{CO}_2$ .  
Temperature,  $25^\circ \text{C}$ .

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0044	50	8.7	91.3
	50		
0.0143	20	20.0	80.0
	20		
0.0562	10	37.3	62.7
	10		
0.2248	10	59.3	40.7
	10		
0.8847	2	64.0	36.0
	2		
	3		

#### Temperature, $37^\circ \text{C}$ .

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0019	50	10.5	89.5
	50		
0.0071	20	21.1	78.9
	20		
0.0276	10	41.3	58.7
	10		
0.030	10	64.5	35.5
	10		
0.421	2	81.9	18.1
	2		
0.815	2	86.5	13.5
	2		
1.795	2+	83.4	16.6
	2		

#### Temperature, $50^\circ \text{C}$ .

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.0017	50	22.2	77.8
	25		
0.0071	20	32.9	67.1
	20		
0.0266	10	50.7	49.3
	20		
0.1014	10	70.0	30.0
	10		
0.4066	10	81.0	19.0
	2		
0.8068	2	86.8	13.2
	2		
1.7486	2.1	87.1	12.9
	2		

#### Temperature, $75^\circ \text{C}$ .

Gram atoms Na per liter	Amount solution used for titration cc.	Amount Na combined as $\text{Na}_2\text{CO}_3$ Per cent	Amount Na combined as $\text{NaHCO}_3$ Per cent
0.003	50	25.7	74.3
	25		
0.019	20	34.8	65.2
	20		
0.036	10	55.7	44.3
	10		
0.270	5	79.5	20.5
	5		
0.702	1	85.0	15.0
	1		
6.56	1	84.8	15.2
	1		

#### System: $\text{Na}_2\text{CO}_3$ and $\text{NaHCO}_3$ at $25^\circ \text{C}$ .

Total salts dissolved grams	$\text{Na}_2\text{CO}_3$		$\text{NaHCO}_3$	
	Weight Grams	Per cent	Weight Grams	Per cent
0.3555	0.0203	5.71	0.3352	94.29
1.1053	0.1505	13.62	0.9548	86.38
4.0443	1.1041	27.30	2.9402	72.70
14.6558	7.0212	47.91	7.6346	52.09
56.3982	29.8223	52.88	26.5759	47.12

(Cameron and Briggs, J. phys. Chem. 1901, 5. 540.)

100 g. acohol of 0.941 sp. gr. dissolve 1.2 g.  $\text{NaHCO}_3$  at  $15.5^\circ$ .

100 g. glycerol dissolve 8 g.  $\text{NaHCO}_3$  at  $15.5^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

#### Sodium dihydrogen tricarbonat, $\text{Na}_2\text{H}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ .

More sol. than  $\text{NaHCO}_3$ , less sol. than  $\text{Na}_2\text{CO}_3$  in  $\text{H}_2\text{O}$ . (Rose, Pogg. 34. 160.)

100 pts.  $\text{H}_2\text{O}$  dissolve, calculated as  $2\text{Na}_2\text{O}$ ,  $3\text{CO}_2$ —

at $0^\circ$	12.63 pts.	at $60^\circ$	29.68 pts.
" $10^\circ$	15.50 "	" $70^\circ$	32.55 "
" $20^\circ$	18.30 "	" $80^\circ$	35.8 "
" $30^\circ$	21.15 "	" $90^\circ$	38.63 "
" $40^\circ$	23.95 "	" $100^\circ$	41.59 "
" $50^\circ$	26.78 "		

(Poggiale, A. ch. (3) 8. 468.)

Min. Trona, Urao. See  $\text{Na}_2\text{H}(\text{CO}_3)_2 + 2\text{H}_2\text{O}$ .

**Trisodium hydrogen carbonate**,  $\text{Na}_3\text{H}(\text{CO}_3)_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

True formula of "Trona" and "Urao." (Zepharovich, Zeit. Kryst. 13. 135; de Mon-desur, C. R. 104. 1505.)

**Sodium thorium carbonate**,  $3\text{Na}_2\text{CO}_3 \cdot \text{Th}(\text{CO}_3)_2 + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Cleve.)

**Sodium uranyl carbonate**,  $2\text{Na}_2\text{CO}_3 \cdot (\text{UO}_2)_2\text{CO}_3$ .

Slowly sol. in  $\text{H}_2\text{O}$ . Solution sat. at  $15^\circ$  has sp. gr. = 1.161. (Anthon, Dingl. 156. 207.)

**Sodium yttrium carbonate**,  $\text{Na}_2\text{CO}_3 \cdot \text{Y}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. Not decomp. by cold  $\text{H}_2\text{O}$ . (Cleve.)

**Sodium zinc carbonate**,  $3\text{Na}_2\text{O} \cdot 8\text{ZnO} \cdot 11\text{CO}_2 + 8\text{H}_2\text{O} = 3\text{Na}_2\text{CO}_3 \cdot 8\text{ZnCO}_3 + 8\text{H}_2\text{O}$ .

Sl. decomp. by pure  $\text{H}_2\text{O}$ . (Wöhler.)

Less easily decomp. by  $\text{H}_2\text{O}$  than most double carbonates. (Deville, A. ch. (3) 33. 101.)

$\text{Na}_2\text{O} \cdot 3\text{ZnO} \cdot 4\text{CO}_2 + 3\text{H}_2\text{O}$ . (Kraut, Z. anorg. 1897, 13. 13.)

**Sodium carbonate sulphite**,  $\text{Na}_2\text{CO}_3 \cdot 2\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ , sl. sol. in cold  $\text{H}_2\text{O}$ . (Johnson, J. Soc. Chem. Ind. 1895, 14. 271.)

**Strontium carbonate**,  $\text{SrCO}_3$ .

Sol. in 18,045 pts.  $\text{H}_2\text{O}$  at ordinary temp. (Fresenius.)

Sol. in 12,522 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, Pogg. 85. 247.)

Sol. in 33,000 pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 511.)

Less sol. in  $\text{H}_2\text{O}$  than  $\text{SrSO}_4$ . (Dulong.)

Sol. in 1536 pts. boiling  $\text{H}_2\text{O}$ . (Hepe, Edinb. Trans. 4. 5.)

Calculated from electrical conductivity of  $\text{SrCO}_3 + \text{Aq}$ ,  $\text{SrCO}_3$  is sol. in 121,760 pts.  $\text{H}_2\text{O}$  at  $8.8^\circ$  and 91,468 pts. at  $24.3^\circ$  (Holle-mann, Z. phys. Ch. 12. 130).

1 l.  $\text{H}_2\text{O}$  dissolves 11 mg.  $\text{SrCO}_3$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

"Solubility product" =  $15.67 \times 10^{-10}$  mol. litre. (McCoy and Smith, J. Am. Chem. Soc. 1911, 33. 473.)

Sol. in 833 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  at  $10^\circ$ . (Gmelin.)

Sol. in 56,545 pts.  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3$ .

Quite sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , but reprecipitated on addition of  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Fresenius.)

Partially decomp. by boiling with aqueous solutions of  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{CaSO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{HPO}_4$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3$ ,  $(\text{NH}_4)_2\text{SO}_3$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,

$\text{Na}_2\text{AsO}_3$ ,  $\text{K}_2\text{AsO}_3$ ,  $\text{K}_2\text{C}_2\text{O}_4$ ,  $\text{Na}_2\text{C}_2\text{O}_4$ ,  $\text{NaF}$ , and  $\text{K}_2\text{CrO}_4$ . Decomp. is complete with the  $\text{NH}_4$  salts. (Dulong, A. ch. 82. 286.)

Sl. decomp. by  $\text{Na}_2\text{SO}_4$  or  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Persoz.)

Easily sol. in  $\text{NH}_4$  chloride, nitrate, or succinate +  $\text{Aq}$ , but less so than  $\text{BaCO}_3$ . (Fresenius.) Sol. in ferric salts +  $\text{Aq}$ , with pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Sol. in  $\text{Na}$  citrate +  $\text{Aq}$ . (Spiller.) Not decomp. by a mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 6 pts. absolute alcohol, or by alcoholic solutions of tartaric, racemic, citric, or glacial acetic acids; immediately decomp. by  $\text{HNO}_3$  + absolute alcohol, or  $\text{H}_2\text{C}_2\text{O}_4$  + abs. alcohol.

Solubility of  $\text{SrCO}_3$  in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

% $\text{NH}_4\text{Cl}$	% $\text{SrCO}_3$
5.35	0.179
10	0.259
20	0.358

(Cantoni and Goguelia, Bull. Soc. 1905, (3) 33. 13.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal. (Eid-mann, C. C. 1899, II. 1014.)

Min. *Strontianite*.

**Strontium hydrogen carbonate.**

$\text{SrCO}_3$  is sol. in 850 pts. of a sat. solution of  $\text{CO}_2$  in  $\text{H}_2\text{O}$ .

**Strontium uranyl carbonate**,  $\text{SrO} \cdot 2\text{UO}_3 \cdot 2\text{CO}_2 + 16\text{H}_2\text{O}$ .

As  $\text{Ba}$  comp. (Blinkoff, Dissert. 1900.)

**Terbium carbonate.**

Ppt. Insol. in excess  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Potratz, C. N. 1905, 92. 3.)

**Thallos carbonate**,  $\text{Tl}_2\text{CO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Tl}_2\text{CO}_3$  (C = according to Crookes; L = according to Lamy) at—

15.5°	18°	62°	100°	100.8°
4.2	5.23	12.85	27.2	22.4
C	L	L	C	L

Insol. in absolute alcohol (L), and ether (C). Insol. in acetone and pyridine. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Thallos carbonate, acid**,  $\text{Tl}_2\text{O} \cdot 2\text{CO}_2$ .

Rather easily sol. in cold  $\text{H}_2\text{O}$ . (Carstan-jen.)

**TIHCO<sub>3</sub>.** (Giorgia, Gass. ch. it. 1894, 24, 474-479.)

**Thallous carbonate platinocyanide,**  $\text{Ti}_2\text{CO}_3 \cdot \text{Ti}_2\text{Pt}(\text{CN})_4$ .

Sl. sol. in hot, insol. in cold  $\text{H}_2\text{O}$ . (Friswell, Chem. Soc. (2) 9, 461.)

**Thorium carbonate, basic,**  $2\text{ThO}_2 \cdot \text{CO}_2 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{CO}_2 + \text{Aq}$ , but sol. in excess of alkali carbonates +  $\text{Aq}$ , if conc.

**Tin (stannous) carbonate,**  $2\text{SnO} \cdot \text{CO}_2$ .

Easily decomp. on air; insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (Deville, A. ch. (3) 35, 448.)

**Uranyl carbonate, basic,**  $5(\text{UO}_2)(\text{OH})_2 \cdot 3(\text{UO}_2)\text{CO}_3 + 6\text{H}_2\text{O}$ .

Ppt. (Seubert and Elten, Z. anorg. 1893, 4, 80.)

**Ytterbium carbonate, basic,**  $\text{Yb}(\text{OH})\text{CO}_3 + \text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32, 146.)

**Ytterbium carbonate,**  $\text{Yb}_2(\text{CO}_3)_3 + 4\text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32, 146.)

**Yttrium carbonate,**  $\text{Y}_2(\text{CO}_3)_3 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; very al. sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4$  salts, and alkali carbonates +  $\text{Aq}$  to some extent. More sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Berlin.) More sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  than cerium, but 5 or 6 times less sol. than glucinum carbonate. (Vauquelin.) Sol. in large excess of  $\text{KHCO}_3 + \text{Aq}$ . (Rose.) Slowly sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Berzelius.)

**Zinc carbonates, basic,**  $8\text{ZnO} \cdot \text{CO}_2 + 2\text{H}_2\text{O}$ ;  $5\text{ZnO} \cdot 2\text{CO}_2 + 3$ , or  $7\text{H}_2\text{O}$ ;  $3\text{ZnO} \cdot \text{CO}_2 + \text{H}_2\text{O}$ ;  $11\text{ZnO} \cdot 4\text{CO}_2 + 14\text{H}_2\text{O}$ ;  $14\text{ZnO} \cdot 5\text{CO}_2 + 9\text{H}_2\text{O}$ ;  $2\text{ZnO} \cdot \text{CO}_2 + \text{H}_2\text{O}$ ;  $8\text{ZnO} \cdot 3\text{CO}_2 + 5\text{H}_2\text{O}$ , etc.

All ppts. formed from Zn salts and carbonates +  $\text{Aq}$ . Sol. in 2000-3000 pts. cold  $\text{H}_2\text{O}$ , separates out on heating and does not redissolve on cooling. (Schindler.) Sol. in 20,895 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Kremers, Pogg. 85, 248.) Sol. in 44,600 pts.  $\text{H}_2\text{O}$  at ord. temp. (Fresema.)

Sol. in 1428 pts. sat.  $\text{H}_2\text{CO}_3 + \text{Aq}$ . (Lassaigne.) Sol. in 189 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat. at 4-6 atmos. (Wagner, Z. anal. 6, 107.) Easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and in acids. Somewhat sol. in alkali bicarbonates and  $\text{NH}_4$  salts +  $\text{Aq}$ . (Fresema.) Sol. in hot (Fuchs), also cold (Brett, 1837)  $\text{NH}_4\text{Cl} + \text{Aq}$ ; less sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

Sol. in all  $\text{NH}_4$  salts +  $\text{Aq}$  excepting  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Terreil, Bull. Soc. (2) 9, 441.)

Insol. in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Sol. in ferric salts +  $\text{Aq}$  with pptn. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . (Fuchs, 1831.)

The carbonates described by Boussingault, Waackenroder, Rose, and probably all salts between  $\text{ZnO}$ ,  $\text{CO}_2$ , and  $5\text{ZnO} \cdot 2\text{CO}_2$ , are mixtures. (Kraut, Z. anorg. 1897, 13, 1-15.)

$3\text{ZnO} \cdot \text{CO}_2 + 2\text{H}_2\text{O}$ . Min. *Zinc bloom*, *Hydrozincite*.

$\text{ZnCO}_3$ ,  $3\text{ZnO} \cdot \text{H}_2\text{O}$ . Min. *Auricalcite*.

**Zinc carbonate,  $\text{ZnCO}_3$ .**

1 l.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolves 0.01 g.; 1 l.  $\text{H}_2\text{O}$  dissolves  $1.64 \times 10^{-4}$  mols., or 0.206 g.  $\text{ZnCO}_3$  at  $25^\circ$ . (Agono and Valla, Att. acc. Linc. 1911, 20, II, 706.)

1 l. 5.85%  $\text{NaCl} + \text{Aq}$  dissolves 0.0586 g.; 1 l. 7.45%  $\text{KCl} + \text{Aq}$  dissolves 0.0477 g.  $\text{ZnCO}_3$ . (Essen, Gm.-K. 4, 1, 680.)

Sol. in acids,  $\text{KOH} + \text{Aq}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$ .

Sol. in  $\text{H}_2\text{CO}_3 + \text{Aq}$ .

Solubility in various salts +  $\text{Aq}$ .

Solvent	g. $\text{ZnCO}_3$ sol. in 1 l. of the solvent
10% $\text{NaNO}_3 + \text{Aq}$	0.058981
sat. $\text{NaNO}_3 + \text{Aq}$	0.149000
5% $\text{NaCl} + \text{Aq}$	0.021730
10% $\text{NaCl} + \text{Aq}$	0.046564
sat. $\text{NaCl} + \text{Aq}$	0.130380
10% $\text{Na}_2\text{SO}_4 + \text{Aq}$	0.009313
sat. $\text{Na}_2\text{SO}_4 + \text{Aq}$	0.015521

(Ehlert, Z. Elektrochem. 1912, 18, 728.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 830.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37, 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

Min. *Calamine*, *Smithsonite*.

*Calamine* is sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  only in the presence of  $\text{NH}_4$  salts. (Brandhorst, Zeit. angew. Ch. 1904, 17, 513.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . (Mikusch, Z. anorg. 1908, 56, 366.)

+  $\text{H}_2\text{O}$ . (Belar, Zeit. Kryst. 1890, 17, 126.)

**Zinc carbonate ammonia,  $\text{ZnCO}_3 \cdot \text{NH}_3$ .**

Slowly decomp. by  $\text{H}_2\text{O}$ , but not on the air, or by boiling with alcohol. (Favre, A. ch. (3) 10, 474.)

**Zinc carbonate hydroxylamine,  $\text{ZnCO}_3 \cdot 2\text{NH}_2\text{OH}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Goldschmidt and Syngros, Z. anorg. 5, 129.)

**Zirconium carbonate,  $3\text{ZrO}_2 \cdot \text{CO}_2 + 6\text{H}_2\text{O}$ .**

Decomp. by hot  $\text{H}_2\text{O}$ , all  $\text{CO}_2$  being given off. (Hermann.)

Sol. in alkali carbonates +  $\text{Aq}$ .

**Percarbonic acid.**

See Percarbonic acid.

**Carbonic anhydride, CO<sub>2</sub>.**

See Carbon dioxide.

**Carbonophosphoric acid.**

Potassium carbonophosphate, (K<sub>2</sub>HPO<sub>4</sub>)<sub>2</sub>, 2CO<sub>2</sub>, 2KHCO<sub>3</sub>.

Known only in solution. (Barillé, C. R. 1903, 137. 566.)

**Carbonyl bromide, COBr<sub>2</sub>.**

Decomp. by H<sub>2</sub>O. (Besson, C. R. 1895, 120. 192.)

**Carbonyl platinumous bromide, CO, PtBr<sub>2</sub>.**

Sol. in H<sub>2</sub>O with almost instant decomp. Sol. in absolute alcohol. (Pullinger, Chem. Soc. 59. 603.)

Quite easily sol. in hot C<sub>6</sub>H<sub>6</sub>, insol. in ligroine, and can be crystallized from CCl<sub>4</sub>. Very easily sol. in HBr+Aq. (Mylius and Förster, B. 24. 2432.)

**Carbonyl bromochloride, COClBr.**

Decomp. by H<sub>2</sub>O. (Besson.)

**Carbonyl chloride, COCl<sub>2</sub>.**

*Phosgene.* Cold H<sub>2</sub>O dissolves 1-2 vols. COCl<sub>2</sub> gas with slow decomposition. Alcohol decomp. immediately. Immediately absorbed by KOH, or NH<sub>4</sub>OH+Aq. Very sol. in glacial HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, benzene, and most liquid hydrocarbons. (Berthelot, Bull Soc. (2) 13. 14.)

Sol. in SCl<sub>2</sub>.

1 vol. AsCl<sub>3</sub> absorbs 10 vols. COCl<sub>2</sub>.

**Dicarbonyl cuprous chloride, Cu<sub>2</sub>Cl<sub>2</sub>, 2CO + 4H<sub>2</sub>O.**

Decomp. by air. (Jones, Am. Ch. J. 1899, 22. 305.)

**Carbonyl platinumous chloride, 2COCl<sub>2</sub>, PtCl<sub>2</sub>.**

Sl. deliquescent. Easily sol. in H<sub>2</sub>O without decomp.; sl. sol. in alcohol. Almost insol. in CCl<sub>4</sub>. (Pullinger, Chem. Soc. 59. 600.)

**Monocarbonyl platinumous chloride, CO, PtCl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O and alcohol; sol. in hot CCl<sub>4</sub>. (Schützenberger, A. ch. (4) 15. 100.)

Sol. in conc. HCl+Aq. (Mylius and Förster.)

**Dicarbonyl platinumous chloride, 2CO, PtCl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O and alcohol. Sol. in CCl<sub>4</sub>. (Schützenberger.)

Decomp. by conc. HCl+Aq into CO and CO, PtCl<sub>2</sub>. (Mylius and Förster.)

**Sesquicarbonyl platinumous chloride, 3CO, 2PtCl<sub>2</sub>.**

Decomp. by H<sub>2</sub>O or alcohol. Much more sol. in CCl<sub>4</sub> than 2CO, PtCl<sub>2</sub>.

**Carbonyl platinumous iodide, CO, PtI<sub>2</sub>.**

Not hygroscopic. Insol. in, but slowly decomp. by, H<sub>2</sub>O. Easily sol. in benzene or ether, also in alcohol, which decomp. on warming; sol. in HI+Aq. (Mylius and Förster.)

**Carbonyl platinumous sulphide, CO, PtS.**

Easily decomp. Insol. in ordinary solvents. (Mylius and Förster.)

**Carbonyl sulphide, COS.**

H<sub>2</sub>O absorbs 1 vol. COS.

Absorption of COS by H<sub>2</sub>O at t°.

t°	Coefficient of absorption
0	1.333
10	0.835
20	0.561
30	0.403

(Winkler, Z. phys. Ch. 1906, 55. 351.)

1 ccm. H<sub>2</sub>O at 13.5° and 756 mm. pres. dissolves 0.8 ccm. COS. (Hempel, Zeit. angew. ch. 1901, 14. 867.)

1 ccm. of a hydrochloric acid solution of Cu<sub>2</sub>Cl<sub>2</sub> absorbs about 0.2 ccm. COS. (Hempel.)

**Carbonyl ferrocyanhydric acid.**

H<sub>3</sub>Fe(CO)(CN)<sub>5</sub>.

Very sol. in H<sub>2</sub>O; decomp. on heating. (Müller, A. ch. (6) 17. 94.)

**Cobalt carbonyl ferrocyanide.**

Sl. sol. in H<sub>2</sub>O; very sol. in dil. HNO<sub>3</sub>+Aq. (M.)

**Cupric carbonyl ferrocyanide,**

Cu<sub>2</sub>[Fe(CO)(CN)<sub>5</sub>]<sub>2</sub>.

Insol. in H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub>, or dil. HNO<sub>3</sub>+Aq. (M.)

**Iron (ferric) carbonyl ferrocyanide,**

Fe<sub>3</sub>FeCO(CN)<sub>5</sub>.

Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>+Aq. Insol. in acetic, lactic, succinic, tartaric, and citric acids+Aq, but easily sol. in the neutral salts of those acids. Insol. in KCl, or KNO<sub>3</sub>+Aq, but sensibly sol. in Na<sub>2</sub>HPO<sub>4</sub>+Aq. Insol. even on warming in very dil. H<sub>2</sub>SO<sub>4</sub>, or H<sub>3</sub>PO<sub>4</sub>+Aq. (Müller.)

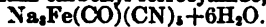
**Potassium carbonyl ferrocyanide,**

K<sub>2</sub>Fe(CO)(CN)<sub>5</sub>·3½H<sub>2</sub>O.

100 pts. H<sub>2</sub>O dissolve 148 pts. at 16°. (Müller, C. R. 104. 992.)

**Silver carbonyl ferrocyanide,**

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq; scarcely attacked by conc.  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq. (Müller.)

**Sodium carbonyl ferrocyanide,**

Sol. in  $\text{H}_2\text{O}$ . (Müller.)

**Uranyl carbonyl ferrocyanide,**

Sl. sol. in  $\text{H}_2\text{O}$ , but more easily if  $\text{H}_2\text{O}$  is acidified with  $\text{HC}_2\text{H}_3\text{O}_2$ .

**Cericotungstic acid.**

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith. (Smith, J. Am. Chem. Soc. 1904, 26. 1481.)

**Cerium, Ce.**

Decomp. pure  $\text{H}_2\text{O}$  very slowly at ordinary temp. Not attacked by cold conc.  $\text{H}_2\text{SO}_4$  or red fuming  $\text{HNO}_3$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ +Aq,  $\text{HNO}_3$ +Aq, and conc. or dil.  $\text{HCl}$ +Aq. (Hillebrand and Norton, Pogg. 165. 633.)

**Cerous bromide,  $\text{CeBr}_3$ .**

*Anhydrous.* As the chloride. (Robinson, Proc. Roy. Soc. 37. 150.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+ $z\text{H}_2\text{O}$ . Very deliquescent. (Jolin.)

**Cerium gold bromide,  $\text{CeBr}_3$ ,  $\text{AuBr}_3 + 8\text{H}_2\text{O}$ .**

See Bromaurate, cerium.

**Cerium carbide,  $\text{CeC}_2$ .**

Decomp. by fused alkali nitrates, chlorates, hydroxides and carbonates; and by conc.  $\text{H}_2\text{SO}_4$  on heating. Insol. in conc.  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Moissan, C. R. 1896, 122. 359.)

$\text{CeC}_2$ . Not attacked by hot conc. acids. (Delafontaine, J. B. 1865. 176.)

**Cerous chloride,  $\text{CeCl}_3$ .**

*Anhydrous.* Deliquescent. Sol. in  $\text{H}_2\text{O}$  with hissing and evolution of heat; sol. in alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+ $7\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH}$ +Aq. (Denia, Z. anorg. 1894, 7. 260.)

+ $7\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. (Berzelius.)

Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol. in 1 pt.  $\text{H}_2\text{O}$  at ord. temp. and 3-4 pts. alcohol. (Dumas.)

**Ceric chloride.**

Known only in solution, which decomposes by slight heat. (Berzelius.)

**Cerous mercuric chloride.**

Not deliquescent. (v. Bonsdorff.)

$\text{CeCl}_3$ ,  $4\text{Hg}_2\text{Cl}_2 + 10\text{H}_2\text{O}$ . Permanent; easily sol. in  $\text{H}_2\text{O}$ . (Jolin, Bull. Soc. (2) 21. 533.)

**Cerium stannic chloride.**

See Chlorostannate, cerium.

**Cerous chloride zinc iodide.**

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Holmann, J. pr. 84. 76.)

**Cerous fluoride,  $\text{CeF}_3$ .**

Insol. ppt.

+ $\frac{1}{2}\text{H}_2\text{O}$ .

**Ceric fluoride,  $\text{CeF}_4$ .**

Insoluble precipitate. (Berzelius.)

+ $\text{H}_2\text{O}$  Insol. in  $\text{H}_2\text{O}$ . (Brauner, B. 14. 1944.)

**Ceric cobaltous fluoride,  $2\text{CeF}_4$ ,  $\text{CoF}_2 + 7\text{H}_2\text{O}$ .**

Ppt. Easily decomp. by  $\text{H}_2\text{O}$ . (Rimbach, A. 1909, 368. 107.)

**Ceric cupric fluoride,  $2\text{CeF}_4$ ,  $\text{CuF}_2 + 7\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, l. c.)

**Ceric nickel fluoride,  $2\text{CeF}_4$ ,  $\text{NiF}_2 + 7\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, l. c.)

**Ceric potassium fluoride,  $2\text{CeF}_4$ ,  $3\text{KF} + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Brauner, B. 14. 1944; 15. 109.)

Could not be obtained pure. (Rimbach, l. c.)

**Ceric zinc fluoride,  $2\text{CeF}_4$ ,  $\text{ZnF}_2 + 7\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Rimbach, l. c.)

**Ceroceric fluoride,  $2\text{CeF}_3$ ,  $\text{CeF}_4$ .**

Min. *Fluocerite*.

**Cerium hydride,  $\text{CeH}_3$ .**

Decomp. by acids. (Winkler, B. 24. 873.)

$\text{CeH}_3$ . Decomp. in moist air; decomp. by hot or cold  $\text{H}_2\text{O}$ ; sol. in acids with evolution of  $\text{H}_2$ . Decomp. by alkalis. (Muthmann, A. 1902, 325. 266.)

**Cerous hydroxide,  $\text{Ce}_2\text{O}_3$ ,  $z\text{H}_2\text{O}$ .**

Easily sol. in acids. Insol. in excess of alkali hydroxides+Aq. Sol. in  $(\text{NH}_4)_2\text{CO}_3$ +Aq.

100 ccm. of a solution in glycerine+Aq containing about 60% by vol. of glycerine contain 7.9 g.  $\text{Ce}_2\text{O}_3$ . (Müller, Z. anorg. 1905, 43. 322.)

Exists in two modifications: one insol. in



cold  $\text{HCl} + \text{Aq.}$ ; the other sol. in cold  $\text{HCl} + \text{Aq.}$  (Brauner, C. N. 1895, 71. 283.)

**Ceric hydroxide,  $2\text{CeO}_2, 3\text{H}_2\text{O}$ .**

Sol. in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ ; also in  $\text{HCl} + \text{Aq.}$  forming cerous chloride and free chlorine. Insol. in hydrofluoric, acetic, or formic acids +  $\text{Aq.}$  Somewhat sol. in dil.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq.}$  (Ordway, Am. J. Sci. (2) 26. 205.) Insol. in  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq.}$  Sl. sol. in alkali carbonates +  $\text{Aq.}$  (Dumas.)

Sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Ordway.)

100 ccm. of a solution in glycerine +  $\text{Aq.}$  containing about 60% by vol. of glycerine contain 0.08 g.  $\text{CeO}_2$ . (Müller, Z. anorg. 1905, 43. 232.)

**Cerous iodide,  $\text{CeI}_3$ .**

Sol. in acetone. (Eidmann, C. C. 1890, II. 1014; Naumann, B. 1904, 37. 4328.)

+  $9\text{H}_2\text{O}$ . Very deliquescent and sol. in  $\text{H}_2\text{O}$ . (Lange, J. pr. 82. 134.)

Sol. in alcohol.

**Cerium nitride,  $\text{CeN}$ .**

Decomp. by  $\text{H}_2\text{O}$  and alkali. Sol. in mineral acids with formation of cerous and ammonium salts. (Muthmann, A. 1902, 325. 272.)

**Cerous oxide,  $\text{Ce}_2\text{O}_3$ .**

When ignited, insol. in  $\text{HCl} + \text{Aq.}$ ; when long digested with  $\text{H}_2\text{SO}_4$ , is sol. in  $\text{HCl} + \text{Aq.}$  with addition of alcohol.

**Ceric oxide,  $\text{CeO}_2$ .**

When ignited, is only dissolved in traces, even on heating, by  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  Sol. in conc.  $\text{H}_2\text{SO}_4$  when warmed. Sol. in the cold in a solution of  $\text{KI}$  in  $\text{HCl} + \text{Aq.}$  (Bunsen), in a mixture of  $\text{HCl}$  and  $\text{FeCl}_3 + \text{Aq.}$  or any reducing substance.

**Cerium peroxide,  $\text{Ce}_2\text{O}_4$ .**

Insol. in boiling conc. acids. Sol. in  $\text{H}_2\text{SO}_4$  by long digestion. (Popp, A. 131. 361.)

Probably does not exist. (Rammelsberg, Pogg. 106. 40.)

$\text{Ce}_2\text{O}_4$ . (Hermann, J. pr. 30. 184.)

Probably does not exist. (Rammelsberg.)

$\text{CeO}_2 + z\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq.}$  (Popp, A. 131. 361); (Lecoq de Boisbaudran, C. R. 100. 605.)

$\text{CeO}_2 + \text{H}_2\text{O}_2$ , according to Cleve (Bull. Soc. (2) 43. 57.)

**Cerium oxycarbide,  $\text{CeC}_2, 2\text{CeO}_2$ .**

Stable in the air. Slowly attacked by cold  $\text{H}_2\text{O}$ . With hot  $\text{H}_2\text{O}$  and with acids, it gives unsat. hydrocarbons. (Sterba, C. R. 1902, 134. 1058.)

**Cerium oxychloride,  $\text{CeOCl}$ .**

Slightly attacked by hot conc.  $\text{HCl} + \text{Aq.}$  Slowly sol. in conc.  $\text{HNO}_3 + \text{Aq.}$  (Wöhler.)

Easily sol. in dil. acids. (Didier, C. R. 101. 882.)

**Cerium oxychloride tungsten trioxide,  $\text{CeOCl}, \text{WO}_3$ .**

(Didier, C. R. 102. 823.)

**Cerium selenide.**

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in acids. (Berselius.)

**Cerium silicide,  $\text{CeSi}$ .**

Insol. in  $\text{H}_2\text{O}$ , by which it is acted upon only very slowly.

Sol. in  $\text{HCl}$  and  $\text{HF} + \text{Aq.}$  with evolution of  $\text{H}_2$ .

Not attacked by alkalis +  $\text{Aq.}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$

Insol. in organic solvents. (Sterba, C. R. 1902, 135. 170.)

**Cerium silicide,  $\text{Ce}_2\text{Si}_3$ .**

Insol. in acids. (Ullik, W. A. B. 52, 2. 115.)

**Cerium disulphide,  $\text{CeS}_2$ .**

Not decomp. by cold  $\text{H}_2\text{O}$ .

Slowly sol. in cold dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid. Rapidly sol. in warm dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid with decomp. (Bilts, B. 1906, 41. 3342.)

**Cerium sesquisulphide,  $\text{Ce}_2\text{S}_3$ .**

Insol. in, and not decomp. by,  $\text{H}_2\text{O}$ , but easily decomp. by the weakest acids. (Mossander); (Didier, C. R. 100. 1461.)

**Monochloramine,  $\text{NH}_2\text{Cl}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Raschig, Ch. Z. 1907, 31. 926.)

**Chlorotetramine comps.**

See Chlorotetramine comps.

**Metachlorantimonie acid,  $\text{HSbCl}_4 + 4\frac{1}{2}\text{H}_2\text{O}$ .**

Hydroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp.; sol. in alcohol, acetone, and acetic acid. (Weinland, Z. anorg. 1905, 44. 43.)

**Metachlorantimonie acid ammonia,  $\text{HSbCl}_4, 2\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Weinland and Schmid, Z. anorg. 1905, 44. 59.)

**Aluminum metachlorantimonate,  $\text{Al}(\text{SbCl}_4)_3 + 15\text{H}_2\text{O}$ .**

Hydroscopic.

Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland, B. 1903, 36. 254.)

- Ammonium metachlorantimonate**,  $\text{NH}_4\text{SbCl}_6 + \text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in  $\text{H}_2\text{O}$ . Solution decomp. slowly when cold, rapidly on warming.  
Sol. in dil.  $\text{HCl}$ . (Weinland, B. 1903, 36. 251.)
- Cadmium metachlorantimonate ammonia**,  $\text{Cd}(\text{SbCl}_4)_2 \cdot 7\text{NH}_3$ .  
Ppt. (Weinland and Schmid, Z. anorg. 1905, 44. 56.)
- Calcium metachlorantimonate**,  $\text{Ca}(\text{SbCl}_4)_2 + 9\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland, B. 1903, 36. 253.)
- Chromium metachlorantimonate**,  $\text{Cr}(\text{SbCl}_4)_3 + 13\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland.)
- Chromium orthochlorantimonate**,  $\text{CrSbCl}_5 + 10\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland.)
- Cupric metachlorantimonate ammonia**,  $\text{Cu}(\text{SbCl}_4)_2 \cdot 5\text{NH}_3$ .  
(Weinland and Schmid, Z. anorg. 1905, 44. 55.)
- Glucinum metachlorantimonate**,  $\text{Gl}(\text{SbCl}_4)_2 + 10\text{H}_2\text{O}$ .  
Very hydroscopic.  
Sol. in dil.  $\text{HCl}$ . (Weinland, B. 1903, 36. 252.)
- Iron (ferric) orthochlorantimonate**,  $\text{FeSbCl}_5 + 8\text{H}_2\text{O}$ .  
Hydroscopic.  
Can easily be cryst. from dil.  $\text{HCl} + \text{Aq.}$  (Weinland.)
- Lithium metachlorantimonate**,  $\text{LiSbCl}_4 + 4\text{H}_2\text{O}$ .  
Very hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland, l. c.)
- Magnesium pyrochlorantimonate**,  $\text{MgSbCl}_5 + 9\text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland.)
- Nickel metachlorantimonate ammonia**,  $\text{Ni}(\text{SbCl}_4)_2 \cdot 6\text{NH}_3$ .  
Sol. in  $\text{H}_2\text{O}$ . (Weinland and Schmid, Z. anorg. 1905, 44. 57.)
- Potassium metachlorantimonate**,  $\text{KSbCl}_4 + \text{H}_2\text{O}$ .  
Hydroscopic.  
Sol. in  $\text{H}_2\text{O}$ . Solution decomp. slowly when cold, rapidly when warmed.
- Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland, B. 1903, 36. 250.)
- Rubidium metachlorantimonate**,  $\text{RbSbCl}_4$ .  
Hydroscopic.  
Sol. in dil.  $\text{HCl} + \text{Aq.}$  (Weinland.)
- Silver metachlorantimonate ammonia**,  $\text{AgSbCl}_4 \cdot 2\text{NH}_3$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Weinland and Schmid.)
- Zinc metachlorantimonate ammonia**,  $\text{Zn}(\text{SbCl}_4)_2 \cdot 4\text{NH}_3$ .  
(Weinland and Schmid.)
- Chlorarsenious acid**.  
See Arsenyl chloride.
- Chlorauric acid**,  $\text{HAuCl}_4 + 4\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.  
Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)  
Difficultly sol. in  $\text{PCl}_5$ . (Walden.)  
Cryst. with  $3\text{H}_2\text{O}$  as stated by Weber and Schottlander and not with  $4\text{H}_2\text{O}$  as stated by Thomsen. (Schmidt, C. C. 1906, II. 855.)
- Chloraurates**.  
All chloraurates are easily sol. in  $\text{H}_2\text{O}$  and in alcohol. (v. Bonsdorff, 1829.)
- Ammonium chloraurate**,  $\text{NH}_4\text{AuCl}_4 + \text{H}_2\text{O}$ .  
Very easily sol. in  $\text{H}_2\text{O}$ .  
 $+ 2\text{H}_2\text{O}$ . Very easily sol. in  $\text{H}_2\text{O}$ .
- Barium chloraurate**,  $\text{Ba}(\text{AuCl}_4)_2 + x\text{H}_2\text{O}$ .  
Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff, Pogg. 17. 261.)
- Cadmium chloraurate**.  
Not deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)
- Cæsium chloraurate**,  $\text{CsAuCl}_4$ .  
100 pts. aqueous sat. solution contain at:  

10°	20°	30°	40°	50°
0.5	0.8	1.7	3.2	5.4

 pts. anhydrous salt,  

60°	70°	80°	90°	100°
8.2	12.0	16.3	21.7	27.5

 pts. anhydrous salt.  
(Rosenblatt, B. 19. 2538.)  
 $+ \frac{1}{2}\text{H}_2\text{O}$ . (Wells and Wheeler, Am. J. (3) 44. 157.)
- Calcium chloraurate**,  $\text{Ca}(\text{AuCl}_4)_2 + 6\text{H}_2\text{O}$ .  
Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)
- Cerium chloraurate**,  $\text{CeCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$ .  
Extremely deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Holzmann, C. C. 1863. 206.)  
 $+ 13\text{H}_2\text{O}$ . (Jolin, Bull. Soc. (?) 21. 534.)

**Cobalt chloraurate**,  $\text{Co}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Topsoë.)

**Didymium chloraurate**,  $\text{DiCl}_2, \text{AuCl}_3 + 10\text{H}_2\text{O}$ .

Very deliquescent. (Cleve, Bull. Soc. (2) 43. 361.)

$2\text{DiCl}_2, 3\text{AuCl}_3 + 20\text{H}_2\text{C}$ . (Cleve.)

**Gadolinium chloraurate**,  $\text{GdCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{C}$ . (Benedicks, Z. anorg. 1900, 22. 404.)

**Lanthanum chloraurate**,  $\text{LaCl}_3, \text{AuCl}_3 + 5\text{H}_2\text{O}$ .

Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$ . (Cleve, B. 8. 128.)

**Lithium chloraurate**,  $\text{LiAuCl}_4$ .

100 pts. aqueous solution contain at:

10°	20°	30°	40°
53.1	57.7	62.5	67.3 pts. anhydrous salt,

50°	60°	70°	80°
72.0	76.4	81.0	85.7 pts. anhydrous salt.

(Rosenblatt.)

+  $2\text{H}_2\text{O}$ . (Antony and Lucchesi, Gazz. ch. it. 1890, 20. 601.)

+  $4\text{H}_2\text{O}$ . Not stable.

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Fasbender, C. C. 1894, I. 409.)

**Magnesium chloraurate**,  $\text{Mg}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .

Somewhat deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Topsoë.)

+  $12\text{H}_2\text{O}$ .

**Manganese chloraurate**,  $\text{Mn}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Topsoë.)

+  $12\text{H}_2\text{O}$ .

**Nickel chloraurate**,  $\text{Ni}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Topsoë.)

**Potassium chloraurate**,  $\text{KAuCl}_4$ .

Anhydrous. Very stable. (Lainer, W. A. B. 99, 2b. 247.)

100 pts. solution in  $\text{H}_2\text{O}$  contain at:

10°	20°	30°
27.7	38.2	48.7 pts. anhydrous salt,

40°	50°	60°
59.2	70.0	80.2 pts. anhydrous salt.

(Rosenblatt, B. 19. 2538.)

Sol. in  $\text{H}_2\text{O}$  and alcohol; insol. in ether. (Fasbender, C. C. 1894, I. 409.)

1 pt. is sol. in 4 pts. 98% alcohol. (Fasbender, C. C. 1894, II. 609.)

+  $2\text{H}_2\text{O}$ . Efflorescent.

+  $\frac{1}{2}\text{H}_2\text{O}$ .

**Praseodymium chloraurate**,  $\text{PrCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sol. in conc.  $\text{HCl}$ . (von Schule, Z. anorg. 1898, 18. 354.)

**Rubidium chloraurate**,  $\text{RbAuCl}_4$ .

100 pts. sat.  $\text{RbAuCl}_4 + \text{Aq}$  contain at:

10°	20°	30°	40°	50°
4.6	9.0	13.4	17.7	22.2 pts. anhydrous salt,

60°	70°	80°	90°	100°
26.6	31.0	35.3	39.7	44.2 pts. anhydrous salt.

(Rosenblatt.)

1 pt. sol. in  $\frac{1}{2}$  pts. 98% alcohol. Insol. in ether. (Fasbender, C. C. 1894, II. 609.)

**Samarium chloraurate**,  $\text{SmCl}_3, \text{AuCl}_3 + 10\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 185.)

**Scandium chloraurate**,  $3\text{ScCl}_3, 2\text{AuCl}_3 + 21\text{H}_2\text{O}$ .

Very deliquescent. (Crookes, Phil. Trans. 1910, 210. A, 365.)

**Silver chloraurate**,  $\text{AgAuCl}_4$ .

Decomp. in the air.

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HCl}$  and  $\text{NH}_3$ . (Herrmann, B. 1894, 27. 597.)

**Sodium chloraurate**,  $\text{NaAuCl}_4 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol.

100 pts. aqueous solution contain at:

10°	20°	30°
58.2	60.2	64.0 pts. anhydrous salt,

40°	50°	60°
69.4	77.5	90.0 pts. anhydrous salt.

(Rosenblatt.)

Easily sol. in  $\text{NaCl} + \text{Aq}$ .

Easily sol. in  $\text{H}_2\text{O}$ , alcohol and ether. (Fasbender, C. C. 1894, I. 409.)

**Strontium chloraurate**.

Sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

**Thallium chloraurate**.

(Carstanjen.)

**Ytterbium chloraurate**,  $\text{YbCl}_3, \text{AuCl}_3 + 9\text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 138.)

**Yttrium chloraurate**,  $\text{YtCl}_3, 2\text{AuCl}_3 + 16\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Zinc chloraurate**,  $\text{Zn}(\text{AuCl}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

+  $12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

**Chlorauricyanhydric acid.**

**Barium chlorauricyanide**,  $\text{Ba}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  or alcohol. (Lindbom, Lund Univ. Arsk. 12. No. 6.)

**Potassium chlorauricyanide**,  $\text{KAu}(\text{CN})_2\text{Cl}_2 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  or alcohol.

**Strontium chlorauricyanide**,  $\text{Sr}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Zinc chlorauricyanide**,  $\text{Zn}[\text{Au}(\text{CN})_2\text{Cl}_2]_2 + 7\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ .

**Chlorhydric acid, HCl.**

**Liquid.** Miscible with liquid  $\text{CO}_2$ , and  $\text{H}_2\text{S}$ .  
**Gas.** Absorbed by  $\text{H}_2\text{O}$  with production of much heat.

$\text{H}_2\text{O}$  absorbs 400–500 vols. at ord. temp. and pressure or a little less than 1 pt. by weight. (Dalton.)

1 vol.  $\text{H}_2\text{O}$  absorbs 480 vols. at  $0^\circ$ ; sp. gr. of sat. solution is 1.2109. (Davy.)

1 vol.  $\text{H}_2\text{O}$  absorbs 417 822 vols. at  $20^\circ$ , the vol. increasing to 1.4138 vols.; 1 vol. of  $\text{HCl} + \text{Aq}$  then contains 311 vols.  $\text{HCl}$ , has sp. gr. 1.1958, and contains 40.39%  $\text{HCl}$  by weight. (Thomson, 1831.)

1 vol.  $\text{H}_2\text{O}$  absorbs 464 vols. and sat. solution has 1.21 sp. gr. and contains 42.4%  $\text{HCl}$  by weight. (Wittstein.)

$\text{H}_2\text{O}$  sat. at  $0^\circ$  contains 480 times its vol. of  $\text{HCl}$  and sp. gr. = 1.2109; sat. at ord. temp. contains 38.3% of its weight in  $\text{HCl}$ , and sp. gr. = 1.192. (Berselius.)

1 vol.  $\text{H}_2\text{O}$  absorbs V vols.  $\text{HCl}$  at  $t^\circ$  and 760 mm. pressure, and the liquid formed has the given sp. gr. and contains the given per cent  $\text{HCl}$ .

$t^\circ$	V	Sp. gr.	% $\text{HCl}$
0	525.2	1.2257	45.148
4	494.7	1.2265	44.361
8	480.3	1.2185	43.828
12	471.3	1.2148	43.277
14	462.4	1.2074	42.829
18	451.2	1.2064	42.344
18.25	450.7	1.2056	42.283
23	435.0	1.2014	41.536

(Deicke, Pogg. 119. 156.)

At 760 mm. pressure 1 g.  $\text{H}_2\text{O}$  absorbs g.  $\text{HCl}$  at  $t^\circ$ .

$t^\circ$	g. $\text{HCl}$	$t^\circ$	g. $\text{HCl}$	$t^\circ$	g. $\text{HCl}$
0	0.825	22	0.710	44	0.618
2	0.814	24	0.700	46	0.611
4	0.804	26	0.691	48	0.603
6	0.793	28	0.682	50	0.596
8	0.783	30	0.673	52	0.589
10	0.772	32	0.665	54	0.582
12	0.762	34	0.657	56	0.575
14	0.752	36	0.649	58	0.568
16	0.742	38	0.641	60	0.561
18	0.731	40	0.633	..	..
20	0.721	42	0.626	..	..

(Roscoe and Dittmar.)

Conc.  $\text{HCl} + \text{Aq}$  loses  $\text{HCl}$ , and dil.  $\text{HCl} + \text{Aq}$  loses  $\text{H}_2\text{O}$  on warming, until an acid of constant composition is formed, containing 20.18%  $\text{HCl}$ , with a sp. gr. of 1.101 at  $15^\circ$ , which can be distilled unchanged at  $110^\circ$ . (Bineau, A. ch. (3) 7. 257.)

The above is true if barometer is at 760 mm., but the composition changes with the pressure as follows—

Mm. Hg	% $\text{HCl}$	Mm. Hg	% $\text{HCl}$	Mm. Hg	% $\text{HCl}$
50	23.2	800	20.2	1700	18.8
100	22.9	900	19.9	1800	18.7
200	22.3	1000	19.7	1900	18.6
300	21.8	1100	19.5	2000	18.5
400	21.4	1200	19.4	2100	18.4
500	21.1	1300	19.3	2200	18.3
600	20.7	1400	19.1	2300	18.2
700	20.4	1500	19.0	2400	18.1
760	20.24	1600	18.9	2500	18.0

(Roscoe and Dittmar.)

Conc.  $\text{HCl} + \text{Aq}$  gradually gives off  $\text{HCl}$  on the air until it has a sp. gr. 1.128 at  $15^\circ$ , and contains 25.2%  $\text{HCl}$ . (Bineau, l. c.)

According to Roscoe and Dittmar, this depends on the temperature. If a current of air is passed through  $\text{HCl} + \text{Aq}$ , acid or water is given off according as the acid is strong or weak, until an acid of constant composition for a given temperature is formed, as follows—

Temp.	% $\text{HCl}$	Temp.	% $\text{HCl}$	Temp.	% $\text{HCl}$
$0^\circ$	25.0	$35^\circ$	23.9	$70^\circ$	22.6
5	24.9	40	23.8	75	22.3
10	24.7	45	23.6	80	22.0
15	24.6	50	23.4	85	21.7
20	24.4	55	23.2	90	21.4
25	24.3	60	23.0	95	21.1
30	24.1	65	22.8	100	20.7

From the above it is seen that the acid which distills unchanged at a given pressure, that is, boils at a certain constant temperature, is identical with the acid which undergoes no change in composition by a current of dry air at the same temperature, and under the ordinary pressure, thus—

Mm. Hg	B.-pt.	% $\text{HCl}$	Temp. of air current	% $\text{HCl}$
100	61–62°	22.8	62°	22.9
200	76–77°	22.1	77	22.2
300	84–85	21.7	85	21.7
380	91	21.3	91	21.4
490	97	20.9	98	21.1
620	103	20.6	..	..

(Roscoe and Dittmar.)

Solubility of HCl in H<sub>2</sub>O at 0° under different degrees of pressure. P=partial pressure in mm. Hg, i. e., total pressure minus the tension of aqueous vapour at the given temp.; G=grammes of HCl dissolved in 1 g. H<sub>2</sub>O at the pressure P and 0° temp.

P	G	P	G
60	0.613	350	0.751
70	0.628	400	0.763
80	0.640	450	0.772
90	0.649	500	0.782
100	0.657	550	0.791
110	0.664	600	0.800
120	0.670	650	0.808
130	0.676	700	0.817
140	0.681	750	0.824
150	0.686	800	0.831
175	0.697	900	0.844
200	0.707	1000	0.856
225	0.716	1100	0.869
250	0.724	1200	0.882
275	0.732	1300	0.895
300	0.738	...	..

(Roscoe and Dittmar, A. 112. 334.)

1 vol. H<sub>2</sub>O dissolves 560 vols. HCl at -12°  
 " " " 500 " " 0°  
 " " " 440 " " +20°

(Berthelot, C. R. 76. 779.)

1 vol. H<sub>2</sub>O absorbs 480 vols. HCl at 15° to form a solution containing 42.85% HCl with a sp. gr. of 1.215. (Hager.)

Solubility of HCl at low temperatures, and 760 mm. pressure.

t°	Pts. HCl in 1 pt. H <sub>2</sub> O	t°	Pts. HCl in 1 pt. H <sub>2</sub> O
0	0.842	-18	0.957
-5	0.864	-19	0.965
-10	0.898	-20	0.974
-15	0.933	-21	0.983
-17	0.949	-24	1.012

(Roozeboom, R. t. c. 1884, 3. 79.)

Solubility in H<sub>2</sub>O at t°.

t°	% HCl
50	61.65
45	61.76
40	62.27
35	62.90
30	63.21
20	64.19
15	64.70
10	65.18
5	65.48
0	65.85
-5	66.44
-10	66.71
-50	67.29
-20	67.65

(Rupert, J. Am. Chem. Soc. 1909, 31. 860.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.203	40.66	1.1285	27.21	1.0960	20.44
1.179	37.00	1.1197	25.52	1.0902	19.47
1.162	33.95	1.1127	24.03	1.0860	18.59
1.149	31.35	1.1060	22.70	1.0820	17.79
1.139	29.13	1.1008	21.51	1.0780	17.05

(Thomson, in his System, 2. 189.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	Sp. gr.	% HCl
1.21	42.43	1.10	20.20
1.20	40.80	1.09	18.18
1.19	38.38	1.08	16.16
1.18	36.36	1.07	14.14
1.17	34.34	1.06	12.12
1.16	32.32	1.05	10.10
1.15	30.30	1.04	8.08
1.14	28.28	1.03	6.06
1.13	26.26	1.02	4.04
1.12	24.24	1.01	2.02
1.11	20.30	....	....

(Edm. Davy.)

Sp. gr. of HCl+Aq.

Sp. gr.	% HCl	B.-pt.	Sp. gr.	% HCl	B.-pt.
1.199	34.01	49°	1.094	16.08	111°
1.181	31.09	65	1.075	13.16	109
1.166	28.29	76	1.064	11.16	107
1.154	26.57	87	1.047	8.62	105
1.144	24.84	100	1.035	6.92	104
1.136	23.25	103	1.018	3.52	102
1.127	21.06	105	1.009	1.86	101
1.121	20.74	109	.....	...	...

(Kirwan and Dalton.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.
2.22	1.0103	29.72	1.1504
3.80	1.0189	31.50	1.1588
6.26	1.0310	34.24	1.1730
11.02	1.0557	36.63	1.1844
15.20	1.0751	38.67	1.1938
18.67	1.0942	40.51	1.2021
20.91	1.1048	41.72	1.2074
23.72	1.1196	43.09	1.2124
25.96	1.1308	....	...

(Kolb, C. R. 74. 337.)

Sp. gr. of HCl+Aq at 15°.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.2000	40.777	1.1620	32.621	1.1206	24.466
1.1982	40.389	1.1599	32.213	1.1185	24.058
1.1964	39.961	1.1578	31.805	1.1164	23.650
1.1946	39.554	1.1557	31.398	1.1143	23.242
1.1928	39.146	1.1536	30.990	1.1123	22.834
1.1910	38.738	1.1515	30.582	1.1102	22.426
1.1893	38.330	1.1494	30.174	1.1082	22.019
1.1875	37.923	1.1473	29.767	1.1061	21.611
1.1859	37.516	1.1452	29.359	1.1041	21.203
1.1846	37.108	1.1431	28.951	1.1020	20.796
1.1822	36.700	1.1410	28.544	1.1000	20.388
1.1802	36.292	1.1399	28.136	1.0980	19.980
1.1782	35.884	1.1369	27.728	1.0960	19.572
1.1762	35.476	1.1349	27.321	1.0939	19.165
1.1741	35.068	1.1328	26.913	1.0919	18.757
1.1721	34.660	1.1308	26.505	1.0899	18.349
1.1701	34.252	1.1287	26.098	1.0879	17.941
1.1681	33.845	1.1267	25.690	1.0859	17.534
1.1661	33.437	1.1247	25.282	1.0838	17.126
1.1641	33.029	1.1226	24.874	1.0818	16.718

Sp. gr. of HCl+Aq at 15°—Continued.

Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl
1.0798	16.310	1.0517	10.602	1.0259	5.301
1.0778	15.902	1.0497	10.194	1.0239	4.893
1.0758	15.494	1.0477	9.786	1.0220	4.486
1.0738	15.087	1.0457	9.379	1.0200	4.078
1.0718	14.679	1.0437	8.971	1.0180	3.670
1.0697	14.271	1.0417	8.563	1.0160	3.262
1.0677	13.863	1.0397	8.155	1.0140	2.854
1.0657	13.456	1.0377	7.747	1.0120	2.447
1.0637	13.049	1.0357	7.340	1.0100	2.039
1.0617	12.641	1.0337	6.932	1.0080	1.631
1.0597	12.233	1.0318	6.524	1.0060	1.224
1.0577	11.825	1.0298	6.116	1.0040	0.816
1.0557	11.418	1.0279	5.709	1.0020	0.408
1.0537	11.010	...	...	...	...

(Ure, Handwörterbuch.)

Sp. gr. of HCl+Aq. U=sp. gr. at 15.55° according to Ure; K=sp. gr. at 15° according to Kremers.

% HCl	U	K	% HCl	U	K
1	1.005	1.005	22	1.109	1.111
2	1.010	1.010	23	1.114	1.116
3	1.015	1.015	24	1.119	1.121
4	1.020	1.020	25	1.124	1.126
5	1.025	1.025	26	1.128	1.131
6	1.030	1.030	27	1.133	1.136
7	1.034	1.034	28	1.138	1.141
8	1.039	1.039	29	1.143	1.146
9	1.044	1.044	30	1.147	1.151
10	1.048	1.048	31	1.153	1.157
11	1.053	1.053	32	1.157	1.163
12	1.059	1.059	33	1.163	1.169
13	1.064	1.065	34	1.169	1.179
14	1.069	1.070	35	1.174	...
15	1.074	1.075	36	1.179	...
16	1.079	1.080	37	1.183	...
17	1.084	1.085	38	1.188	...
18	1.089	1.090	39	1.193	...
19	1.094	1.095	40	1.197	...
20	1.098	1.100	41	1.203	...
21	1.104	1.105	...	...	...

(Calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of HCl+Aq at 15° (H<sub>2</sub>O at 0°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
0	0.9992	15	1.07539	30	1.15079
1	1.00503	16	1.08042	31	1.15581
2	1.01005	17	1.08545	32	1.16084
3	1.01508	18	1.09047	33	1.16587
4	1.02010	19	1.09550	34	1.17089
5	1.02513	20	1.10052	35	1.17592
6	1.03016	21	1.10555	36	1.18095
7	1.03518	22	1.11058	37	1.18597
8	1.04021	23	1.11560	38	1.191
9	1.04524	24	1.12063	39	1.196
10	1.05026	25	1.12566	40	1.200
11	1.05529	26	1.13068	41	1.204
12	1.06031	27	1.13571	42	1.208
13	1.06534	28	1.14074	43	1.212
14	1.07037	29	1.14516	...	...

(Kolb, recalculated by Gerlach, Z. anal. 27. 316.)

Sp. gr. of HCl+Aq at 15°.

% HCl	Sp. gr.	% HCl	Sp. gr.	% HCl	Sp. gr.
5	1.0244	20	1.0982	35	1.1739
10	1.0488	25	1.1234	40	1.1969
15	1.0733	30	1.1488	41	1.2013

(Hager, Adjumenta varia, Leipzig, 1876.)

Sp. gr. of HCl+Aq at 15° (H<sub>2</sub>O at 15°=1).

% HCl	Sp. gr.	% HCl	Sp. gr.
44.345	1.21479	34.464	1.17138
43.136	1.21076	25.260	1.12479
41.901	1.20430	19.688	1.09675
41.212	1.20204	14.788	1.07255
39.831	1.19703	6.382	1.03150
37.596	1.18687	....	...

(Pickering, B. 26. 277.)

Most accurate table.

Sp. gr. of HCl+Aq at 15° (H<sub>2</sub>O at 4°=1).

Sp. gr.	% HCl	Kg. HCl in 1 l.	Sp. gr.	% HCl	Kg. HCl in 1 l.
1.000	0.16	0.016	1.105	20.97	0.232
1.005	1.15	0.012	1.110	21.92	0.243
1.010	2.14	0.022	1.115	22.86	0.255
1.015	3.12	0.032	1.120	23.82	0.267
1.020	4.13	0.042	1.125	24.78	0.278
1.025	5.15	0.053	1.130	25.75	0.291
1.030	6.15	0.064	1.135	26.70	0.303
1.035	7.15	0.074	1.140	27.66	0.315
1.040	8.16	0.085	1.145	28.61	0.322
1.045	9.16	0.096	1.150	29.57	0.340
1.050	10.17	0.107	1.155	30.55	0.353
1.055	11.18	0.118	1.160	31.52	0.366
1.060	12.19	0.129	1.165	32.49	0.379
1.065	13.19	0.141	1.170	33.46	0.392
1.070	14.17	0.152	1.175	34.42	0.404
1.075	15.16	0.163	1.180	35.39	0.418
1.080	16.15	0.174	1.185	36.31	0.430
1.085	17.13	0.186	1.190	37.23	0.443
1.090	18.11	0.197	1.195	38.16	0.456
1.095	19.06	0.209	1.200	39.11	0.469
1.100	20.01	0.220	...	...	...

(Lunge and Marchlewski, Z. angew. Ch. 1891. 133.)

Sp. gr. of HCl+Aq at room temp.

% HCl	Sp. gr.
8.14	1.0370
16.125	1.0843
23.045	1.1138

(Wagner, W. Ann. 1883, 18. 264.)

Relation of sp. gr. of HCl+Aq at  $t^\circ$  to sp. gr. at  $19.5^\circ = 1.0$ .

$t^\circ$	8.9 % HCl sp. gr. = 1.0401	16.6 % HCl sp. gr. = 1.0704	25.5 % HCl sp. gr. = 1.101	35.8 % HCl sp. gr. = 1.133	46.6 % HCl sp. gr. = 1.1606
0	0.99557	0.99379	0.99221	0.99079	0.98982
19.5	1.00000	1.00000	1.00000	1.00000	1.00000
40	1.00707	1.00781	1.00877	1.00990	1.01063
60	1.01588	1.01665	1.01794	1.01969	1.02180
80	1.02639	1.02676	1.02791	1.02986	...
100	1.03855	1.03801	1.03867	1.04059	...

(Kremers, Pogg. 106. 115.)

Sp. gr. of HCl+Aq.

G. equivalents HCl per liter.	$t^\circ$	Sp. gr. $t^\circ/t^\circ$
0.005036	17.111	1.0000943
0.01006	17.125	1.0001892
0.02008	17.148	1.0003775
0.04990	17.138	1.000935
0.09885	17.133	1.001843
0.19641	17.162	1.003633
0.29247	17.147	1.005382
0.48278	17.140	1.008811
0.4994	17.28	1.00908
4.994	17.35	1.08390

(Kohlrausch, W. Ann. 1894, 53. 28.)

Sp. gr. of a normal solution of HCl+Aq at  $18^\circ/4^\circ = 1.0165$ . (Loomis, W. Ann. 1896, 60. 550.)Sp. gr. of HCl+Aq at  $19.5^\circ$ , when  $p$  = per cent strength of solution;  $d$  = observed density;  $w$  = volume conc. in grams per cc. ( $\frac{pd}{100} = w$ )

$p$	$d$	$w$
36.0	1.1818	0.4255
29.97	1.1511	0.3450
24.35	1.1207	0.2729
18.55	1.0910	0.2024
12.22	1.0587	0.1294
9.148	1.0433	0.0954
6.559	1.0305	0.0676
3.540	1.0159	0.0360
5.345	1.0246	0.0548
1.356	1.0051	0.0136

(Barnes, J. Phys. Chem. 1898, 2. 546.)

Sp. gr. of HCl+Aq at  $18^\circ/4^\circ$ .

g. HCl in 100 g. of solution	Sp. gr.
0.12149	0.99928
0.060757	0.99900
0.040609	0.99887
0.030328	0.99881

(Jahn, Z. phys. Ch. 1900, 33. 567.)

Sp. gr. of HCl+Aq at  $20^\circ$ .

Normality of HCl+Aq.	% HCl	Sp. gr.
8.42	27.10	1.1336
5.784	19.30	1.0936
3.77	12.94	1.0618
2.031	7.17	1.0334
1.588	5.65	1.0261
1.138	4.05	1.0187
0.523	1.90	1.0076

(Forchheimer, Z. phys. Ch. 1900, 34. 28.)

Sp. gr. at  $20^\circ$  of HCl+Aq containing  $M$  g. mols. HCl per liter.

$M$	0.025	0.05	0.075	0.10
Sp. gr.	1.00034	1.00101	1.00135	1.00180

$M$	0.25	0.50	0.75	1.0
Sp. gr.	1.00425	1.00849	1.01264	1.01749

$M$	1.5	2.0
Sp. gr.	1.02542	1.03414

(Jones and Pearce, Am. Ch. J. 1907, 33. 730.)

HCl is not absorbed by conc.  $H_2SO_4$ +Aq, but in large amounts by anhydrous  $H_2SO_4$  (Aimé.)Absorption of HCl by  $H_2SO_4$ +Aq.Temp. =  $17^\circ$ .

Sp. gr.	g. per l.		g. per 100 g.	
	HCl	$H_2SO_4$	HCl	$H_2SO_4$
1.211	517.8	...	42.7	...
1.220	487.3	22.7	39.9	1.86
1.220	478.8	58.0	39.2	4.75
1.235	455.3	99.3	36.9	8.04
1.260	418.0	161.7	33.2	12.8
1.305	371.4	273.2	28.5	20.9
1.355	306.6	417.7	22.6	30.8
1.430	215.3	638.2	15.0	44.6
1.545	96.7	917.6	6.26	59.4
1.580	51.3	1033.5	3.25	65.4
1.660	10.3	1224.0	0.62	73.7
1.735	1.89	1344.9	0.11	77.5
1.815	1.24	1615.3	0.068	89.0

Absorption of HCl by  $\text{H}_2\text{SO}_4 + \text{Aq}$ —Cont.  
Temp. = 40°.

Sp. gr.	g. per l.		g. per 100 g.	
	HCl	$\text{H}_2\text{SO}_4$	HCl	$\text{H}_2\text{SO}_4$
1.185	421.4	42.2	35.6	3.56
1.195	416.4	70.0	34.8	5.86
1.210	392.1	107.7	32.4	8.90
1.255	346.3	211.2	27.6	16.8
1.255	325.4	236.3	25.9	18.8
1.340	247.4	383.7	18.5	28.6
1.400	161.6	619.4	11.5	44.2
1.520	50.9	929.3	3.35	61.1
1.575	18.5	1046.0	1.17	66.4
1.650	2.9	1207.6	0.17	73.2
1.725	1.4	1370.5	0.081	79.4
1.755	0.57	1428.4	0.032	81.4
1.770	0.52	1478.4	0.029	83.5

## Temp. = 70°.

Sp. gr.	g. per l.		g. per 100 g.	
	HCl	$\text{H}_2\text{SO}_4$	HCl	$\text{H}_2\text{SO}_4$
1.145	374.1	18.4	32.7	1.61
1.150	357.3	38.9	31.1	3.38
1.160	353.8	55.7	30.5	4.80
1.180	341.3	93.6	28.9	7.93
1.225	277.7	231.9	22.8	18.9
1.230	274.3	246.4	22.3	20.0
1.315	173.7	476.7	13.2	36.2
1.380	96.5	661.8	6.99	48.0
1.510	23.6	946.1	1.56	62.7
1.560	8.4	1055.0	0.54	67.6
1.700	0.86	1371.3	0.05	80.7
1.745	0.62	1448.2	0.035	83.0
1.745	0.57	1455.2	0.032	83.4

(Coppadoro, Gazz. ch. it. 1910, 39, II, 626.)

100 pts. alcohol of 36° B absorb 68 pts. HCl at 12.5°. (Boullay.)

Alcohol of 0.836 sp. gr. dissolves 327 vols. HCl at 17.5° and 758 mm. pressure, and the solution has sp. gr. = 1.005. (Pierre, A. ch. (3) 31. 135.)

Solubility of HCl in methyl alcohol (absolute)  
at t°.

t°	% HCl	t°	% HCl
-10.3	54.6	18	46.9
0	51.3	31.7	43

(de Bruyn, R. t. c. 11. 112.)

Solubility of HCl in ethyl alcohol (absolute)  
at t°.

t°	% HCl	t°	% HCl
0	45.4	19.2	41
6.5	44.2	23.5	40.2
11.5	42.7	32.0	38.1

(de Bruyn, l.c.)

Solubility of HCl in ether at t° and 760 mm. pressure.

t°	% HCl	t°	% HCl
-9.2	37.51	15	27.62
-5	37.0	20	24.9
0	35.6	25	22.18
+5	33.1	30	19.47
10	30.35	..	.....

(Schuncke, Z. phys. Ch. 1894, 14. 336.)

Sol. in glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , ether, hexane, benzene, xylene, etc.

Oil of turpentine absorbs 50% HCl. (Thénard.)

Oil of turpentine absorbs 163 vols. HCl at 22° and 724 mm.; isoterebenthene absorbs 34% at 24° and 724 mm.; metaterebenthene absorbs 17.7% at 24° and 724 mm. (Berthelot.)

Oil of lavender absorbs 68.7 vols. at 24°. (Thénard.)

Oil of lavender absorbs 210 vols. without being saturated; oil of rosemary absorbs 218 vols. at 22°; sol. in 0.4 vol. petroleum. (Sausure.)

Absorbed by caprylic alcohol. (Bouis.)

Fuming HCl + Aq is sol. in glycerine and miscible with conc.  $\text{HC}_2\text{H}_3\text{O}_2$ .

Solubility of HCl in phenol + Aq at 12°.

Comp. of $\text{H}_2\text{O}$ layer		Comp. of phenol layer	
% HCl	% phenol	% HCl	% phenol
0	7.45	0	72
3.1	6.6	0.09	78
6.6	5.3	0.2	80.3
8.0	5.1	0.36	82.6
10.7	4.8	0.52	84.5

Composition of solution in contact with solid phenol.

% $\text{H}_2\text{O}$	% HCl	% phenol
11.22	0	88.78
14.98	0.52	84.5
84.5	10.7	4.8
80.38	15.64	3.98
72.43	24.37	3.2
60.25	36.25	3.5

(Schreinemakers, Z. phys. Ch. 1912, 79. 553.)

+  $\text{H}_2\text{O}$ . F.-pt. - 15.35°.

Very sol. in  $\text{H}_2\text{O}$  but only slightly sol. in HCl. (Rupert, J. Am. Chem. Soc. 1909, 31. 866.)

+  $2\text{H}_2\text{O}$ . M.-pt. - 17.4°.

+  $3\text{H}_2\text{O}$ . M.-pt. - 24.8°. (Pickering, B. 1893, 26. 280.)

The composition of the hydrates formed by HCl at different dilutions is calculated



from determinations of the lowering of the f.-pt. produced by HCl, and of the conductivity and sp. gr. of HCl + Aq. (Jones, Am. Ch. J. 1905, **34**, 323.)

### Chlorhydric cyanhydric acid, 3HCl, 2HCN.

Decomp. by H<sub>2</sub>O or alcohol; sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. Insol. in ether, chloroform, or acetic ether. (Claisen, B. 16, 309.)

HCl, HCN. Sol. in H<sub>2</sub>O, absolute alcohol, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and CHCl<sub>3</sub>, with decomp.; decomp. is especially rapid in H<sub>2</sub>O. (Gautier, A. ch. (4) 17, 130.)

### Chloric acid, HClO<sub>3</sub>.

Known only in aqueous solution, which can be concentrated in vacuo to a sp. gr. of 1.282 at 14.2°, and then contains 40.10% HClO<sub>3</sub>, corresponding to HClO<sub>3</sub> + 7H<sub>2</sub>O; if left longer in vacuo over H<sub>2</sub>SO<sub>4</sub>, an acid corresponding to HClO<sub>3</sub> + 4½H<sub>2</sub>O is obtained. Aqueous solution of HClO<sub>3</sub> decomp. at 40°. (Kämmerer, Pogg. 138, 390.)

### Chlorates.

All chlorates except mercurous chlorate are sol. in H<sub>2</sub>O; most of them are deliquescent; many are sol. in alcohol.

### Aluminum chlorate, Al(ClO<sub>3</sub>)<sub>3</sub> + 6H<sub>2</sub>O.

Very hygroscopic. (Dobroserdow, G. C. 1904, II, 177.)

+9H<sub>2</sub>O. Very sol. in cold but much less than in hot H<sub>2</sub>O. (Dobroserdow.)

### Ammonium chlorate, NH<sub>4</sub>ClO<sub>3</sub>.

Easily sol. in H<sub>2</sub>O; less sol. in alcohol.

Much less sol. in H<sub>2</sub>O at 0° than NaClO<sub>3</sub>. (Storer.)

Very sl. sol. in absolute alcohol. (Wächter, J. pr. 30, 321.)

### Barium chlorate, Ba(ClO<sub>3</sub>)<sub>2</sub> + H<sub>2</sub>O.

Sol. in 4 pts. cold, and less hot H<sub>2</sub>O. (Chevenix.)

100 pts. H<sub>2</sub>O dissolve at:

0° 20° 40° 60° 80° 100°  
22.8 37.0 52.1 77.5 98.0 126.4 pts. Ba(ClO<sub>3</sub>)<sub>2</sub>.

100 grams sat. Ba(ClO<sub>3</sub>)<sub>2</sub> + Aq at t° contain grams anhydrous Ba(ClO<sub>3</sub>)<sub>2</sub>.

t°	Grams Ba(ClO <sub>3</sub> ) <sub>2</sub>	t°	Grams Ba(ClO <sub>3</sub> ) <sub>2</sub>
Eutectic point.			
-2.749 ± 0.004	15.28	50	36.69
0	16.90	60	40.05
+10	21.73	70	43.04
20	25.26	80	45.90
25	27.53	90	48.70
30	29.43	99.1	51.17
40	33.16	*104.6	52.67

\* 104.6° is bpt. at 740 mm. pressure = 105.0° at 760 mm. pressure.

(Anschütz, Z. phys. Ch. 1906, **56**, 238.)

### Solubility of Ba(ClO<sub>3</sub>)<sub>2</sub> in H<sub>2</sub>O.

t°	g. Ba(ClO <sub>3</sub> ) <sub>2</sub> in 100 g. H <sub>2</sub> O	Sp. gr.
0	25.5	1.195
20	39.3	1.274
40	55.9	1.355
60	74.1	1.433
80	92.1	1.508
100	113.2	1.580
105.6*	120.	1.600

\* Bpt. of sat. solution.

(Carlson, Dissert. 1910.)

Only slight traces dissolve in absolute alcohol. (Wächter, J. pr. 30, 334.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, **37**, 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790); ethylacetate (Naumann, B. 1910, **43**, 314.)

### Bismuth chlorate.

Known only in solution, which decomp. on evaporation.

### Cadmium chlorate, Cd(ClO<sub>3</sub>)<sub>2</sub> + 2H<sub>2</sub>O.

Very deliquescent; sol. in H<sub>2</sub>O and alcohol. Melts in crystal H<sub>2</sub>O at 80°. (Wächter, J. pr. 30, 321.)

Solubility in H<sub>2</sub>O.

Sat. solution contains at:

-20°	-15°	0°	+18°
72.18	72.53	74.95	76.36
49°	65°		
80.08	82.95%	Cd(ClO <sub>3</sub> ) <sub>2</sub> .	

Sp. gr. of solution containing 76.36% Cd(ClO<sub>3</sub>)<sub>2</sub> at 18° = 2.284. (Meusser, B. 1902, **35**, 1422.)

Sol. in acetone. (Naumann, B. 1904, **37**, 4328.)

### Cadmium chlorate ammonia, Cd(ClO<sub>3</sub>)<sub>2</sub>, 6NH<sub>3</sub>.

Ppt. (Ephraim, B. 1915, **48**, 49.)

### Cæsium chlorate, CsClO<sub>3</sub>.

100 g. H<sub>2</sub>O dissolve at:

0°	8°	19.8°	30°	42.2°
2.46	3.50	6.28	9.53	14.94
50°	77°	99°		
19.40	41.65	76.5 g. CsClO <sub>3</sub> .		

(Calzolari, Acc. Sc. med. di Ferrara, 1911, **85**, 150.)

### Calcium chlorate, Ca(ClO<sub>3</sub>)<sub>2</sub> + 2H<sub>2</sub>O.

Deliquescent; very sol. in H<sub>2</sub>O and alcohol. (Wächter, J. pr. 30, 323.)

Melts in its water of crystallisation at over 100°.

Sp. gr. of solution sat. at 18° = 1.729, containing 64%  $\text{Ca}(\text{ClO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

#### Chromic chlorate.

Easily sol. in  $\text{H}_2\text{O}$ . (Prudhomme, C. C. 1890, 1. 668.)

#### Cobaltous chlorate, $\text{Co}(\text{ClO}_3)_2 + 2\text{H}_2\text{O}$ .

(Meusser, B. 1902, 35. 1418.)

+4 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

18°	21°	35°	47°	61°
64.19	64.39	67.09	69.66	76.12%

Sp. gr. of solution containing 64.19%  $\text{Co}(\text{ClO}_3)_2$  at 18° = 1.861, (Meusser, B. 1902, 35. 1418.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. Melts in crystal  $\text{H}_2\text{O}$  at 50°.

(Wächter, J. pr. 30. 321.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-21°	-19°	0°	+10.5°
53.30	53.61	57.45	61.83%

(Meusser, B. 1902, 35. 1418.)

#### Cupric chlorate, basic, $\text{Cu}(\text{ClO}_3)_2, 3\text{Cu}(\text{OH})_2$ .

Insol. in  $\text{H}_2\text{O}$ . Very sol. in dil. acids. Sol. in warm conc.  $\text{Cu}(\text{ClO}_3)_2 + \text{Aq}$ , the solubility increasing with the conc. and temp. (Bourgeois, Bull. Soc. 1898, (3) 19. 950.)

#### Cupric chlorate, $\text{Cu}(\text{ClO}_3)_2 + 4\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-31°	-21°	+0.8°	18°	45°
54.59	57.12	58.51	62.17	66.17

59.6°  
69.42

71°  
76.9%  $\text{Cu}(\text{ClO}_3)_2$ .

Sp. gr. of the solution containing 62.17%  $\text{Cu}(\text{ClO}_3)_2$  at 18° = 1.695. (Meusser, B. 1902, 35. 1420.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Melts in its crystal  $\text{H}_2\text{O}$  at 65°. (Wächter, J. pr. 30. 321.)

Sp. gr. of  $\text{Cu}(\text{ClO}_3)_2 + \text{Aq}$  at 15°.

% $\text{Cu}(\text{ClO}_3)_2$	2.106	4.778	6.945
Sp. gr.	1.01620	1.03857	1.05714

% $\text{Cu}(\text{ClO}_3)_2$	10.016	14.387
Sp. gr.	1.0844	1.12531

(Traube, Gm.-K. 5. 1, 921.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

#### Cupric chlorate ammonia, $\text{Cu}(\text{ClO}_3)_2, 4\text{NH}_3$ .

Ppt. Not hygroscopic. Insol. in alcohol.  $\text{Cu}(\text{ClO}_3)_2, 6\text{NH}_3$ . Not hygroscopic. (Ephraim, B. 1915, 48. 46.)

#### Erbium chlorate, $\text{Er}(\text{ClO}_3)_3 + 8\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol.

#### Glucinum chlorate.

Known only in aqueous solution, which decomposes on evaporation.

#### Ferrous chlorate.

Known only in solution.

#### Ferric chlorate, $\text{Fe}(\text{ClO}_3)_3$ .

Sol. in  $\text{H}_2\text{O}$ .

Basic salt. Insol. in  $\text{H}_2\text{O}$ .

#### Lanthanum chlorate, $\text{La}(\text{ClO}_3)_3$ .

Deliquescent. (Cleve.)

#### Lead chlorate, $\text{Pb}(\text{ClO}_3)_2 + \text{H}_2\text{O}$ .

Deliquescent; easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Wächter, J. pr. 30. 321.)

Sp. gr. of solution sat. at 18° = 1.947 and contains 60.2%  $\text{Pb}(\text{ClO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)

100 g.  $\text{H}_2\text{O}$  dissolve 440 g.  $\text{Pb}(\text{ClO}_3)_2$  at 18°; sp. gr. of sat. solution = 1.63. (Carlson, Dissert. 1910.)

#### Lithium chlorate, $\text{LiClO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Very deliquescent and sol. in  $\text{H}_2\text{O}$ . Very easily sol. in alcohol. Melts at 50° in its crystal water. (Wächter, J. pr. 30. 321.)

$\text{LiClO}_3 + \text{Aq}$  sat. at 18° contains 75.8%  $\text{LiClO}_3$ . Sp. gr. = 1.815. (Mylius, B. 1897, 30. 1718.)

483 g.  $\text{LiClO}_3$  dissolve in 100 g.  $\text{H}_2\text{O}$  at 15°; sp. gr. of solution = 1.82. (Carlson, Dissert. 1910.)

Contains 3 $\text{H}_2\text{O}$ , and is not deliquescent. (Lagorio, Zeit. f. Kryst. 15. 80.)

Salt is anhydrous. (Retgers, Z. phys. Ch. 5. 449.)

#### Magnesium chlorate, $\text{Mg}(\text{ClO}_3)_2$ .

128.1 g.  $\text{Mg}(\text{ClO}_3)_2$  dissolve in 100 g.  $\text{H}_2\text{O}$  at 19°; sp. gr. of solution = 1.59. (Carlson, Dissert. 1910.)

Sp. gr. of solution containing 56.5%  $\text{Mg}(\text{ClO}_3)_2$  at 18° = 1.554. (Meusser, l.c.)

Sp. gr. of solution sat. at 18° = 1.594, containing 56.3%  $\text{Mg}(\text{ClO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

+2 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

39.5°	61°	68°	93°
65.37	69.46	70.69	73.71%

(Meusser, B. 1902, 35. 1416.)

+4H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

Sat. solution contains at:

42°	65.5°
63.82	69.12% Mg(ClO <sub>3</sub> ) <sub>2</sub> .
(Meusser, <i>l.c.</i> )	

+6H<sub>2</sub>O. Very deliquescent and sol. in H<sub>2</sub>O. Very easily sol. in alcohol. Melts at 40° in its crystal water. (Wächter, J. pr. 30. 325.)

Solubility in H<sub>2</sub>O.

Sat. solution contains at:

-18°	0°	+18°	29°	35°
51.64	53.27	56.50	60.23	63.65% Mg(ClO <sub>3</sub> ) <sub>2</sub> .
(Meusser)				

**Manganous chlorate, Mn(ClO<sub>3</sub>)<sub>2</sub>.**

Known only in solution which decomposes on evaporation. (Wächter.)

**Mercurous chlorate, Hg<sub>2</sub>(ClO<sub>3</sub>)<sub>2</sub>.**

α. Easily sol. in alcohol and H<sub>2</sub>O. (Wächter, J. pr. 30. 321.)

β. Insol. in H<sub>2</sub>O; easily sol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Wächter.) Decomp. by boiling H<sub>2</sub>O.

**Mercuric chlorate, 2HgO, Cl<sub>2</sub>O<sub>5</sub> + H<sub>2</sub>O.**

Deliquescent. Decomp. by H<sub>2</sub>O into oxide and an acid salt. (Wächter.)

Sol. in 4 pts. cold H<sub>2</sub>O. (Chevenix, 1802.)

**Nickel chlorate, Ni(ClO<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O.**

Solubility in H<sub>2</sub>O.

Sat. solution contains at:

48.5°	55°	65°	79.5°
67.60	68.78	69.05	75.50% Ni(ClO <sub>3</sub> ) <sub>2</sub> .
(Meusser, B. 1902, 35. 1419.)			

+6H<sub>2</sub>O. Deliquescent. Easily sol. in H<sub>2</sub>O and alcohol. Melts in crystal H<sub>2</sub>O at 80°. (Wächter, J. pr. 30. 321.)

Solubility in H<sub>2</sub>O.

Sat. solution contains at:

-18°	-8°	0°	+18°	40°
49.55	51.52	52.66	56.74	64.47% Ni(ClO <sub>3</sub> ) <sub>2</sub> .

Sp. gr. of solution containing 56.74% Ni(ClO<sub>3</sub>)<sub>2</sub> at 18° = 1.661.

Goes over into 4H<sub>2</sub>O salt at 39°. (Meusser.)

156 g. Ni(ClO<sub>3</sub>)<sub>2</sub> dissolve in 100 g. H<sub>2</sub>O at 16°; sp. gr. of solution = 1.76. (Carlson, Dissert. 1910.)

**Nickel chlorate ammonia, Ni(ClO<sub>3</sub>)<sub>2</sub>, 6NH<sub>3</sub>.**

Ppt. (Ephraim, B. 1915, 48. 47.)

**Potassium chlorate, KClO<sub>3</sub>.**

Sol. in H<sub>2</sub>O with absorption of heat.

Sol. in about 16 pts. cold, and in much less hot H<sub>2</sub>O. (Chevenix, 1802.)

Sol. in 30.03 pts. H<sub>2</sub>O at 0°; 17.85 pts. at 13.3°; and in 1.66 pts. at 104.78°. (M. R. and P.)

Sol. in 16 pts. H<sub>2</sub>O at 18.75°. (Abl.)  
100 pts. H<sub>2</sub>O at 15.5° dissolve 6.2 pts.; at 100°, 40 pts. (Ure's Dict.)

100 pts. H<sub>2</sub>O dissolve pts. KClO<sub>3</sub> at t°—

t°	28	35	40	47	65
Pts. KClO <sub>3</sub>	9.5	12.3	14.4	18.3	29.1

(Gerardin.)

100 pts. H<sub>2</sub>O dissolve pts. KClO<sub>3</sub> at t°.

t°	Pts. KClO <sub>3</sub>	t°	Pts. KClO <sub>3</sub>
0	3.33	35.0	12.05
13.32	5.60	49.08	18.96
15.37	6.03	74.89	35.40
24.43	8.44	104.78	60.24

(Gay-Lussac, A. ch. 11. 314.)

100 pts. H<sub>2</sub>O dissolve pts. KClO<sub>3</sub> at t°.

t°	Pts. KClO <sub>3</sub>	t°	Pts. KClO <sub>3</sub>
0	3.3	130	88.5
100	56.5	180	190

(Tilden and Shenstone, Roy. Soc. Proc. 35. 345.)

100 pts. H<sub>2</sub>O dissolve pts. KClO<sub>3</sub> at t°.

t°	Pts. KClO <sub>3</sub>	t°	Pts. KClO <sub>3</sub>
120	73.7	160	148
136	98.9	190	183

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

Coefficient of solubility is 3.2+0.109t+0.0043t<sup>2</sup> between 0° and 35°. (Blarez, C. R. 112. 1213.)

Sat. KClO<sub>3</sub> + Aq contains % KClO<sub>3</sub> at t°.

t°	% KClO <sub>3</sub>	t°	% KClO <sub>3</sub>
-0.5	2.6	92	31.2
-0.3	2.4	106	37.2
+4.5	3.5	130	47.0
4.5	2.9	171	59.8
11	4.7	180	62.1
19	6.1	190	63.1
29	8.9	200	64.2
36	9.9	207	66.0
42	11.4	300	87.0
56	15.1	330	96.7
58	16.6		

(Etard, A. ch. 1894, (7) 2. 528.)

Solubility in  $H_2O$ .

Temp.	% $KClO_3$ in a sat. sol.	Pts. sol. in 100 pts. $H_2O$	Pts. $H_2O$ to 1 pt. $KClO_3$
0°	3.06	3.14	31.8
5	3.67	3.82	26.2
10	4.27	4.45	22.5
15	5.11	5.35	18.5
20	6.76	7.22	13.6
25	7.56	8.17	12.2
30	8.46	9.26	10.8
35	10.29	11.47	8.7
40	11.75	13.31	7.5
45	13.16	14.97	6.6
50	15.18	17.95	5.6
55	16.85	20.27	4.9
60	18.97	23.42	4.2
65	20.32	25.50	3.9
70	22.55	29.16	3.4
75	24.82	32.99	3.0
80	26.97	36.93	2.6
85	29.25	41.35	2.4
90	31.36	46.11	2.1
95	33.76	51.39	1.9
100	35.83	55.54	1.8

(Pawlewski, B. 1899, 32, 1041.)

1 l.  $KClO_3$ +Aq at 25° contains 675 milli-  
mols.  $KClO_3$ . (Calvert, Z. phys. Ch. 1901,  
38, 541.)

100 g.  $H_2O$  dissolve at:

	0°	20°	40°	60°
	3.3	7.4	13.8	24.0 g. $KClO_3$
Sp. gr.	1.021	1.045	1.073	1.115

	80°	100°	104° *
	37.7	56.5	59.9 g. $KClO_3$
Sp. gr.	1.165	1.219	1.230

\* Bpt. of sat. solution.

(Carlson, Dissert. 1910.)

100 g.  $H_2O$  dissolve at:

8°	19.8°	30°	99°
4.48	7.15	10.27	57.3 g. $KClO_3$

(Calzolari, Acc. Sc. med. di Ferrara,  
1911, 86, 150.)Sat.  $KClO_3$ +Aq contains at:

53°	68°	81°	86° (?)
17.37	23.25	23.53	30.46% $KClO_3$

(Tschugaeff, Z. anorg. 1914, 96, 161.)

Sp. gr. of  $KClO_3$ +Aq, according to Kremer's  
experiments (Pogg. 96, 62), and Gerlach's  
calculations. (Z. anal. 8, 290.)

% $KClO_3$	Sp. gr.	% $KClO_3$	Sp. gr.
1	1.007	6	1.039
2	1.014	7	1.045
3	1.020	8	1.052
4	1.026	9	1.059
5	1.033	10	1.066

Sp. gr. of  $KClO_3$ +Aq at 20° containing 1  
mol.  $KClO_3$  to 100 mols.  $H_2O$  = 1.04122.  
(Nicol, Phil. Mag. (5) 16, 122.)

Sp. gr. of  $KClO_3$ +Aq at 15° containing 5%  
 $KClO_3$  = 1.0316. (Kohlrausch, W. Ann. 1879,  
1.)

B.-pt. of  $KClO_3$ +Aq containing pts.  $KClO_3$   
to 100 pts.  $H_2O$ .

Pts. $KClO_3$	B.-pt.	Pts. $KClO_3$	B.-pt.
6.5	100.5°	44.6	103.0°
13.2	101.0	53.4	103.5
20.2	101.5	62.2	104.0
27.8	102.0	69.2	104.4
35.8	102.5	....	...

(Gerlach, Z. anal. 26, 450.)

Saturated solution boils at 105°. (Kremers.)

Saturated solution boils at 104.2°, and con-  
tains 61.5 pts.  $KClO_3$  to 100 pts.  $H_2O$ .  
(Legrand.)

Saturated solution boils at 103.3°, and con-  
tains 66.6 pts.  $KClO_3$  to 100 pts.  $H_2O$ . (Grif-  
fiths.)

Saturated solution boils at 104.4°. (Ger-  
lach, Z. anal. 26, 427.)

Sol. in pure  $HNO_3$  without decomp., but  
decomp. at once by  $HNO_3$  containing  $NO_2$ .  
(Millon, A. ch. (3) 6, 92.)

Sol. in sat.  $NH_4Cl$ +Aq without causing  
pptn.

1 mol. (= 129 pts.)  $KClO_3$  dissolves in 2493  
vols.  $H_2O$ ; in 2208 vols.  $H_2O$  when 1 mol.  
(= 59 pts.)  $NaCl$  is added; in 2060 vols.  $H_2O$   
with 2 mols. (= 118 pts.)  $NaCl$ ; and in 1910  
vols.  $H_2O$  with 4 mols. (= 236 pts.)  $NaCl$ .  
(Gladstone, Chem. Soc. 15, 302.)

 $KClO_3$  is sol. in about—29.50 pts.  $H_2O$ .35.50 pts.  $NH_4OH$ +Aq conc.39.00 pts. dil.  $NH_4OH$ +Aq (1 vol. conc.: 3  
vols.  $H_2O$ ).30.50 pts.  $HNO_3$ +Aq (1 vol. conc.  $HNO_3$ :  
5 vols.  $H_2O$ ).33.0 pts.  $HCl$ +Aq (1 vol. conc.  $HCl$ : 4 vols.  
 $H_2O$ ).48.00 pts.  $HC_2H_3O_2$ +Aq (1 vol. commer-  
cial  $HC_2H_3O_2$ : 1 vol.  $H_2O$ ).31.50 pts.  $NH_4Cl$ +Aq (1 pt.  $NH_4Cl$ : 10 pts.  
 $H_2O$ ).18.00 pts.  $NH_4NO_3$ +Aq (1 pt.  $NH_4NO_3$ : 10  
pts.  $H_2O$ ).34.00 pts.  $NH_4C_2H_3O_2$ +Aq (dil.  $NH_4OH$ +  
Aq+dil.  $HC_2H_3O_2$ +Aq).32.50 pts.  $Na_2C_2H_3O_2$ +Aq (commercial  
 $HC_2H_3O_2$ + $Na_2CO_3$ , diluted with 4 vols.  $H_2O$ ).31.50 pts.  $Cu(C_2H_3O_2)_2$ +Aq. (See Stolba,  
Z. anal. 2, 390.)33.50 pts. cane-sugar (1 pt. cane-sugar : 10  
pts.  $H_2O$ ).36.50 pts. grape-sugar (1 pt. grape-sugar: 10  
pts.  $H_2O$ ). (Pearson, Zeit. Chem. 1869, 662.)

Addition of K salts to sat.  $KClO_3$ +Aq ppt.  
 $KClO_3$  in such a way, that the sum of the

KClO<sub>3</sub> remaining in solution and the K in the salt added, is a constant, which constant is equal to the solubility of KClO<sub>3</sub>, so that the following formula represents the coefficient of solubility of KClO<sub>3</sub> after addition of a K salt,  $3.2 + 0.109t + 0.0043t^2$  - K of salt added. (Blares, C. R. 112. 1213.)

#### Solubility of KClO<sub>3</sub> + TiClO<sub>3</sub>.

100 g. H<sub>2</sub>O dissolve g. salts

t°	g. TiClO <sub>3</sub>	g. KClO <sub>3</sub>
0	2.8	3.3
15	10	1.5
50	12.67	16.2
100	57.3	48.2

(Rabe, Z. anorg. 1902, 31. 156.)

#### Solubility of KClO<sub>3</sub> in KNO<sub>3</sub> + Aq.

t°	g. per l.	
	KNO <sub>3</sub>	KClO <sub>3</sub>
19.85	0.00	69.88
	12.65	64.86
	25.29	60.33
	101.19	45.85
	202.38	40.20
23.87	0.00	79.09
	50.59	63.14

(Arrhenius, Z. phys. Ch. 1893, 11. 397.)

#### Solubility in KCl + Aq at 20° C.

G. KCl in 1 litre	G. KClO <sub>3</sub> in 1 litre	Sp. gr.
0	71.1	1.050
10	58	1.050
20	49	1.050
30	43	1.050
40	39.5	1.054
50	36.5	1.058
60	34	1.064
70	32	1.070
80	30	1.075
90	28	1.081
100	27	1.086
110	25.5	1.091
120	24.5	1.098
130	23.5	1.103
140	22.5	1.108
150	21.5	1.113
160	21.0	1.119
170	20.5	1.124
180	20.0	1.130
190	20.0	1.135
200	20	1.140
210	20	1.145
220	20	1.150
230	20	1.156
240	20	1.161
250	20	1.168

(Winteler, Z. Elektrochem. 1900, 7. 361.)

#### Solubility in KOH + Aq at 25°.

KOH + Aq	Millimols KClO <sub>3</sub> per litre of the solution
$\frac{1}{2}$ -normal	624
$\frac{1}{4}$ -normal	573

(Calvert, Z. phys. Ch. 1901, 33. 541.)

#### Solubility in H<sub>2</sub>O<sub>2</sub> at 25°.

Concentration of H <sub>2</sub> O <sub>2</sub> millimols per litre	Millimols KClO <sub>3</sub> per litre of the solution
1260	730
1310	737

(Calvert, l.c.)

#### Solubility in $\frac{1}{4}$ normal KOH + Aq in presence of H<sub>2</sub>O<sub>2</sub> at 25°.

Concentration of H <sub>2</sub> O <sub>2</sub> millimols per litre	Millimols KClO <sub>3</sub> per litre of the solution
15	578
276	584
954	616
1073	673

(Calvert, l.c.)

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1892, 20. 828.)

Neither dissolved nor attacked by liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)  
Sol. in 120 pts. alcohol of 83% at 16° (Wittstein.)

Sol. in 120 pts. alcohol of 77.1%. (Pohl, W. A. B. 6. 595.)

Insol. in absolute alcohol. (Gerardin.)

Solubility of KClO<sub>3</sub> in dil. alcohol. D = sp. gr. of alcohol; S = solubility in 100 pts. alcohol at t°.

D = 0.9904		D = 0.9848		D = 0.9793	
t°	S	t°	S	t°	S
13	4.9	14	4.7	14	3.2
21	6.3	26	7.1	26	5.4
25	7.5	39	9.3	38	7.9
30	9.1	47	12.8	46	10.8
35	10.2	55	16.1	51	12.2
44	13.6	65	22.3	63	17.5
50	16.2	66	22.5	65	19.0

D = 0.9726		D = 0.9573		D = 0.9390	
t°	S	t°	S	t°	S
13	2.2	13	1.9	14.5	1.1
20	3.3	20	2.7	26	2.2
33	5.8	29	3.6	40	3.4
43	7.2	36	4.3	50	4.3
56	11.4	55	7.9	62	6.6
59	12.9	60	9.7	67	7.6
..	....	63	10.5	..	..

Solubility of  $\text{KClO}_3$  in dil. alcohol—*Continued.*

D = 0.9111		D = 0.8967		D = 0.8429	
t°	S	t°	S	t°	S
13	0.74	12	6.46	25	0.09
25	1.08	31	1.28	34	0.12
32	1.78	43	1.95	56	0.24
52	3.35	58	3.10	64	0.32

(Gerardin, A. ch. (4) 5. 148.)

Solubility of  $\text{KClO}_3$  in alcohol + Aq.

wt. % alcohol	g. $\text{KClO}_3$ per 100 g. solution	
	t = 30°	t = 40°
0	9.23	12.23
5	7.72	10.48
10	6.44	8.84
20	4.51	6.40
30	3.21	4.67
40	2.35	3.41
50	1.64	2.41
60	1.01	1.41
70	0.54	0.78
80	0.24	0.34
90	0.06	0.12

(Taylor, J. phys. Ch. 1897, 1. 301.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Solubility of  $\text{KClO}_3$  in acetone + Aq.

wt. % acetone	g. $\text{KClO}_3$ per 100 g. solution	
	t = 30°	t = 40°
0	9.23	12.23
5	8.32	11.10
9.09	7.63	10.28
20	6.09	8.27
30	4.93	6.69
40	3.90	5.36
50	2.90	4.03
60	2.03	2.86
70	1.24	1.68
80	0.57	0.79
90	0.18	0.24

(Taylor, J. phys. Ch. 1897, 1. 301.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Solubility in glycol = 0.9% at ord. temp. (de Coninck, Belg. Acad. Bull. 1906. 359.)

100 g. glycerol (sp. gr. 1.256) dissolve 3.54 g.  $\text{KClO}_3$  at 15–16°. (Ossendowski, Pharm. J. 1907, 79. 575.)Potassium silver chlorate,  $\text{KClO}_3$ ,  $\text{AgClO}_3$ .  
(Pfaundler, W. A. B. 46, 2. 266.)Rubidium chlorate,  $\text{RbClO}_3$ .100 pts.  $\text{H}_2\text{O}$  dissolve 2.8 pts. at 4.7°; 3.9 pts. at 13°; 4.9 pts. at 18.2°; 5.1 pts. at 19°. (Reissig, A. 127. 33.)100 g.  $\text{H}_2\text{O}$  dissolve 3.1  $\text{RbClO}_3$  at 15°; sp. gr. of solution = 1.07. (Carlson, Dissert. 1910.)100 g.  $\text{H}_2\text{O}$  dissolve at:

0°	8°	19.8°	30°
2.138	3.07	5.36	8.00 g. $\text{RbClO}_3$ ,

42.2°	50°	76°	99°
12.48	15.98	34.12	62.8 g. $\text{RbClO}_3$ .

(Calzolari, Acc. Sc. med. di Ferrara, 1911, 85. 150.)

## Scandium chlorate.

(Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

Silver chlorate,  $\text{AgClO}_3$ .Sol. in 10–12 pts. cold  $\text{H}_2\text{O}$  (Vauquelin); in 8–10 pts. cold, and 2 pts. hot  $\text{H}_2\text{O}$  (Chevenix); in 5 pts. cold  $\text{H}_2\text{O}$  (Wächter). Sl. sol. in alcohol (Chevenix); easily sol. in alcohol (Wächter).Silver chlorate ammonia,  $\text{AgClO}_3$ ,  $2\text{NH}_3$ .Easily sol. in  $\text{H}_2\text{O}$  or alcohol. (Wächter, 1843.)Sodium chlorate,  $\text{NaClO}_3$ .

Deliquescent.

Sol. in 3 pts. cold and less hot  $\text{H}_2\text{O}$ . (Wächter; Chevenix.)Sol. in 3 pts.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)100 pts.  $\text{H}_2\text{O}$  dissolve 35.5 pts.  $\text{NaClO}_3$ . (Ure's Dict.)100 pts.  $\text{H}_2\text{O}$  dissolve at:

0°	20°	40°	60°
81.9	99	123.5	147.1 pts. $\text{NaClO}_3$ ,

80°	100°	120°
175.6	232.6	333.3 pts. $\text{NaClO}_3$ .

(Kremers, Pogg. 97. 4.)

100 pts.  $\text{H}_2\text{O}$  dissolve 89.3 pts.  $\text{NaClO}_3$  at 12°. (Schlösing.)100 g.  $\text{H}_2\text{O}$  dissolve at:

–15°	0°	20°	40°
72	79	101	126 pts. $\text{NaClO}_3$ ,

Sp. gr. 1.380 1.389 1.430 1.472

60°	80°	100°	122°*
155	189	230	286 pts. $\text{NaClO}_3$ .

Sp. gr. 1.514 1.559 1.604 1.654

\* Bpt. of sat. solution.

(Carlson, Dissert. 1910.)

100 g.  $\text{NaClO}_3 + \text{Aq}$  contain at:  
 4.78° 19.85° 30.05° 35.10° 44.72°  
 45.47 48.91 51.22 52.36 54.50 g.  $\text{NaClO}_3$ .  
 (Le Blanc and Schmandt, Z. phys. Ch. 1911,  
 77. 614.)

Sp. gr. of  $\text{NaClO}_3 + \text{Aq}$ , containing:  
 10 15 20 25 30 25%  $\text{NaClO}_3$ .  
 1.070 1.108 1.147 1.190 1.235 1.282  
 (Gerlach, Z. anal. 8. 290.)

Sp. gr. of  $\text{NaClO}_3 + \text{Aq}$  at 20° containing 1  
 mol.  $\text{NaClO}_3$  in 100 mols.  $\text{H}_2\text{O} = 1.03844$ .  
 (Nicol, Phil. Mag. (5) 16. 122.)

$\text{NaClO}_3 + \text{Aq}$  containing 7.23%  $\text{NaClO}_3$   
 has sp. gr. 20°/20° = 1.0496. (Le Blanc and  
 Rohland, Z. phys. Ch. 1896, 19. 278.)

Sat. solution boils at 132°, and temp. can  
 be raised to 135° by supersaturation. (Krem-  
 ers, Pogg. 97. 4.)

Easily sol. in liquid HF. (Franklin, Z.  
 anorg. 1905, 46. 2.)

$\text{NaClO}_3 + \text{NaCl}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 50.75 pts.  $\text{NaClO}_3 +$   
 24.4 pts.  $\text{NaCl}$  at 12°; 100 pts.  $\text{H}_2\text{O}$  dissolve  
 249.6 pts.  $\text{NaClO}_3 + 11.5$  pts.  $\text{NaCl}$  at 122°,  
 and when cooled to 12° contain 68.6 pts.  
 $\text{NaClO}_3 + 11.5$  pts.  $\text{NaCl}$ . (Schlössing, C. R.  
 78. 1272.)

#### Solubility in $\text{NaCl} + \text{Aq}$ at 20° C.

G. $\text{NaCl}$ in 1 litre	G. $\text{NaClO}_3$ in 1 litre	Sp. gr.
5	668	1.426
10	661	1.424
15	653	1.423
20	645	1.421
25	638	1.419
30	630	1.418
35	622	1.417
40	615	1.415
45	607	1.414
50	599	1.412
55	590	1.411
60	582	1.409
65	574	1.408
70	566	1.406
75	559	1.405
80	551	1.404
85	544	1.402
90	537	1.401
95	529	1.399
100	522	1.398
105	514	1.396
110	507	1.394
115	499	1.392
120	491	1.391
125	484	1.389
130	476	1.387
135	467	1.385
140	459	1.383
145	451	1.381

#### Solubility in $\text{NaCl} + \text{Aq}$ at 20° C.—Continued

G. $\text{NaCl}$ in 1 litre	G. $\text{NaClO}_3$ in 1 litre	Sp. gr.
150	442	1.379
155	432	1.377
160	423	1.374
165	414	1.372
170	403	1.369
175	393	1.365
180	382	1.362
185	371	1.359
190	360	1.355
195	349	1.350
200	338	1.345
205	326	1.340
210	315	1.335
215	302	1.330
220	287	1.324
225	271	1.319
230	257	1.313
235	243	1.307
240	228	1.301
245	211	1.295
250	197	1.289
255	184	1.283
260	170	1.276
265	150	1.270
270	135	1.263
275	120	1.256
280	105	1.249
285	91	1.241
290	78	1.235
295	67	1.226
300	55	1.217

(Winteler, Z. Elektrochem. 1900, 7. 361.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am.  
 Ch. J. 1898, 20. 829.)

Sol. in 34 pts. alcohol of 83% at 16° and in  
 less hot alcohol. (Wittstein.)

Somewhat more easily sol. in alcohol than  
 $\text{NaCl}$ . (Berzelius.)

#### Solubility of $\text{NaClO}_3$ in alcohol. (g. $\text{NaClO}_3$ per l. of solution.)

t°	Alcohol		
	90 %	75 %	50 %
20	16.1	110.8	311.3
40	22.9	133.5	321.8
60	29.0	155.8	326.8
70	....	161.3	....

(Carlson, Dissert. 1910.)

Insol. in methyl acetate. (Naumann, B.  
 1909, 42. 3790); ethyl acetate. (Naumann,  
 B. 1910, 43. 314.)

100 g. glycerol dissolve 20 g.  $\text{NaClO}_3$  at  
 15.5°. (Ossendowski, Pharm. J. 1907, 79.  
 575.)

**Strontium chlorate,  $\text{Sr}(\text{ClO}_3)_2 + 5\text{H}_2\text{O}$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Topsoë, W. A. B. 66, 2. 29.)

Sp. gr. of solution sat. at  $18^\circ$  containing 63.3%  $\text{Sr}(\text{ClO}_3)_2 = 1.839$ . (Mylius, B. 1897, 30. 1718.)

Easily sol. in  $\text{H}_2\text{O}$ , less in alcohol, but more sol. in alcohol than  $\text{SrCl}_2$ . (Souchay, A. 102. 381.)

Insol. in absolute alcohol. (Wächter.)

**Thallous chlorate,  $\text{TlClO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ , but decomp. by heating.

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$   $20^\circ$   $50^\circ$   $80^\circ$   $100^\circ$

2.80 3.92 12.67 36.65 57.31 pts.  $\text{TlClO}_3$ .

(Muir, Chem. Soc. 29. 857.)

1 l.  $\text{TlClO}_3 + \text{Aq}$  sat. at  $10^\circ$  contains 25.637 g.  $\text{TlClO}_3$ . (Rooseboom, Z. phys. Ch. 8. 532.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.134 equivalents  $\text{TlClO}_3$  at  $20^\circ$ ; or 38.51 g. in 1 l. of the solution (mean of 10 experiments). (Noyes and Farrell, J. Am. Chem. Soc. 1911, 33. 1657.)

**Solubility in  $\text{Ti}_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .**

G. equiv. per l.		Solid phase
$\text{TlClO}_3$	$\text{Ti}_2\text{SO}_4$	
0.1058	0.1366	$\text{TlClO}_3 + \text{Ti}_2\text{SO}_4$

(Noyes and Farrell, l.c.)

**Thallic chlorate,  $\text{Tl}(\text{ClO}_3)_3 + 4\text{H}_2\text{O}$ .**

Very deliquescent; sol. in  $\text{H}_2\text{O}$ . Decomp. slowly in the air. (Gewecke, Z. anorg. 1912, 75. 273.)

**Ytterbium chlorate.**

Sol. in  $\text{H}_2\text{O}$ . (Popp, A. 131. 179.)

**Yttrium chlorate,  $\text{Y}(\text{ClO}_3)_3 + 8\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in alcohol. Sl. sol. in ether. (Cleve.)

**Zinc chlorate,  $\text{Zn}(\text{ClO}_3)_2 + 4\text{H}_2\text{O}$ .**

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

+ $18^\circ$   $30^\circ$   $40^\circ$   $55^\circ$   
66.52 67.66 69.06 75.44%  $\text{Zn}(\text{ClO}_3)_2$ .

Sp. gr. of solution containing 66.52%  $\text{Zn}(\text{ClO}_3)_2$  at  $18^\circ = 1.916$ .

(Meusser, B. 1902, 35. 1417.)

More sol. in  $\text{H}_2\text{O}$  than chlorates of Mg, Co, Ni or Cu; less sol. than chlorate of Cd; more sol. than  $\text{Zn}(\text{NO}_3)_2$ . (Meusser, l.c.)

+ $6\text{H}_2\text{O}$ . Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Melts in crystal  $\text{H}_2\text{O}$  at  $60^\circ$ . (Vauquelin, A. ch. 95. 113.)

**Solubility in  $\text{H}_2\text{O}$ .**

Sat. solution contains at:

- $18^\circ$   $0^\circ$   $8^\circ$   $15^\circ$   
55.62 59.19 60.20 67.32%  $\text{Zn}(\text{ClO}_3)_2$ .  
(Meusser, l.c.)

Sp. gr. of solution sat. at  $18^\circ$  containing 65%  $\text{Zn}(\text{ClO}_3)_2 = 1.914$ . (Mylius, B. 1897, 30. 1718.)

**Zinc chlorate ammonia,  $\text{Zr}(\text{ClO}_3)_2, 4\text{NH}_3$ .**

$\text{Zn}(\text{ClO}_3)_2, 6\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48. 48.)

**Perchloric acid**

See Perchloric acid.

**Chlorides.**

Most chlorides are sol. in  $\text{H}_2\text{O}$ ; a few, however, are insol. or nearly so therein, the chief of which are  $\text{AgCl}$ ,  $\text{Hg}_2\text{Cl}_2$ ,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{PtCl}_2$ , and  $\text{AuCl}$ . Several chlorides are decomp. into insol. basic salts or hydroxides, either by the addition of  $\text{H}_2\text{O}$ , as in the case of  $\text{BiCl}_3$  and  $\text{SbCl}_3$ , or on evaporating the aqueous solution, as  $\text{AlCl}_3$ ,  $\text{ZnCl}_2$ ,  $\text{MgCl}_2$ , etc.

Some chlorides are sol. in alcohol or ether. See under each element.

**Chlorine,  $\text{Cl}_2$ .**

The maximum solubility of  $\text{Cl}$  in  $\text{H}_2\text{O}$  is at  $10^\circ$  (Schönfeld); at  $8-10^\circ$  (Gay-Lussac); at  $9-10^\circ$  (Pelouze).

Solubility decreases from  $9-0^\circ$ ; at  $100^\circ$  the solubility = 0. (Gay-Lussac.)

$\text{Cl}_2 + \text{Aq}$  sat. at  $6^\circ$  has sp. gr. = 1.003. (Berthelot.)

1 vol.  $\text{H}_2\text{O}$  at  $t^\circ$  absorbs vols.  $\text{Cl}$  reduced to  $0^\circ$  and 760 mm. pressure.

$t^\circ$	Vols. $\text{Cl}$	$t^\circ$	Vols. $\text{Cl}$
10	2.5852	26	1.9099
11	2.5413	27	1.8695
12	2.4977	28	1.8295
13	2.4543	29	1.7895
14	2.4111	30	1.7499
15	2.3681	31	1.7104
16	2.3253	32	1.6712
17	2.2828	33	1.6322
18	2.2405	34	1.5934
19	2.1984	35	1.5550
20	2.1565	36	1.5166
21	2.1148	37	1.4785
22	2.0734	38	1.4406
23	2.0322	39	1.4029
24	1.9912	40	1.3655
25	1.9504	..	...

(Schönfeld, A. 93. 26.)



1 vol.  $H_2O$  absorbs vols. Cl at  $t^\circ$  (not corrected).

Vols. Cl	$t^\circ$	Vols. Cl	$t^\circ$	Vols. Cl	$t^\circ$
1.43	0	3.04	8	1.19	50
1.52	3	3.00	10	0.71	70
2.08	6.5	2.37	17	0.15	100
2.17	7	1.61	35	....	...

(Gay-Lussac, A. ch. (3) 7. 124.)

1 vol.  $H_2O$  at  $8^\circ$  absorbs 3.04 vols. Cl, which is the maximum of solubility. At  $50^\circ$ , 1.09 vols. are absorbed; and at  $0^\circ$ , 1.5 vols. (Pelouze and Fremy.)

1 vol.  $H_2O$  at  $t^\circ$  dissolves vols. Cl (not corrected).

$t^\circ$	Vols. Cl	$t^\circ$	Vols. Cl	$t^\circ$	Vols. Cl
0	1.75-1.80	12	2.50-2.60	40	1.55-1.60
9	2.70-2.75	14	2.45-2.50	50	1.15-1.20
10	2.70-2.75	30	2.00-2.10	70	0.60-0.65

(Pelouze, A. ch. (3) 7. 188.)

1 vol.  $H_2O$  absorbs vols. Cl at  $t^\circ$ .

$t^\circ$	Vols. Cl	$t^\circ$	Vols. Cl	$t^\circ$	Vols. Cl
0	1.5-1.6	9	2.65-2.70	14	2.6-2.65
5	2.05-2.1	10	2.9-3.0	16	2.35-2.4
8	2.5-2.6	12	2.65-2.75	30	1.8-1.85

(Riegel and Wals, Berz. J. B. 1846. 72.)

Solubility in  $H_2O$ :  $\alpha$  = coefficient of solubility.

$t^\circ$	$\alpha$	$t^\circ$	$\alpha$	$t^\circ$	$\alpha$
6.9	2.2931	10.1	2.8741	21.7	2.0422
8.4	2.5469	11.2	2.7267	32.1	1.5766
9.3	2.7135	13.7	2.5079	36.7	1.3802

(Goodwin, B. 15. 3040.)

Goodwin also gives tables for solubility of Cl in HCl and various chlorides, but they do not show evidence of accurate work. (A.M.C.)

$Cl_2 + Aq$  contains at 760 mm. pressure:

1.44%	Cl at $0^\circ$
1.07%	" " $6^\circ$
0.95%	" " $9^\circ$
0.87%	" " $12^\circ$

(Rooseboom, R. t. c. 1884, 3. 29.)

See also  $Cl_2 + 8H_2O$ .

Solubility of  $Cl_2$  in  $H_2O$ .

$\beta^1$  = Vol. of Cl (reduced to  $0^\circ$  and 760 mm.) absorbed by 1 vol.  $H_2O$  under a total pressure of 760 mm.

$q$  = g.  $Cl_2$  absorbed by 100 g.  $H_2O$  under a total pressure of 760 mm.

$t^\circ$	$\beta^1$	$q$	$t^\circ$	$\beta^1$	$q$
10	3.095	0.980	25	1.985	0.630
11	2.996	948	26	1.937	615
12	2.900	918	27	1.891	600
13	2.808	889	28	1.848	587
14	2.720	861	29	1.808	574
15	2.635	835	30	1.769	562
16	2.553	809	35	1.575	501
17	2.474	784	40	1.414	451
18	2.399	760	45	1.300	415
19	2.328	738	50	1.204	386
20	2.260	716	60	1.006	324
21	2.200	698	70	0.848	274
22	2.143	680	80	0.672	219
23	2.087	662	90	0.380	125
24	2.035	646	100	0.000	000

(Winkler, Landolt and Börnstein, Tab. 4th Ed. 1912, 597.)

1 l.  $HCl + Aq$  (38%  $HCl$ ) dissolves 17.3 g.  $Cl_2$ ; 1 l.  $HCl + Aq$  (33%  $HCl$ ) dissolves 11 g.  $Cl_2$ ; 1 l.  $HCl + Aq$  (3%  $HCl$ ) dissolves 6.5 g.  $Cl_2$ . (Berthelot, C. R. 91. 191.)

Solubility of  $Cl_2$  in  $HCl + Aq$  at  $20-21^\circ$  and 759-761 mm. pressure.

g. $HCl$ per l.	g. $Cl_2$ per l.	Coefficient of absorption	Solubility
0	7.23	2.1157	2.2799
3.134	5.30	1.5496	1.6698
6.248	4.94	1.4483	1.5607
9.402	4.76	1.3942	1.5013
12.540	4.85	1.4200	1.5292
15.670	5.10	1.4933	1.6092
31.340	5.81	1.6736	1.8033
62.680	6.38	1.8682	2.0131
94.020	7.19	2.1044	2.2677
125.360	7.76	2.2711	2.4473
156.700	8.58	2.5095	2.7043
188.040	9.23	2.7020	2.9117
219.380	9.93	2.9248	3.1312
250.720	10.68	3.1272	3.3677
282.060	11.87	3.3278	3.5859
313.401	12.03	3.5492	3.8224

(Mellor, Chem. Soc. 1901, 75. 227.)

Solubility of  $Cl$  in  $NaCl + Aq$ .  $\alpha$  = coefficient of solubility.

$NaCl = 9.97\%$ .

$t^\circ$	$\alpha$	$t^\circ$	$\alpha$
7.9	1.8115	18.8	1.2785
11.9	1.5879	22.6	1.0081
15.4	1.3684		

Solubility of Cl in NaCl+Aq.—*Continued*

NaCl = 16.01%.

t°	α	t°	α
6	1.5866	21.4	0.8732
11.6	1.2227	26.9	0.7017
16.4	1.0121	....	....

NaCl = 19.66%.

t°	α	t°	α
0	1.6978	15.4	0.9511
9.2	1.2145	20.4	0.7758
9.3	1.2068	21.9	0.7385
14.8	0.9740	....	....

(Kumpf, W. Ann. Beibl. 6. 276.)

## Solubility of Cl in sat. NaCl+Aq at t° and 760 mm. pressure.

t°	Coefficient of absorption at 0° and 760 mm.	Solubility at 0° and 760 mm.
14.5	0.3607	0.3898
29.0	0.3125	0.3458
60.0	0.1332	0.1625
82.0	0.0586	0.0763

(Kohn and O'Brien, J. Soc. Chem. Ind. 1898, 17. 1100.)

Sat. KCl+Aq absorbs 1/3 less Cl at 15° than pure H<sub>2</sub>O. (Dettmer, A. 33. 35.)1 l. of a solution of CaCl<sub>2</sub> (1 pt. in 15 pts. H<sub>2</sub>O) dissolves 2.45 g. Cl at 12°.1 l. of a solution of MgCl<sub>2</sub> (1 pt. in 15 pts. H<sub>2</sub>O) dissolves 2.33 g. Cl at 12°.1 l. of a solution of MnCl<sub>2</sub> (1 pt. in 15 pts. H<sub>2</sub>O) dissolves 2.00 g. Cl at 12°.

Sl. sol. in KOH+Aq. (Fremy.)

Somewhat sol. in liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)CCl<sub>4</sub> absorbs 10% of Cl<sub>2</sub> at 13°. (Perkins, Chem. Soc. 1894, 65. 20.)1 mol. CrOCl<sub>2</sub> dissolves at 0°, 0.70 atom Cl; at -14°, 1.24 atoms; at -21°, 2.31 atoms; and at -24°, 3.00 atoms Cl. (Roozeboom, R. t. c. 4. 379.)

Sulphuryl chloride absorbs 71 vols. Cl or 0.136 pt. Cl by weight at 0°. (Schulze, J. pr. (2) 27. 168.)

Insol. in benzene. (Moride.)

Sl. sol. in chloral and iodal. (Dumas.)

Sol. in perchlorethylene. (Faraday.)

Sol. in a very large quantity of ether with decomp.

Coefficient of solubility of Cl<sub>2</sub> in organic liquids at 15°.

Substance	Coefficient of Solubility
Carbon tetrachloride	51.7
Acetic anhydride	39.6
Acetic acid (99.84%)	36.7
" (90 vol. %)	25.3
" (75 vol. %)	16.43
" (65 vol. %)	13.43

(Jones, Chem. Soc. 1911, 99. 392.)

+8H<sub>2</sub>O. Critical temp. of decomposition in open vessel = 9.8°; in closed vessel = 28.7°.Solubility in H<sub>2</sub>O.% Cl<sub>2</sub> = % of Cl<sub>2</sub> in Cl<sub>2</sub>+Aq sat. at t° and 760 mm. in presence of Cl<sub>2</sub>+8H<sub>2</sub>O.

t°	% Cl <sub>2</sub>	t°	% Cl <sub>2</sub>
0	0.505	12.5	1.10
3	0.64	20	1.82
6	0.709	28.5	3.50
9	0.900		

(Roozeboom, R. t. c. 1884, 3. 57.)

Chlorine monoxide, Cl<sub>2</sub>O.Sol. in H<sub>2</sub>O. At 0°, H<sub>2</sub>O absorbs at least 200 times its volume of Cl<sub>2</sub>O gas.Chlorine trioxide, Cl<sub>2</sub>O<sub>3</sub>.

Decomp. on air at 57° with explosion.

H<sub>2</sub>O absorbs 5-6 vols. Cl<sub>2</sub>O<sub>3</sub>. (Millon, A. ch. (3) 7. 298.)H<sub>2</sub>O absorbs at 8.5° and 753 mm. press. 8.591 vols. Cl<sub>2</sub>O<sub>3</sub>. (Brandan.)100 g. H<sub>2</sub>O dissolve at:

8.5°	and 752.9 mm. press.	4.7655 g. Cl <sub>2</sub> O <sub>3</sub> .
14°	"	756.3 " " 5.0117 "
21°	"	754 " " 5.4447 "
93°	"	760 " " 5.6508 "

(Brandan, A. 151. 340.)

Does not exist, and above data are for mixture of ClO<sub>2</sub> and Cl. (Garzaroli-Thurnlakh, A. 209. 184.)Chlorine tetroxide, ClO<sub>2</sub>.H<sub>2</sub>O at 4° absorbs about 20 vols. ClO<sub>2</sub> with formation of HClO<sub>2</sub> and HClO<sub>3</sub>.H<sub>2</sub>SO<sub>4</sub> at -18° absorbs about 20 vols. ClO<sub>2</sub>. (Millon, A. ch. (3) 7. 285.)Solubility of ClO<sub>2</sub> in H<sub>2</sub>O.

t°	g. ClO <sub>2</sub> per l.
1	> 108.6
10.7	116.7
14.0	> 107.9

ray, Z. phys. Ch. 1906, 54. 569.)

+8H<sub>2</sub>O ( $\approx$ 1H<sub>2</sub>O).

Solubility in H<sub>2</sub>O.

t°	g. ClO <sub>2</sub> per l.	t°	g. ClO <sub>2</sub> per l.
0.79*	26.98	10	60.06
0	27.59	15.3	60.06
1	29.48	18.2	107.9
5.7	42.10		

\* Entertic.

(Bray.)

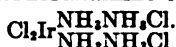
**Chlorine oxide, Cl<sub>2</sub>O<sub>17</sub>.**

Very easily decomp. (Millon, A. 46. 281.)  
Probably a mixture of ClO<sub>2</sub> and O.

**Chlorine heptoxide, Cl<sub>2</sub>O<sub>7</sub>.**

Explosive; decomp. by H<sub>2</sub>O; sol. in well cooled benzene with sl. decomp. (Michael, Am. Ch. J. 1909, 23. 447.)

**Chlorirididiamine chloride,**



Sl. sol. in cold, easily in hot H<sub>2</sub>O. (Skobli-koff, A. 84. 275.)

— **nitrate, Cl<sub>2</sub>Ir(N<sub>2</sub>H<sub>5</sub>NO<sub>2</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O.

— **sulphate, Cl<sub>2</sub>Ir(N<sub>2</sub>H<sub>5</sub>)SO<sub>4</sub>.**

Sl. sol. in cold, much more easily in hot H<sub>2</sub>O.

**Chloriridic acid.**

**Chloriridates.**

Most of the chloriridates are very difficultly sol. in H<sub>2</sub>O, but a little more sol. than the corresponding chloroplatinates. Insol. or nearly so in alcohol, but not so difficultly sol. as the chloroplatinates. (Rose.)

**Ammonium chloriridate, (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>6</sub>.**

Sol. in 20 pts. cold H<sub>2</sub>O (Vauquelin); sl. sol. in cold, much more in hot H<sub>2</sub>O (Claus); sol. in HCl+Aq (Soblewsky); insol. in cold NH<sub>4</sub>Cl+Aq (Claus); insol. in alcohol (Berzelius).

100 pts. H<sub>2</sub>O dissolve at:

14.4° 26.8° 39.4°  
0.699 0.905 1.226 pts. (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>6</sub>,

52.2° 61.2° 69.3°  
1.608 2.130 2.824 pts. (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>6</sub>.

(Rimbach and Korten, Z. anorg. 1907, 52. 407.)

**Cesium chloriridate, Cs<sub>2</sub>IrCl<sub>6</sub>.**

Only sl. sol. in H<sub>2</sub>O. (Delépine, C. R. 1908, 146. 1268.)

**Lithium chloriridate, Li<sub>2</sub>IrCl<sub>6</sub>.**

Somewhat deliquescent; very sol. in H<sub>2</sub>O. (Antony, Gazz. ch. it. 23, 1. 190.)

**Potassium chloriridate, K<sub>2</sub>IrCl<sub>6</sub>.**

Sl. sol. in cold H<sub>2</sub>O; sol. in 15 pts. boiling H<sub>2</sub>O; less sol. in H<sub>2</sub>O containing HCl; insol. in alcohol or sat. KCl and CaCl<sub>2</sub>+Aq.

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 829.)

**Rubidium chloriridate, Rb<sub>2</sub>IrCl<sub>6</sub>.**

Very sl. sol. in H<sub>2</sub>O. (Rimbach, Z. anorg. 1907, 52. 408.)

**Sodium chloriridate, Na<sub>2</sub>IrCl<sub>6</sub>+6H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O; sol. in alcohol of 0.837 sp. gr.

**Thallium chloriridate, Tl<sub>2</sub>IrCl<sub>6</sub>.**

Decomp. by hot HCl forming Tl<sub>2</sub>IrCl<sub>4</sub>. (Delépine, C. R. 1909, 149. 1073.)

**Chloriridium pentamine comps.**

See Iridopentamine chloro comps.

**Chloriridosulphurous acid.**

**Potassium chloriridosulphite, K<sub>4</sub>Ir<sub>2</sub>Cl<sub>2</sub>(SO<sub>3</sub>)<sub>4</sub>, 4KCl+12H<sub>2</sub>O.**

Insol. in cold, decomp. by hot H<sub>2</sub>O. K<sub>4</sub>Ir<sub>2</sub>Cl<sub>2</sub>(SO<sub>3</sub>)<sub>4</sub>, 2K<sub>2</sub>SO<sub>3</sub>. Decomp. by H<sub>2</sub>O. Cl<sub>2</sub>Ir<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>, 8KCl+4H<sub>2</sub>O. Sol. in H<sub>2</sub>O; insol. in alcohol. (Claus, J. pr. 42. 354.)

**Chloriridous acid.**

**Ammonium chloriridite, (NH<sub>4</sub>)<sub>2</sub>IrCl<sub>5</sub>.**

Decomp. by H<sub>2</sub>O. (Delépine, C. R. 1908, 146. 1268.)

+1½H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Claus.)

IrCl<sub>5</sub>(H<sub>2</sub>O)(NH<sub>4</sub>)<sub>2</sub>. (Delépine.)

**Cesium chloriridite, IrCl<sub>5</sub>(H<sub>2</sub>O)Cs<sub>2</sub>.**

(Delépine.)

**Lithium chloriridite, Li<sub>2</sub>IrCl<sub>5</sub>+12H<sub>2</sub>O.**

Deliquescent; sol. in H<sub>2</sub>O and alcohol. (Delépine, C. R. 1914, 158. 1277.)

**Lithium sodium chloriridite, Li<sub>2</sub>NaIrCl<sub>5</sub>+12H<sub>2</sub>O.**

Stable in aq. solution in the presence of excess of lithium salt. (Delépine, C. R. 1914, 158. 1278.)

LiNa<sub>2</sub>IrCl<sub>5</sub>+12H<sub>2</sub>O. Stable in aq. solution in the presence of excess of sodium salt. (Delépine, C. R. 1914, 158. 1278.)

**Potassium chloriridite, K<sub>2</sub>IrCl<sub>5</sub>.**

Decomp. by H<sub>2</sub>O. (Delépine.)

+3H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O; insol. in alcohol; insol. in sat. KCl+Aq. (Berzelius.)

IrCl<sub>5</sub>(H<sub>2</sub>O)K<sub>2</sub>. (Delépine.)

**Rubidium chloriridite**,  $\text{IrCl}_3(\text{H}_2\text{O})\text{Rb}_3$ .  
(Delépine.)

**Silver chloriridite**,  $\text{Ag}_3\text{IrCl}_6$ .

Insol. in  $\text{H}_2\text{O}$  or acids; sl. sol. in  $\text{NH}_4\text{OH}$  + Aq.  
Ppt. (Delépine, Bull. Soc. 1910, (4), 7. 55.)

**Sodium chloriridite**,  $\text{Na}_3\text{IrCl}_6 \cdot 12\text{H}_2\text{O}$ .

Efflorescent; sol. in  $\frac{1}{2}$  pt.  $\text{H}_2\text{O}$ . Insol. in alcohol. Melts in crystal  $\text{H}_2\text{O}$  at  $50^\circ$ .

**Thallium chloriridite**,  $\text{Tl}_3\text{IrCl}_6$ .

Sol. in hot  $\text{HCl}$ ; pptd. on cooling. (Delépine, C. R. 1909, 149. 1073.)

**Chlorotetramine chromium comps.**

See Chlorotetramine chromium comps.

**Chloro-azoimide**,  $\text{N}_2\text{Cl}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Raschig, B. 1908, 41. 4194.)

**Chlorobromo comps.**

See Bromochloro comps.

**Chlorocarbonic acid.**

See Carbonyl chloride.

**Chlorochromic acid**,  $\text{CrO}_2\frac{\text{OH}}{\text{Cl}}$ .

Known only in its salts.  
 $\text{CrO}_2\text{Cl}_2$ . See Chromyl chloride.

**Ammonium chlorochromate**,  $\text{NH}_4\text{CrO}_2\text{Cl} = \text{CrO}_2\frac{\text{Cl}}{\text{ONH}_4}$ .

More sol. in  $\text{H}_2\text{O}$  than the K salt. (Peligot, A. ch. 52. 283.)

**Barium chlorochromate chloride**,  $\text{Ba}(\text{CrO}_2\text{Cl})_2$ ,  $\text{BaCl}_2$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Prätorius, A. 201. 1.)  
+  $\text{H}_2\text{O}$ . Not deliquescent.

**Calcium chlorochromate**,  $\text{Ca}(\text{CrO}_2\text{Cl})_2$ .

Deliquescent. (Peligot.)  
+  $5\text{H}_2\text{O}$ . Very deliquescent. (Prätorius.)

**Chromous chlorochromate.**

See Trichromyl chloride.

**Cobalt chlorochromate**,  $\text{Co}(\text{CrO}_2\text{Cl})_2 \cdot 9\text{H}_2\text{O}$ .

Deliquescent; melts at  $40^\circ$  in crystal  $\text{H}_2\text{O}$ . (Prätorius.)

**Lithium chlorochromate**,  $\text{LiCrO}_2\text{Cl}$ .

Sol. in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  without decomp. (Löwenthal, Z. anorg. 1894, 6. 357.)

**Magnesium chlorochromate**,  $\text{Mg}(\text{CrO}_2\text{Cl})_2$ .

Deliquescent. (Peligot.)  
+  $9\text{H}_2\text{O}$ . Less deliquescent than the other chlorochromates. (Prätorius, A. 201. 1.)  
Very hygroscopic; sol. in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$  without decomp. (Löwenthal, Z. anorg. 1894, 6. 359.)

**Nickel chlorochromate**,  $\text{Ni}(\text{CrO}_2\text{Cl})_2 \cdot 9\text{H}_2\text{O}$ .

Deliquescent; melts in its crystal  $\text{H}_2\text{O}$  at  $46-48^\circ$ . (Prätorius.)

**Potassium chlorochromate**,  $\text{KCrO}_2\text{Cl} = \text{CrO}_2(\text{Cl})\text{OK}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Cryst. from  $\text{H}_2\text{O}$  containing  $\text{HCl}$  without decomp. (Peligot.)  
Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Sodium chlorochromate**,  $\text{NaCrO}_2\text{Cl}$ .

Deliquescent. (Peligot.)  
+  $2\text{H}_2\text{O}$ . Deliquescent. (Prätorius.)

**Strontium chlorochromate**,  $\text{Sr}(\text{CrO}_2\text{Cl})_2 + 4\text{H}_2\text{O}$ .

Deliquescent; melts in crystal  $\text{H}_2\text{O}$  at  $72^\circ$ . (Prätorius.)

**Thalious chlorochromate**,  $\text{TlCrO}_2\text{Cl}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lachaud and Lepierre, C. R. 103. 198.)

**Zinc chlorochromate**,  $\text{Zn}(\text{CrO}_2\text{Cl})_2 + 9\text{H}_2\text{O}$ .

Deliquescent; melts at  $37.5^\circ$  in crystal  $\text{H}_2\text{O}$ . (Prätorius.)  
Very hygroscopic; very sol. in  $\text{H}_2\text{O}$  and acids. (Löwenthal, Z. anorg. 1894, 6. 360.)

**Dichlorochromium bromide**,

$[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Br}$ .

Very deliquescent. Sol. in fuming  $\text{HBr}$ , in a mixture of equal volumes ether and fuming  $\text{HBr}$ , in alcohol and in acetone. (Bjerrum, B. 1907, 40. 2919.)

**Chlorochromotetrammonium comps.**

See Chlorotetramine chromium comps.

**Chlorocolumbium bromide**,  $(\text{Cb}_6\text{Cl}_{13})\text{Br}_2 + 7\text{H}_2\text{O}$ .

Sol. in a small quantity of cold  $\text{H}_2\text{O}$ . (Harned, J. Am. Chem. Soc. 1913, 35. 1083.)

**Chlorocolumbium chloride**,  $(\text{Cb}_6\text{Cl}_{13})\text{Cl}_2 + 7\text{H}_2\text{O}$ .

Insol. in cold, sol. in boiling  $\text{H}_2\text{O}$ .  
Not easily decomp. by boiling with  $\text{NH}_4\text{OH}$ . Conc.  $\text{HNO}_3$  decomp. a boiling solution of this comp. Completely sol. in conc. alkalies. (Harned, J. Am. Chem. Soc. 1913, 35. 1080.)

**Chlorocolumbium hydroxide**,  $(\text{Cb}_2\text{Cl}_{12})(\text{OH})_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids and alkalis. (Harned, J. Am. Chem. Soc. 1913, **35**, 1082.)

**Chloroctamine cobaltic carbonate**,  $\text{Cl}_4\text{Co}_2(\text{NH}_3)_2\text{CO}_3 + 3\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Vortmann and Blasberg, B. **22**, 2651.)

$\text{Cl}_2\text{Co}_2(\text{NH}_3)_2(\text{CO}_3)_2 + \text{H}_2\text{O}$ . (Vortmann and Blasberg.)

**Chloroferrous acid**.

**Calcium chloroferrite**,  $\text{CaO}$ ,  $\text{CaCl}_2$ ,  $\text{Fe}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (le Chatelier, C. R. **99**, 276.)

**Dichlorofulminoplatinum**,

$\text{Pt}_2\text{N}_4\text{Cl}_2\text{O}_{12}\text{H}_{24}(\text{?})$ .

Insol. in  $\text{H}_2\text{O}$ . (v. Meyer, J. pr. (2) **18**, 305.)

**Trichlorofulminoplatinum**,

$\text{Pt}_2\text{N}_4\text{Cl}_3(\text{OH})\text{O}_{12}\text{H}_{24}(\text{?})$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (v. Meyer.)

**Tetrachlorofulminoplatinum**,

$\text{Pt}_2\text{N}_4\text{Cl}_4\text{O}_{12}\text{H}_{24}(\text{?})$

Insol. in  $\text{H}_2\text{O}$ . (v. Meyer.)

**Chlorohydroxylonitritoplatinsemi-diamine nitrite**,  $(\text{OH})\text{ClNO}_2\text{Pt}(\text{NH}_3)_2\text{NO}_2$ .

Easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Chlorohydroxyloplatindiamine bromide**,

$\text{OH Pt}(\text{N}_2\text{H}_5\text{Br})_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

— **carbonate**,  $\text{OH Pt}(\text{N}_2\text{H}_5)_2\text{CO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **chloride**,  $\text{OH Pt}(\text{N}_2\text{H}_5\text{Cl})_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **chromate**,  $\text{OH Pt}(\text{N}_2\text{H}_5)_2\text{CrO}_4$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

— **dichromate**,  $\text{OH Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$ .

Ppt. (Cleve.)

— **nitrate** (Raewsky's nitrate),

$\text{OH Pt}(\text{N}_2\text{H}_5\text{NO}_2)_2$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Gerhardt.)

**Chlorohyposulphuric acid**,  $\text{S}_2\text{O}_2\text{Cl}_4$ .

See Sulphur oxytetrachloride.

**Chloromanganic acid**.

See Manganic hydrogen chloride.

**Chloromercurosulphurous acid**.

**Ammonium chloromercurosulphite**,

$\text{NH}_4\text{SO}_3\text{HgCl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. **9**, 205.)

**Barium chloromercurosulphite**,

$\text{Ba}(\text{SO}_3\text{HgCl})_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Barth.)

**Potassium chloromercurosulphite**,  $\text{KSO}_3\text{HgCl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Sodium chloromercurosulphite**,  $\text{NaSO}_3\text{HgCl} + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Chloromolybdenum bromide**,

$\text{Cl}_4\text{Mo}_2\text{Br}_2 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  and dil. acids; sol. in alcohol.  $+6\text{H}_2\text{O}$ . At first easily sol. in  $\text{H}_2\text{O}$ , but a precipitate soon forms. Can be crystallized from dil.  $\text{HBr} + \text{Aq}$ . Sol. in alcohol and ether. (Blomstrand.)

**Chloromolybdenum potassium bromide**,

$\text{Cl}_4\text{Mo}_2\text{Br}_2, 2\text{KBr} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Can be cryst. from  $\text{HBr} + \text{Aq}$ . (Blomstrand.)

**Chloromolybdenum chloride**,  $\text{Cl}_4\text{Mo}_2\text{Cl}_2 = \text{molybdenum dichloride}$ ,  $\text{MoCl}_5$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sl. sol. in  $\text{HNO}_3$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{NaOH} + \text{Aq}$ , or  $\text{KOH} + \text{Aq}$ , with separation of precipitate on boiling; sol. in alcohol and ether. (Blomstrand, J. pr. **77**, 96.)

Very sol. in conc.  $\text{HCl}$ . (Rosenheim and Kohn, Z. anorg. 1910, **66**, 2.)

$+3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

$+4\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Liechti and Kempe, A. **170**, 351.)

$+6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Blomstrand.)

**Chloromolybdenum hydrogen chloride**,

$\text{Mo}_2\text{Cl}_6, \text{HCl} + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , but ppt. forms after a few minutes. (Rosenheim and Kohn, Z. anorg. 1910, **66**, 5.)

**Chloromolybdenum potassium chloride**,

$\text{Cl}_4\text{Mo}_2\text{Cl}_2, 2\text{KCl} + 2\text{H}_2\text{O}$ .

Decomp. by pure  $\text{H}_2\text{O}$ ; can be recrystallized from  $\text{HCl} + \text{Aq}$ . (Blomstrand, J. pr. **77**, 108.)

**Chloromolybdenum hydroxide**,  $\text{Cl}_4\text{Mo}_9(\text{OH})_2 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. Easily sol. in strong acids if fresh, and washed only with cold  $\text{H}_2\text{O}$ . If washed with warm  $\text{H}_2\text{O}$ , it is less sol. in acids. If precipitated hot, is insol. in acids, even  $\text{H}_2\text{SO}_4$ , or fuming  $\text{HNO}_3$ . (Blomstrand, J. pr. 77. 100.)  
 $+8\text{H}_2\text{O}$ .

**Chloromolybdenum iodide**,  $\text{Cl}_4\text{Mo}_9\text{I}_2 + 3\text{H}_2\text{O}$ .

Preprecipitate.

$+6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Chloromolybdenum potassium iodide**,

$\text{Cl}_4\text{Mo}_9\text{I}_2, 2\text{KI} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Recryst. from  $\text{HI} + \text{Aq}$ . (Blomstrand.)

**Chloromolybdenum oxybromide**,  $\text{Cl}_4\text{Mo}_9\text{Br}^{\text{OH}}$   
 $+2\text{H}_2\text{O}$ .

Insol. in alcohol. (Blomstrand, J. pr. 77. 116.)

**Chloromolybdic acid**,  
 $\text{MoOCl}_2(\text{OH}) + 7\text{H}_2\text{O}$ .

Very hygroscopic. (Weinland, B. 1904, 37. 572.)

**Diammonium tetrachloromolybdate**,

$\text{MoCl}_4(\text{ONH}_2)_2 + 2\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis and ammonia. (Weinland, Z. anorg. 1905, 44. 83.)

**Cesium chlorotrimolybdate, acid**,

$\text{Mo}_3\text{O}_{11}\text{Cl}_{14}(\text{Cs}_2\text{O}) + 22\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis, and ammonia. (Weinland, l.c.)

**Monocesium trichloromolybdate**,

$\text{MoOCl}_2(\text{OCs}) + \text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis and ammonia. (Weinland.)

**Dicesium tetrachloromolybdate**,

$\text{MoCl}_4(\text{OCs})_2$ .

Hygroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in dilute acids, alkalis, and ammonia. (Weinland, Z. anorg. 1905, 44. 83.)

**Monopotassium trichloromolybdate**,

$\text{MoOCl}_2(\text{OK}) + \text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis, and ammonia. (Weinland.)

**Dipotassium tetrachloromolybdate**,

$\text{MoCl}_4(\text{OK})_2 + 2\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis, and ammonia. (Weinland.)

**Potassium hydrogen chlorotrimolybdate**,  
 $\text{Mo}_3\text{O}_{11}\text{Cl}_{14}, \text{K}_2\text{O} + 6\text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis, and ammonia. (Weinland.)

**Monorubidium trichloromolybdate**,

$\text{MoOCl}_2(\text{ORb}) + \text{H}_2\text{O}$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids, alkalis, and ammonia. (Weinland.)

**Dirubidium tetrachloromolybdate**,

$\text{MoCl}_4(\text{ORb})_2$ .

Hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acid, alkalis, and ammonia. (Weinland.)

**Chloronitratoplatinamine nitrite**,

$\text{Cl Pt}(\text{NH}_2\text{NO}_2)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

**Chloronitratoplatindiamine nitrate**,

$\text{Cl Pt}(\text{N}_2\text{H}_4\text{NO}_2)_2$ .

Decomp. by  $\text{H}_2\text{O}$  with formation of  $\text{Cl Pt}[(\text{NH}_2)_2\text{NO}_2]_2$ .

— sulphate,  $\text{Cl Pt}(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

**Chloronitritotetramine cobaltic chloride**,  
 $\text{Cl}(\text{NO}_2)_2\text{Co}(\text{NH}_2)_4\text{Cl}$ .

Not very sol. in cold  $\text{H}_2\text{O}$ . (Jürgensen, Z. anorg. 6. 195.)

**Chloronitritoplatinsemidiamine chloride**,  
 $\text{Cl}_2(\text{NO}_2)_2\text{Pt}(\text{NH}_2)_2\text{Cl}$ .

100 pts. solution in  $\text{H}_2\text{O}$  sat. at  $18^\circ$  contain 1.8 pts. salt; sat. at  $100^\circ$ , 6 pts.

Insol. in abs. alcohol or ether. Not decomp. by conc.  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ , and by  $\text{H}_2\text{SO}_4$  only at a high heat.

Formula given was  $\text{PtN}_2\text{H}_{12}\text{Cl}_2\text{O}_6$ . (Peyrone, J. B. 1855. 421.)

— nitrite,  $\text{Cl}_2(\text{NO}_2)_2\text{Pt}(\text{NH}_2)_2\text{NO}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

**Chlorophosphatoplatindiamine phos-**

**phate**,  $\text{Cl Pt}(\text{N}_2\text{H}_4)_2$   
 $\text{PO}_4 + 2\text{H}_2\text{O}$ .

Nearly insol. in cold, and only very sl. sol. in hot  $\text{H}_2\text{O}$ . (Raewaky.)

**Chloronitrous acid**.

**Iridium potassium chloronitrite**,  $\text{Ir}_2\text{Cl}_2(\text{NO}_2)_4, 6\text{KCl}$ .

Ppt.; decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ . (Leidit, C. R. 1902, 134. 1583.)

$\text{Ir}_2\text{K}_{12}\text{Cl}_{16}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ . Ppt. (Quen-  
nessen, C. R. 1905, 141. 258.)

### Chloropalladic acid.

#### Chloropalladates.

The chloropalladates are generally very sol. in  $\text{H}_2\text{O}$ , and sol. in alcohol. (v. Bonsdorff, Pogg. 17. 264.)

#### Ammonium chloropalladate, $(\text{NH}_4)_2\text{PdCl}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

#### Barium chloropalladate.

Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

#### Cadmium chloropalladate.

As above.

#### Cæsium chloropalladate, $\text{Cs}_2\text{PdCl}_6$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, B. 1905, 38. 2386.)

#### Calcium chloropalladate.

Deliquescent; sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff, 1829.)

#### Glucinum chloropalladate, $\text{GlPdCl}_6 + 8\text{H}_2\text{O}$ .

Very hygroscopic, and sol. in  $\text{H}_2\text{O}$ .

#### Magnesium chloropalladate, $\text{MgPdCl}_6 + 6\text{H}_2\text{O}$ .

Deliquescent; sol. in  $\text{H}_2\text{O}$ .

#### Nickel chloropalladate, $\text{NiPdCl}_6 + 6\text{H}_2\text{O}$ .

Extremely deliquescent.

#### Potassium chloropalladate, $\text{K}_2\text{PdCl}_6$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by long boiling with  $\text{H}_2\text{O}$ . Sl. sol. in dil.  $\text{HCl} + \text{Aq}$  without decomp. Insol. in  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , or  $\text{NaCl} + \text{Aq}$ . Insol. in alcohol. (Berzelius.)

#### Rubidium chloropalladate, $\text{Rb}_2\text{PdCl}_6$ .

Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  or by hot conc.  $\text{H}_2\text{SO}_4$ . (Gutbier, B. 1905, 38. 2387.)

#### Zinc chloropalladate, $\text{ZnPdCl}_6 + 6\text{H}_2\text{O}$ .

Very deliquescent. (v. Bonsdorff.)

### Chloropalladous acid

#### Aluminum chloropalladite, $\text{Al}_2\text{Pd}_2\text{Cl}_{16} + 20\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Welkow, B. 7. 804.)

#### Ammonium chloropalladite, $(\text{NH}_4)_2\text{PdCl}_6 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Claus.)

Easily sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2386.)

#### Barium chloropalladite.

Easily sol. in  $\text{H}_2\text{O}$  or alcohol.

#### Cadmium chloropalladite.

Not deliquescent.

#### Cæsium chloropalladite, $\text{Cs}_2\text{PdCl}_6$ .

Can be cryst. from hot  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2386.)

#### Calcium chloropalladite.

Deliquescent. Sol. in  $\text{H}_2\text{O}$  or alcohol.

#### Glucinum chloropalladite, $\text{GlPdCl}_6 + 6\text{H}_2\text{O}$ .

Very hygroscopic; very sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Welkow.)

#### Magnesium chloropalladite.

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

#### Manganese chloropalladite.

Sol. in  $\text{H}_2\text{O}$  and alcohol.

#### Nickel chloropalladite.

Sol. in  $\text{H}_2\text{O}$ .

#### Potassium chloropalladite, $\text{K}_2\text{PdCl}_6$ .

Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Joannis, C. R. 95. 295.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius.) Sol. in cold sat.  $\text{KCl} + \text{Aq}$ . (Gibbs, Sill. Am. J. (2) 31. 70.) Insol. in alcohol. (Wollaston.) Somewhat sol. in alcohol of 0.84 sp. gr., but insol. in absolute alcohol; decomp. on boiling (Berzelius.)

#### Rubidium chloropalladite, $\text{Rb}_2\text{PdCl}_6$ .

Can be cryst. from hot  $\text{H}_2\text{O}$ . (Gutbier, B. 1905, 38. 2387.)

#### Sodium chloropalladite.

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol.

#### Zinc chloropalladite.

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

#### Chlorophosphoarsenoiiridic acid, $2\text{IrCl}_3, 3\text{H}_2\text{PO}_3, 3\text{H}_3\text{PO}_4, 5\text{H}_2\text{AsO}_4(?)$ .

Very sol. in  $\text{H}_2\text{O}$ . (Geisenheimer.)

#### Lead chlorophosphoarsenoiiridate, $4\text{IrCl}_3, 3\text{Pb}_2\text{H}_2(\text{PO}_3)_2, 3\text{Pb}_2(\text{PO}_4)_2, 5\text{Pb}_2\text{H}_2(\text{AsO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$ .

#### Chlorophosphoiiridic acid, $2\text{IrCl}_3, 3\text{H}_2\text{PO}_4, 3\text{H}_3\text{PO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Geisenheimer, A. ch. (6) 23. 254.)

$2\text{IrCl}_3, 3\text{H}_2\text{PO}_4$ . Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Ammonium chlorophosphoirdate**,  $2\text{IrCl}_3 \cdot 3(\text{NH}_4)_2\text{PO}_4 \cdot 3(\text{NH}_4)_2\text{HPO}_4$ .

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Geisenheimer.)

**Lead chlorophosphoirdate**,  $4\text{IrCl}_3 \cdot 3\text{Pb}_2(\text{PO}_4)_3 \cdot 3\text{PbH}_2(\text{PO}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$  or acetic acid; very sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Geisenheimer.)

**Silver chlorophosphoirdate**,  $2\text{IrCl}_3 \cdot 3\text{AgH}_2\text{PO}_4 \cdot 3\text{AgH}_3\text{PO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Geisenheimer.)

**Chlorophosphoplatinic acid.**

See Chloroplatinophosphoric acid.

**Chlorophosphoric acid.**

**Thorium chlorophosphate**,  $3\text{ThO}_2 \cdot \text{ThCl}_4 \cdot 2\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$  and acids; decomp. by boiling with  $\text{H}_2\text{SO}_4$ , and fusing with alkali carbonates. (Colani, C. R. 1909, 149. 208.)

**Chloroplatinamine chloride**,  $\text{Cl}_2\text{Pt} \begin{smallmatrix} \text{NH}_2\text{Cl} \\ \text{NH}_2\text{Cl} \end{smallmatrix}$ .

Sol. in about 700 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 33–34 pts. at  $100^\circ$ . Not attacked by boiling conc.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Sol. in boiling  $\text{KOH} + \text{Aq}$  with decomp. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Cleve, Sv. V. A. H. 10, 9. 30.)

— **nitrite**,  $\text{Cl}_2\text{Pt}(\text{NH}_2\text{NO}_2)_2$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

— **nitrite silver nitrite**,  $\text{Cl}_2\text{Pt}(\text{NH}_2\text{NO}_2)_2 \cdot \text{AgNO}_2$ .

Easily sol. in hot, sl. sol. in cold  $\text{H}_2\text{O}$ . (Cleve.)

— **nitritochloride**,  $\text{Cl}_2\text{Pt} \begin{smallmatrix} \text{NH}_2\text{NO}_2 \\ \text{NH}_2\text{Cl} \end{smallmatrix}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Chloroplatinidiamine bromide**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Br})_2$ .

Sl. sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **chloride** (Gros' chloride),  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Cl})_2$ .

Nearly insol. in cold, and only sl. sol. in hot  $\text{H}_2\text{O}$ . Sol. in hot conc.  $\text{KOH} + \text{Aq}$ , with decomp. (Grimm.)

Sol. in cold  $\text{KOH} + \text{Aq}$  without decomp. Nearly insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Buckton.)  $+ \text{H}_2\text{O}$ . (Raewsky.)

— **chloroplatinate**,  $\text{NCl}_2\text{Pt}(\text{H}_5\text{Cl})_2$ ,  $\text{PtCl}_4$ .

Easily sol. in hot  $\text{H}_2\text{O}$ .

— **chloroplatinite**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{Cl})_2$ ,  $\text{PtCl}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Chloroplatinidiamine chromate**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{CrO}_4$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **dichromate**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{Cr}_2\text{O}_7$ .

Sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrate** (Gros' nitrate),  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5\text{NO}_2)_2$ .

Much more easily sol. in hot than in cold  $\text{H}_2\text{O}$ . Sol. in hot  $\text{KOH} + \text{Aq}$  with decomp. Nearly insol. in conc.  $\text{HNO}_3 + \text{Aq}$ .

— **nitritochloride**,  $\text{Cl}_2\text{Pt} \begin{smallmatrix} \text{N}_2\text{H}_5\text{NO}_2 \\ \text{N}_2\text{H}_5\text{Cl} \end{smallmatrix}$ .

Ppt. (Jürgensen.)

— **phosphate**.

See Chlorophosphatoplatinidiamine phosphate.

— **sulphate**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2\text{SO}_4$ .

Sl. sol. in both cold or hot  $\text{H}_2\text{O}$ . (Cleve.)  $+ x\text{H}_2\text{O}$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Grimm.)

— **sulphocyanide**,  $\text{Cl}_2\text{Pt}(\text{N}_2\text{H}_5)_2(\text{CNS})_2 + \text{H}_2\text{O}$ .

Ppt. (Cleve.)

**Chloroplatinmonodiamine chloride**,

$\text{Cl}_2\text{Pt} \begin{smallmatrix} (\text{NH}_2)_2\text{Cl} \\ \text{NH}_2\text{Cl} \end{smallmatrix}$ .

Quite easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Chloroplatinsemidiamine carbonate chloride**,  $2\text{Pt}(\text{NH}_2)_2\text{Cl}_2 \cdot \text{Pt}_2(\text{NH}_2)_2\text{Cl}_2(\text{CO}_3)_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol and ether. Decomp. by cold  $\text{HCl} + \text{Aq}$ . (Schon, Z. anorg. 1897, 13. 37.)

**Chloroplatinsemidiamine chloride**,  $\text{Cl}_2\text{Pt}(\text{NH}_2)_2\text{Cl}$ .

Sol. in 300 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 65 pts. at  $100^\circ$ . Not decomp. by conc.  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{KOH} + \text{Aq}$  without decomp. (Cleve.)

**Chloroplatinic acid**,  $\text{H}_2\text{PtCl}_6 + 6\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.  $+ 4\text{H}_2\text{O}$ . Deliquescent. (Pigeon, C. R. 112. 1218.)

$\text{PtCl}_4$ ,  $\text{HCl} + 2\text{H}_2\text{O}$ . (Pigeon.)

**Aluminum chloroplatinate**,  $\text{AlCl}_3$ ,  $\text{PtCl}_4 + 15\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Welkow, B. 7. 304.)

Insol. in ether.

**Ammonium chloroplatinate**,  $(\text{NH}_4)_2\text{PtCl}_6$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Fresenius.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.666 pt. at ord. temp. and 12.5 pts. at  $100^\circ$ . (Crookes, C. N. 9. 37.)



Insol. in cold HCl + Aq. Separates out on cooling from solution in hot HCl, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>. (Fischer.)

Very al. sol. in cold, easily in hot NH<sub>4</sub>OH + Aq. (Fresenius.)

Conc. NH<sub>4</sub>Cl + Aq ppts. it almost completely from aqueous solution. (Böttger.)

Sol. in NH<sub>4</sub> succinate + Aq. (Düpping.)

Less sol. in H<sub>2</sub>PtCl<sub>6</sub> + Aq than in H<sub>2</sub>O. (Rogojski, A. ch. (3) 41. 452.)

Sol. in SnCl<sub>4</sub> + Aq. (Fischer.)

Very sol. with decomp. in KCNS + Aq. (Claus.)

At 15–20°, sol. in 26,535 pts. 97.5% alcohol, in 1476 pts. 76% alcohol, and in 665 pts. 55% alcohol. If free HCl is present, it is sol. in 672 pts. 76% alcohol. (Fresenius, A. 59. 118.)

Insol. in absolute alcohol or ether.

**Barium chloroplatinate**, BaPtCl<sub>6</sub> + 6H<sub>2</sub>O.

Permanent; sol. in H<sub>2</sub>O; decomp. by alcohol. (v. Bonsdorff, Pogg. 17. 250.)

**Barium monochloroplatinate**, PtCl(OH)<sub>3</sub>Ba + H<sub>2</sub>O.

Insol. in H<sub>2</sub>O and in org. solvents. (Bellucci, C. C. 1903, I. 131.)

**Barium pentachloroplatinate**, OH.PtCl<sub>5</sub>Ba + H<sub>2</sub>O.

(Miolati, Chem. Soc. 1900, 78. (2) 732.)

**Cadmium chloroplatinate**, CdPtCl<sub>6</sub> + 6H<sub>2</sub>O.

Deliquescent, and easily sol. in H<sub>2</sub>O. (v. Bonsdorff.)

**Cesium chloroplatinate**, Cs<sub>2</sub>PtCl<sub>6</sub>.

100 pts. H<sub>2</sub>O dissolve at:

0°	10°	20°	30°
0.024	0.050	0.079	0.110 pts. Cs <sub>2</sub> PtCl <sub>6</sub> ,
40°	50°	60°	70°
0.142	0.177	0.213	0.251 pts. Cs <sub>2</sub> PtCl <sub>6</sub> ,
80°	90°	100°	
0.291	0.332	0.377	pts. Cs <sub>2</sub> PtCl <sub>6</sub> .

(Bunsen, Pogg. 113. 337.)

Sol. in 1308 pts. H<sub>2</sub>O at 15°, and 261 pts. at 100°. (Crookes, C. N. 9. 205.)

**Calcium chloroplatinate**, CaPtCl<sub>6</sub> + 8H<sub>2</sub>O.

Deliquescent; easily sol. in H<sub>2</sub>O. (v. Bonsdorff.)

**Calcium monochloroplatinate**, PtCl(OH)<sub>3</sub>Ca + H<sub>2</sub>O.

Insol. in H<sub>2</sub>O and in org. solvents. (Bellucci, C. C. 1903, I. 131.)

**Cerium chloroplatinate**, CeCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O.

Deliquescent; very sol. in H<sub>2</sub>O or alcohol; insol. in ether. (Marignac.)

4CeCl<sub>3</sub>, 3PtCl<sub>4</sub> + 8H<sub>2</sub>O. Deliquescent; easily sol. in H<sub>2</sub>O or alcohol; insol. in ether. (Holzmann, J. pr. 84. 80.)

**Chromium chloroplatinate**, CrCl<sub>3</sub>, PtCl<sub>4</sub> + 10½H<sub>2</sub>O.

Deliquescent. (Nilson, B. 9. 1056.)

+ 10H<sub>2</sub>O. Very sol. in H<sub>2</sub>O and alcohol. Nearly insol. in acetone. (Higley, J. Am. Chem. Soc. 1904, 26. 617.)

**Cobalt chloroplatinate**, CoPtCl<sub>6</sub> + 6H<sub>2</sub>O.

Very deliquescent. (Jørgensen.)

**Copper chloroplatinate**, CuPtCl<sub>6</sub> + 6H<sub>2</sub>O.

Deliquescent in moist air. (v. Bonsdorff.)

**Didymium chloroplatinate**, DiCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O.

Less deliquescent than the cerium salt. (Marignac.)

+ 10½H<sub>2</sub>O. Deliquescent. (Cleve, Bull. Soc. (2) 43. 361.)

**Erbium chloroplatinate**, ErCl<sub>3</sub>, PtCl<sub>4</sub> + 11H<sub>2</sub>O.

Very deliquescent. (Cleve.)

**Gadolinium chloroplatinate**, GdCl<sub>3</sub>, PtCl<sub>4</sub> + 10H<sub>2</sub>O.

Ppt. (Benedicko, Z. anorg. 1900, 22. 204.)

**Glucinum chloroplatinate**, GlPtCl<sub>6</sub> + 8H<sub>2</sub>O.

Deliquescent in moist air. Very sol. in H<sub>2</sub>O, moderately in alcohol. Insol. in ether. (Welkow, B. 6. 1288.)

**Indium chloroplatinate**, 2InCl<sub>3</sub>, 5PtCl<sub>4</sub> + 36H<sub>2</sub>O.

Deliquescent. (Nilson.)

**Iron (ferrous) chloroplatinate**, FePtCl<sub>6</sub> + 6H<sub>2</sub>O.

Deliquescent. (Topsoë.)

**Iron (ferric) chloroplatinate**, FeCl<sub>3</sub>, PtCl<sub>4</sub> + 10½H<sub>2</sub>O.

Deliquescent. (Nilson.)

**Lanthanum chloroplatinate**, LaCl<sub>3</sub>, PtCl<sub>4</sub> + 13H<sub>2</sub>O.

Deliquescent; extremely sol. in H<sub>2</sub>O. (Cleve.)

**Lead chloroplatinate**, PbPtCl<sub>6</sub> + 3H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O and alcohol (Topsoë), with decomp. (Birnbbaum, Zeit. Ch. 1867. 520.)

**Lead monochloroplatinate**, [PtCl(OH)<sub>3</sub>Pb, Pb(OH)<sub>3</sub>].

Ppt. (Bellucci, Chem. Soc. 1902, 82, II. 155.)

**Lead pentachloroplatinate, basic**, PtCl<sub>5</sub>(OH)Pb, Pb(OH)<sub>3</sub>].

(Miolati, Chem. Soc. 1900, 78. (2) 732.)

**Lithium chloroplatinate**, Li<sub>2</sub>PtCl<sub>6</sub> + 6H<sub>2</sub>O.

Extremely deliquescent (Jørgensen); efflorescent. Easily sol. in H<sub>2</sub>O, alcohol, or ether-alcohol; insol. in ether. (Scheibler.)

**Lithium pentachloroplatinate**, OH.PtCl<sub>5</sub>Li<sub>2</sub>.

Very hygroscopic. (Miolati, Chem. Soc. 1900, 78 (2) 732.)

**Magnesium chloroplatinate,  $MgPtCl_6 \cdot 6H_2O$ .**Sol. in  $H_2O$  and abs. alcohol.+12 $H_2O$ . Sol. in  $H_2O$ .**Manganese chloroplatinate,  $MnPtCl_6 \cdot 6H_2O$ .**Not deliquescent; sol. in  $H_2O$ .+12 $H_2O$ . Sl. efflorescent.**Nickel chloroplatinate,  $NiPtCl_6 \cdot 6H_2O$ .**Sol. in  $H_2O$ .**Potassium chloroplatinate,  $K_2PtCl_6$ .**100 pts.  $H_2O$  dissolve at:

0°	10°	20°	30°	40°	50°
0.74	0.90	1.12	1.41	1.76	2.17

pts.  $K_2PtCl_6$ ,  
 60° 70° 80° 90° 100°  
 2.64 3.19 3.79 4.45 5.18 pts.  $K_2PtCl_6$ .

(Bunsen, Pogg. 113. 337.)

100 pts.  $H_2O$  dissolve 0.926 pt. at 15°, and 5.26 pts. at 100°. (Crookes, C. N. 9. 205.)100 g.  $H_2O$  dissolve at:

2°	16°	25°	35°	48°
0.4812	0.6718	0.8641	1.132	1.745

g.  $K_2PtCl_6$ ,  
 59° 68° 78° 92°  
 2.396 2.913 3.589 4.484 g.  $K_2PtCl_6$ .

(Archibald, J. Am. Chem. Soc. 1908, 30. 752.)

Not attacked by cold conc.  $H_2SO_4$ . (Lassaigne.)Sl. sol. in cold, more easily in hot dil. acids. Less sol. in  $KCl$ +Aq than in  $H_2O$ , and nearly insol. in sat.  $KCl$ +Aq. (Schrötter, W. A. B. 50, 2. 268.)**Solubility in  $KCl$ +Aq at 20°.**

G. mol. $KCl$ per l. of $KCl$ +Aq.	G. $K_2PtCl_6$ in 100 g. of solution.
0.00	0.7742
0.20	0.0236
0.25	0.0207
0.50	0.0109
1.00	0.0046
2.00	0.0045
3.00	0.0043
4.00	0.0042
sat.	0.0034

(Archibald, J. Am. Chem. Soc. 1908, 30. 757.)

**Solubility in  $NaCl$ +Aq at 16°.**

G. mol. $NaCl$ per litre of $NaCl$ +Aq.	G. $K_2PtCl_6$ in 100 g. of solution
0.00	0.672
0.05	0.700
0.10	0.729
0.25	0.758
0.50	0.775
0.75	0.791
1.00	0.805
2.00	0.834

(Archibald, J. Am. Chem. Soc. 1908, 30. 757.)

Sol. in  $KOH$ +Aq. Insol. in cold or hot alkali carbonates or bicarbonates+Aq. (Rose.)Easily sol. in warm  $Na_2S_2O_3$ +Aq. (Himly.)Sol. in  $NH_4Cl$ +Aq. (Brett.)Sol. in  $NH_4$  succinate+Aq. (Düpping.)

At 15–20°, sol. in 12,083 pts. absolute alcohol, in 3775 pts. 76% absolute alcohol, and in 1053 pts. 55% absolute alcohol. (Fresenius.)

Sol. in 1835 pts. 76% alcohol containing  $HCl$  at 15–20°. (Fresenius.)

Nearly absolutely insol. in alcohol containing ether.

Sol. in 42,800 pts. absolute alcohol. (Precht, Z. anal. 18. 509.)

1 l. methyl alcohol dissolves 0.072 g. at 20°. (Peligot, Monit. Sci. 1892, (4) 6. I, 873.)

**Solubility in methyl alcohol+Aq at 20°.**

% alcohol by wt.	G. $K_2PtCl_6$ in 100 g. of solution
0	0.7742
5	0.5350
10	0.4120
20	0.2642
30	0.1831
40	0.1165
50	0.0625
60	0.0325
70	0.0182
80	0.0124
90	0.0038
100	0.0027

(Archibald, J. Am. Chem. Soc. 1908, 30. 755.)

**Solubility in ethyl alcohol+Aq at 20°.**

% alcohol by wt.	G. $K_2PtCl_6$ in 100 g. of solution
0	0.7742
5	0.4910
10	0.3720
20	0.2180
30	0.1340
40	0.0760
50	0.0491
60	0.0265
70	0.0128
80	0.0085
90	0.0025
100	0.0009

(Archibald, J. Am. Chem. Soc. 1908, 30. 755.)

**Solubility in isobutyl alcohol+Aq at 20°.**

% alcohol	g. $K_2PtCl_6$ in 100 g. of solution
0	0.7742
8.20	0.6250
sat.	0.3180

(Archibald, J. Am. Chem. Soc. 1908, 30. 755.)

**Potassium pentachlorohydroplatinat**,  $K_3(PtCl_5OH)$ .

Easily sol. in  $H_2O$ . (Ruff, B. 1913. 46. 925.)

**Praseodymium chloroplatinate**,  $PrCl_3, PtCl_4 + 12H_2O$ .

Very sol. in  $H_2O$ . Sol. in conc.  $HCl$ . (von Scheele, Z. anorg. 1898, 18. 353.)

**Rubidium chloroplatinate**,  $Rb_2PtCl_6$ .

100 pts.  $H_2O$  dissolve at:

0°	10°	20°
0.184	0.154	0.141 pts. $Rb_2PtCl_6$ ,
30°	40°	50°
0.145	0.166	0.203 pts. $Rb_2PtCl_6$ ,
60°	70°	80°
0.253	0.329	0.417 pts. $Rb_2PtCl_6$ ,
90°	100°	
0.521	0.634	pts. $Rb_2PtCl_6$ .

(Bunsen, Pogg. 113. 337.)

Sol. in 740 pts.  $H_2O$  at 15°, and 157 pts. at 100°. (Crookes, C. N. 9. 205.)

Insol. in alcohol.

**Samarium chloroplatinate**,  $SmCl_3, PtCl_4 + 10\frac{1}{2}H_2O$ .

Deliquescent. Very sol. in  $H_2O$ . (Cleve, Bull. Soc. (2) 43. 165.)

**Silver chloroplatinate**,  $Ag_2PtCl_6$ .

Ppt. Gradually decomp. by  $H_2O$  into  $AgCl$  and  $PtCl_4$ . (Jørgensen, J. pr. (2) 16. 345.)

$Ag_2PtCl_6(OH)_2$ . Ppt.

**Silver monochloroplatinate**,  $[PtCl(OH)_2]Ag_2$ .

Ppt. (Bellucci, Chem. Soc. 1902, 82. (2). 155.)

**Silver pentachloroplatinate**,  $(OH)PtCl_5Ag_2$ .

Ppt.; stable in boiling  $H_2O$ . (Miolati, Chem. Soc. 1900, 78 (2). 732.)

**Silver chloroplatinate ammonia**,  $Ag_2PtCl_6, 2NH_3$ .

Insol. in  $H_2O$ . (Birnbbaum.)

**Sodium chloroplatinate**,  $Na_2PtCl_6 + 6H_2O$ .

Easily sol. in  $H_2O$ . Sat. solution at 15° contains 39.77 g.  $Na_2PtCl_6$  and has sp. gr. of 1.368. Sol. in  $NaCl + Aq$ . More sol. in absolute alcohol than in 95% alcohol. Sat. solution in abs. alcohol contains 11.90%; 95% alcohol, 6.34%. Mixture of equal parts of alcohol and ether dissolve 2.43%. Insol. in ether. (Precht, Z. anal. 18. 502.)

**Sodium pentachloroplatinate**,  $(OH)PtCl_5Na_2$ .

Exists only in solution. (Miolati, l.c.)

**Strontium chloroplatinate**,  $SrPtCl_6 + 8H_2O$ .

Very sol. in  $H_2O$ .

**Strontium monochloroplatinate**,  $PtCl(OH)_2Sr + H_2O$ .

Insol. in  $H_2O$  and org. solvents. (Bellucci, C. C. 1903, I. 131.)

**Thallium chloroplatinate**,  $Tl_2PtCl_6$ .

Very sl. sol. in  $H_2O$ . Sol. in 15,585 pts.  $H_2O$  at 15°, and 1948 pts. at 100°. (Crookes.)

**Thallium monochloroplatinate**,  $[PtCl(OH)_2]Tl$ .

Ppt. (Bellucci, Chem. Soc. 1902, 82. (2). 155.)

**Thallium pentachloroplatinate**,  $(OH)PtCl_5Tl_2$ .

(Miolati, Chem. Soc. 1900, 78 (2). 732.)

**Thorium chloroplatinate**,  $ThCl_4, PtCl_4 + 12H_2O$ .

Very deliquescent. (Cleve, Bull. Soc. (2). 21. 118.)

**Tin (stannic) chloroplatinate**,  $SnCl_4, PtCl_4 + 12H_2O$ .

(Nilson, B. 9. 1142.)

**Ytterbium chloroplatinate**,  $2YbCl_3, PtCl_4 + 22H_2O$ , and  $+35H_2O$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 137.)

**Vanadyl chloroplatinate**,  $(VO)PtCl_4 + 10\frac{1}{2}H_2O$ .

Sol. in  $H_2O$ ; cryst. from  $PtCl_4 + Aq$ . (Brauner, M. 3. 58.)

**Yttrium chloroplatinate**,  $4YCl_3, 5PtCl_4 + 52H_2O$ .

Very deliquescent. (Cleve.)

$2YCl_3, 3PtCl_4 + 30H_2O$ . (Nilson, B. 9. 1059.)

$2YCl_3, PtCl_4 + 21H_2O$ . (Nilson.)

**Zinc chloroplatinate**,  $ZnPtCl_6 + 6H_2O$ .

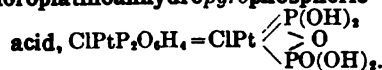
Deliquescent; sol. in  $H_2O$  and alcohol.

**Zinc tetrachloroplatinate**,  $ZnPt(OH)_2Cl_4 + 5H_2O$ .

Extremely sol. in  $H_2O$  and alcohol. (Miolati, Z. anorg. 1900, 22. 458.)

**Zirconyl chloroplatinate**,  $(ZrO)PtCl_6 + 12H_2O$ . (Nilson.)

**Chloroplatinocyanhydropyrophosphoric**



Not deliquescent. Sol. in  $H_2O$ . (Schützenberger, Bull. Soc. (2) 18. 154.)

**Chloroplatinocyanhydric acid**,  $H_2Pt(CN)_4Cl_2$ .

See Perchloroplatinocyanhydric acid.

**Potassium chloroplatinocyanide**,  $5K_2Pt(CN)_4$ ,  $K_2Pt(CN)_4Cl_2 + 21H_2O$ .

Sol. in  $H_2O$ ; insol. in alcohol.

**Silver chloroplatinocyanide**,

$Ag_2(PtCl_2(CN)_4)_2$ .

Ppt. (Miolati, C. C. 1901, I. 500.)

**Chloroplatinophosphoric acid**,

$Cl_3PtP(OH)_3$ .

Very deliquescent, and sol. in  $H_2O$ . (Schützenberger, Bull. Soc. (2) 17. 493.)

**Lead chloroplatinophosphate**,  $Pb_2(Cl_3PtPO_3)_2 + 8H_2O$ .

Ppt.

$Pb_2(Cl_3PtPO_3)_2$ ,  $2PbO + 4H_2O$ . Ppt. (Schützenberger, Bull. Soc. (2) 17. 494.)

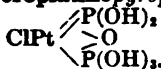
**Silver chloroplatinophosphate**,  $Ag_2HPO_3$ ,  $PtCl_3$ .

Ppt. (Schützenberger, Bull. Soc. (2) 17. 494.)

**Chloroplatinodiphosphoric acid**,  $PtCl_3$ ,  $P_2(OH)_4$ .

Very deliquescent, and easily sol. in  $H_2O$ . (Schützenberger, Bull. Soc. (2) 18. 153.)

**Chloroplatinopyrophosphoric acid**,



Less deliquescent than chloroplatinodiphosphoric acid.

**Chloroplatinous acid**,  $H_2PtCl_4$ .

Known only in solution.

**Aluminum chloroplatinite**,  $AlPtCl_3 + 10\frac{1}{2}H_2O$ .

Very deliquescent; sol. in  $H_2O$ . (Nilson, J. pr. (2) 15. 260.)

**Ammonium chloroplatinite**,  $(NH_4)_2PtCl_4$ .

Sl. sol. in cold, easily in hot  $H_2O$ . Insol. in alcohol. (Peyrone, A. 55. 206.)

**Barium chloroplatinite**,  $BaPtCl_4 + 3H_2O$ .

Not deliquescent; sol. in  $H_2O$ . Very sl. sol. in 93% alcohol.

**Cadmium chloroplatinite ammonia**,  $CdPtCl_4$ ,  $4NH_3$ .

Insol. in  $H_2O$  or  $NH_4OH + Aq$ . Sol. in  $HCl + Aq$ . (Thomsen, B. 2. 668.)

**Cæsium chloroplatinite**,  $Cs_2PtCl_4$ .

Sl. sol. in cold, easily in hot  $H_2O$ .

100 pts.	$H_2O$	dissolve	3.4 pts.	salt at	20°
"	"	"	6.73	"	40°
"	"	"	8.68	"	60°
"	"	"	10.92	"	80°
"	"	"	12.10	"	100°

(Godeffroy, A. 181. 176.)

$Cs_2PtCl_4$ . Ppt. Very sensitive to sunlight. Decomp. by  $H_2O$  into the higher and lower chlorides. (Wöhler, B. 1909, 42. 4104.)

**Calcium chloroplatinite**,  $CaPtCl_4 + 8H_2O$ .

Deliquescent; sol. in  $H_2O$ .

**Cerium chloroplatinite**,  $CeCl_3$ ,  $2PtCl_2 + 10\frac{1}{2}H_2O$ .

Deliquescent; easily sol. in  $H_2O$ . (Nilson, B. 9. 1847.)

**Chromium chloroplatinite**,  $Cr_2Pt_2Cl_{12} + 18H_2O$ .

Deliquescent.

**Cobalt chloroplatinite**,  $CoPtCl_4 + 6H_2O$ .

Sl. deliquescent in moist, efflorescent in dry air.

**Copper chloroplatinite**,  $CuPtCl_4 + 6H_2O$ .

Extremely deliquescent. (Topsøe.)

**Copper chloroplatinite ammonia (cuprammonium chloroplatinite)**,  $Cu(NH_3)_4PtCl_4$ .

Insol. in  $H_2O$  or  $NH_4OH + Aq$ ; easily sol. in  $H_2SO_4 + Aq$ . (Millon and Commaille, C. R. 57. 822.)

**Didymium chloroplatinite**,  $DiCl_3$ ,  $2PtCl_2 + 10H_2O$ .

Deliquescent; very sol. in  $H_2O$ . (Nilson.)  $2DiCl_3$ ,  $3PtCl_2 + 18H_2O$ . As above. (Nilson.)

**Erbium chloroplatinite**,  $ErPtCl_3 + 13\frac{1}{2}H_2O$ .

Deliquescent.

$Er_2Pt_2Cl_{12} + 24H_2O$ . Deliquescent in moist air.

**Glucinum chloroplatinite**,  $GlPtCl_4 + 5H_2O$ .

Deliquescent in moist air. Sol. in  $H_2O$  in all proportions.

**Iron (ferrous) chloroplatinite**,  $FePtCl_4 + 7H_2O$ .

Deliquescent. Rather sl. sol. in cold, very sol. in hot  $H_2O$ . (Nilson.)

**Lanthanum chloroplatinite**,  $La_2Pt_2Cl_{12} + 18$ , and  $27H_2O$ .

Deliquescent.

**Lead chloroplatinite**,  $PbPtCl_4$ .

Insol. in cold  $H_2O$ .

**Lithium chloroplatinite**,  $Li_2PtCl_4 + 6H_2O$ .

Sol. in  $H_2O$ .

**Magnesium chloroplatinite**,  $MgPtCl_4 + 6H_2O$ .

Not very deliquescent; very sol. in  $H_2O$ .

**Manganese chloroplatinite,  $\text{MnPtCl}_6 + 6\text{H}_2\text{O}$ .**

As the Mg salt.

**Mercurous chloroplatinite.**

Ppt.

**Nickel chloroplatinite,  $\text{NiPtCl}_6 + 6\text{H}_2\text{O}$ .**

As the Co salt.

**Potassium chloroplatinite,  $\text{K}_2\text{PtCl}_6$ .**Moderately sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol.**Rubidium chloroplatinite,  $\text{Rb}_2\text{PtCl}_6$ .**Sl. sol. in cold; easily in hot  $\text{H}_2\text{O}$ .**Silver chloroplatinite,  $\text{Ag}_2\text{PtCl}_6$ .**Insol. in  $\text{H}_2\text{O}$ .  $\text{NH}_4\text{OH} + \text{Aq}$  dissolves out  $\text{AgCl}$ . (Lang.) $\text{AgCl}$ ,  $\text{PtCl}_2$ (?). As above. (Commaille, Bull. Soc. (2) 6. 262.)**Silver chloroplatinite ammonia,  $\text{Ag}_2\text{PtCl}_6, 4\text{NH}_3$ .**

(Thomsen.)

**Sodium chloroplatinite,  $\text{Na}_2\text{PtCl}_6 + 4\text{H}_2\text{O}$ .**Deliquescent; very sol. in  $\text{H}_2\text{O}$ .**Strontium chloroplatinite,  $\text{SrPtCl}_6 + 6\text{H}_2\text{O}$ .**Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .**Thallium chloroplatinite,  $\text{Tl}_2\text{PtCl}_6$ .**Very sl. sol. even in boiling  $\text{H}_2\text{O}$ .**Thorium chloroplatinite,  $\text{Th}_2\text{PtCl}_6 + 24\text{H}_2\text{O}$ .**

Very deliquescent.

**Yttrium chloroplatinite,  $\text{Y}_2\text{PtCl}_6 + 24\text{H}_2\text{O}$ .**

Deliquescent.

**Zinc chloroplatinite,  $\text{ZnPtCl}_6 + 6\text{H}_2\text{O}$ .**Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ ; insol. in alcohol.**Zinc chloroplatinite ammonia,  $\text{ZnPtCl}_6, 4\text{NH}_3$ .**Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Thomsen, J. B. 1868. 278.)**Zirconyl chloroplatinite,  $(\text{ZrO})\text{PtCl}_6 + 8\text{H}_2\text{O}$ .**

(Nilson.)

**Trichloroplatinous acid,  $\text{H}_2\text{Pt}(\text{OH})\text{Cl}_3$ .**Sol. in  $\text{H}_2\text{O}$ . (Miolati, Z. anorg. 1902, 33. 265.) $+ \text{H}_2\text{O}$ . (Nilson, J. pr. (2) 15. 260.)**Lead trichloroplatinite,  $\text{PbPt}(\text{OH})\text{Cl}_3$ .**

Ppt. (Miolati.)

**Silver trichloroplatinite,  $\text{Ag}_2\text{Pt}(\text{OH})\text{Cl}_3$ .**

Ppt. (Miolati.)

**Chloroplatosulphurous acid.****Ammonium chloroplatosulphite, acid,  $\text{NH}_4\text{PtClSO}_3, \text{H}_2\text{SO}_3 + 4\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Birnbäum, A. 152. 149.)**Ammonium chloroplatosulphite chloride sulphite,  $\text{NH}_4\text{PtClSO}_3, (\text{NH}_4)_2\text{SO}_3, \text{NH}_4\text{Cl}$ .**

Very deliquescent. (Birnbäum.)

**Ammonium chloroplatosulphite sulphite,  $\text{NH}_4\text{ClPtSO}_3, (\text{NH}_4)_2\text{SO}_3 + 3\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Birnbäum.)**Barium chloroplatosulphite chloride ammonium chloride,  $\text{Ba}(\text{ClPtSO}_3)_2, \text{Ba}(\text{PtClSO}_3)_2\text{Cl}, 6\text{NH}_4\text{Cl} + 3\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Birnbäum.)**Potassium chloroplatosulphite ammonium chloride,  $\text{KPtClSO}_3, 2\text{NH}_4\text{Cl}$ .**

Very deliquescent. (Birnbäum, A. 152. 142.)

**Potassium chloroplatosulphite chloride,  $\text{KPtClSO}_3, 2\text{KCl}$ .**Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Birnbäum, A. 152. 145.)**Potassium chloroplatosulphite ammonium potassium sulphite,  $\text{KPtClSO}_3, (\text{NH}_4)_2\text{KSO}_3 + 3\text{H}_2\text{O}$ .**

Very deliquescent. (Birnbäum, A. 159. 120.)

**Sodium chloroplatosulphite ammonium chloride,  $\text{NaPtClSO}_3, 2\text{NH}_4\text{Cl}$ .**

Very deliquescent. (Birnbäum, A. 159. 117.)

**Chloroplumbic acid,  $\text{H}_2\text{PbCl}_4$ .**

Decomp. in solution on standing. (Gutbier, J. pr. 1914, (2) 90. 497.)

**Ammonium chloroplumbate,  $(\text{NH}_4)_2\text{PbCl}_4$ .**Ppt. Difficultly sol. in a small amount of  $\text{H}_2\text{O}$ . Solution decomp. slowly when cold, more rapidly when warmed.Decomp. by a large amount of  $\text{H}_2\text{O}$ . Sol. without decomp. in 20%  $\text{HCl}$ . Decomp. by dil. acids and alkalis. (Elbs, Z. Elektrochem. 1903, 9. 778.)Difficultly sol. in small amount of  $\text{H}_2\text{O}$  and solution decomp. slowly in the cold, more rapidly when warmed. Decomp. by a large amount of  $\text{H}_2\text{O}$ . (Gutbier, J. pr. 1914, (2) 90. 498.)Sol. in cold  $\text{HNO}_3$  without decomp. (Friedrich, M. 1893, 14. 511.)Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Nikoljukin, B. 18. 370 R.) $5\text{NH}_4\text{Cl}, 2\text{PbCl}_4$ . Not hygroscopic. Decomp. by  $\text{H}_2\text{O}$  with pptn. of  $\text{PbO}_2$ . Sol. in  $\text{HCl} + \text{Aq}$  and in cold  $\text{HNO}_3 + \text{Aq}$  without

decomp. (Classen and Zahoraki, *Z. anorg.* **4**, 100.)

Composition is  $2\text{NH}_4\text{Cl}$ ,  $\text{PbCl}_2$ . (Friedrich, *W. A. B.* **102**, 2b. 527.)

**Cesium chloroplumbate**,  $\text{Cs}_2\text{PbCl}_4$ .

Nearly absolutely insol. in conc.  $\text{CsCl} + \text{Aq}$  in presence of  $\text{Cl}_2$ . (Wells, *Z. anorg.* **4**, 335.)

1 ccm. conc.  $\text{HCl} + \text{Aq}$  containing  $\text{PbCl}_2$  dissolves 0.000049 g.  $\text{Cs}_2\text{PbCl}_4$ . (Wells, *Z. anorg.* **4**, 341.)

Reacts with  $\text{H}_2\text{O}$  as the corresponding ammonium salt. (Gutbier, *J. pr.* 1914, (2) 90. 506.)

**Potassium chloroplumbate**,  $\text{K}_2\text{PbCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{KCl} + \text{Aq}$ . (Wells, *Z. anorg.* **4**, 335.)

Readily decomp. in the air. (Gutbier, *J. pr.* 1914, (2) 90. 499.)

**Rubidium chloroplumbate**,  $\text{Rb}_2\text{PbCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in conc.  $\text{RbCl} + \text{Aq}$ . (Wells, *Z. anorg.* **4**, 335.)

1 ccm. conc.  $\text{HCl} + \text{Aq}$  containing  $\text{PbCl}_2$  dissolves 0.003 g.  $\text{Rb}_2\text{PbCl}_4$ . (Wells, *Z. anorg.* **4**, 341.)

Reacts with  $\text{H}_2\text{O}$  as the corresponding ammonium salt. (Gutbier, *J. pr.* 1914, (2) 90. 499.)

Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Insol. in 96% alcohol. (Erdmann, *A.* 1896, 294. 76.)

**Chloropurpleochromium bromide**,  $\text{CrCl}(\text{NH}_3)_5\text{Br}_2$ .

Somewhat more easily sol. in  $\text{H}_2\text{O}$  than the chloride. (Jørgensen, *J. pr.* (2) 20. 105.)

— **chloride**,  $\text{CrCl}(\text{NH}_3)_5\text{Cl}_2$ .

Difficultly sol. in cold, and decomp. by hot  $\text{H}_2\text{O}$ .

1 pt. dissolves in 154 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . Insol. in conc.  $\text{HCl} + \text{Aq}$ . More sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. (Jørgensen, *J. pr.* (2) 20. 105.)

— **mercuric chloride**,  $\text{CrCl}(\text{NH}_3)_5\text{Cl}_2 \cdot 3\text{HgCl}_2$ .

Very difficultly sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chloroplatinate**,  $\text{CrCl}(\text{NH}_3)_5(\text{PtCl}_6)$ .

Extremely difficultly sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chromate**,  $\text{CrCl}(\text{NH}_3)_5(\text{CrO}_4)$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; sl. more sol. than chloropurpleocobalt chromate. (Jørgensen.)

— **dithionate**,  $\text{CrCl}(\text{NH}_3)_5(\text{S}_2\text{O}_8)$ .

Very sl. sol. in cold, but much more easily in hot  $\text{H}_2\text{O}$ . (Jørgensen.)

**Chloropurpleochromium ferrocyanide**,  $[\text{CrCl}(\text{NH}_3)_5]_2\text{Fe}(\text{CN})_6 \cdot 4\text{H}_2\text{O}$ .

Very difficultly sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

— **fluosilicate**,  $\text{CrCl}(\text{NH}_3)_5(\text{SiF}_6)$ .

Very difficultly sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{SiF}_6 + \text{Aq}$ . (Jørgensen, *J. pr.* (2) 20. 105.)

— **mercuric iodide**,  $\text{CrCl}(\text{NH}_3)_5\text{I}_2 \cdot 2\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in alcohol and warm  $\text{KCN} + \text{Aq}$ .

$\text{CrCl}(\text{NH}_3)_5\text{I}_2 \cdot \text{HgI}_2$ . Very difficultly sol. in cold  $\text{H}_2\text{O}$ ; easily sol. in  $\text{KCN} + \text{Aq}$ . (Jørgensen, *l.c.*)

— **nitrate**,  $\text{CrCl}(\text{NH}_3)_5(\text{NO}_3)_2$ .

Sol. in 71 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ . (Jørgensen.)

— **oxalate**,  $\text{CrCl}(\text{NH}_3)_5\text{C}_2\text{O}_4$ .

Very sl. sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen, *l.c.*)

— **sulphate**,  $\text{CrCl}(\text{NH}_3)_5\text{SO}_4 \cdot 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; precipitated by alcohol. (Jørgensen.)

— **sulphate, acid**,  $[\text{CrCl}(\text{NH}_3)_5]_2\text{SO}_4(\text{HSO}_4)_2$ .

Quite sol. in  $\text{H}_2\text{O}$ . (Jørgensen, *J. pr.* (2) 20. 185.)

— **pentasulphide**,  $\text{CrCl}(\text{NH}_3)_5\text{S}_5$ .

Very sl. sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$ . Decomp. by dil.  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Jørgensen.)

**Chloropurpleocobaltic bromide**,  $\text{CoCl}(\text{NH}_3)_5\text{Br}_2$ .

Properties resemble the chloride very closely. Sol. in 214 pts.  $\text{H}_2\text{O}$  at  $14.3^\circ$  (Jørgensen, *J. pr.* (2) 18. 205.)

— **mercuric bromide**,  $4\text{CoCl}(\text{NH}_3)_5\text{Br}_2 \cdot 9\text{HgBr}_2$ .

Ppt. (J.)

— **bromoplatinate**,  $\text{CoCl}(\text{NH}_3)_5\text{Br}_2 \cdot \text{PtBr}_6$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (J.)

— **carbonate**,  $\text{CoCl}(\text{NH}_3)_5\text{CO}_3 \cdot 4\frac{1}{2}\text{H}_2\text{O}$ .

Efflorescent; very easily sol. in  $\text{H}_2\text{O}$ . (J.)

— **chloride**,  $\text{CoCl}(\text{NH}_3)_5\text{Cl}_2$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in 244 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ . (Claudet, *Phil. Mag. J.* (4) 2. 253.) In 287 pts.  $\text{H}_2\text{O}$  at  $10.2^\circ$  and 255 pts. at  $11.5^\circ$ . (Rose, *Pogg.* **20**, 152.) 100 pts.  $\text{H}_2\text{O}$  dissolve 0.232 pt.  $\text{CoCl}_2$ ,  $5\text{NH}_3$ , at  $0^\circ$ , and 1.031 pts. at  $46.6^\circ$ . (Kurnakoff, *J. Russ. Soc.* **24**, 629.)

Sl. decomp. by cold, completely by boiling  $\text{H}_2\text{O}$ ; decomp. prevented by a little  $\text{HCl}$ . Pptd. from aqueous solution by alcohol,  $\text{HCl}$ ,

or sat. KCl or NaCl + Aq; not decomp. by boiling HCl + Aq. (Claudet, *l.c.*) Nearly insol. in cold, but sol. in hot H<sub>2</sub>O, to which a few drops of HCl have been added. Less sol. in dil. HCl + Aq than luteocobaltic chloride. (Rogojski, A. ch. (3) 41. 447.)

Insol. in alcohol. (Gibbs and Genth.)

**Chloropurpureocobaltic antimony chloride,**  
2CoCl(NH<sub>3</sub>)<sub>5</sub>Cl<sub>3</sub>, SbCl<sub>3</sub>.

Ppt. Decomp. by H<sub>2</sub>O. (Gibbs.)

— **bismuth chloride.**

Insol. in conc. HCl. Easily decomp. by H<sub>2</sub>O. (Gibbs.)

— **mercuric chloride,** CoCl(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>,  
3HgCl<sub>2</sub>.

Insol. in cold, less sol. in hot H<sub>2</sub>O than chloropurpureocobaltic chloride. Insol. in cold fuming HCl + Aq; sl. sol. in hot HCl + Aq, separating on cooling; sl. sol. in hot aqua regia; moderately sol. in hot HNO<sub>3</sub> + Aq; partly sol. in cold conc. H<sub>2</sub>SO<sub>4</sub>, wholly on warming. Easily sol. in warm H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq. Insol. in HgCl<sub>2</sub> + Aq.

Moderately sol. in NH<sub>4</sub>OH + Aq or (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Carstanjen.)

CoCl(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>, 2HgCl<sub>2</sub>. Sl. sol. in cold, but much more easily in hot H<sub>2</sub>O. (Gibbs, Proc. Am. Acad. 10. 33.)

— **chloropalladite,** CoCl(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>, PdCl<sub>2</sub>.

Sl. sol. in cold, moderately sol. in hot H<sub>2</sub>O. (Carstanjen.)

— **chloroplatinate,** CoCl(NH<sub>3</sub>)<sub>5</sub>Cl<sub>3</sub>, PtCl<sub>4</sub>.

Nearly insol. in cold. Very sl. sol. in hot H<sub>2</sub>O. (Gibbs and Genth, Sill. Am. J. (2) 23. 319.)

— **chromate,** CoCl(NH<sub>3</sub>)<sub>5</sub>CrO<sub>4</sub>.

Very sl. sol. in H<sub>2</sub>O. (J.)

— **dichromate,** CoCl(NH<sub>3</sub>)<sub>5</sub>Cr<sub>2</sub>O<sub>7</sub>.

Much more easily sol. in H<sub>2</sub>O than the neutral salt. (J.)

— **dithionate,** CoCl(NH<sub>3</sub>)<sub>5</sub>S<sub>2</sub>O<sub>8</sub>.

Very sl. sol. in cold, more easily in hot H<sub>2</sub>O. (J.)

— **manganic fluoride.**

Ppt. Sl. sol. in dil. HF + Aq. (Christensen, J. pr. (2) 35. 161.)

— **fluosilicate,** CoCl(NH<sub>3</sub>)<sub>5</sub>SiF<sub>6</sub>.

Very sl. sol. in HF + Aq.

— **iodide,** CoCl(NH<sub>3</sub>)<sub>5</sub>I<sub>2</sub>.

Much more sol. in H<sub>2</sub>O than bromide or chloride. Sol. in 54.5 pts. H<sub>2</sub>O at 15.6°, and 50 pts. at 19.3°. (J.)

**Chloropurpureocobaltic mercuric iodide,**  
CoCl(NH<sub>3</sub>)<sub>5</sub>I<sub>2</sub>, 2HgI<sub>2</sub>.

Sl. sol. in H<sub>2</sub>O. (J.)

CoCl(NH<sub>3</sub>)<sub>5</sub>I<sub>2</sub>, HgI<sub>2</sub>. Very sl. sol. in cold H<sub>2</sub>O. (J.)

— **nitrate,** CoCl(NH<sub>3</sub>)<sub>5</sub>(NO<sub>3</sub>)<sub>2</sub>.

Sol. in 80 pts. H<sub>2</sub>O at 15°. Rather easily sol. in hot H<sub>2</sub>O. (Jørgensen, J. pr. (2) 18. 209.)

— **oxalate,** CoCl(NH<sub>3</sub>)<sub>5</sub>C<sub>2</sub>O<sub>4</sub>.

Sl. sol. in H<sub>2</sub>O. (J.)

— **pyrophosphate,** CoCl(NH<sub>3</sub>)<sub>5</sub>(H<sub>2</sub>P<sub>2</sub>O<sub>7</sub>).

Sl. and very slowly sol. in cold, much more easily in warm H<sub>2</sub>O. (J.)

[CoCl(NH<sub>3</sub>)<sub>5</sub>]<sub>2</sub>P<sub>2</sub>O<sub>7</sub> + xH<sub>2</sub>O. Quite easily sol. in H<sub>2</sub>O.

— **diphosphopentamolybdate,**

[CoCl(NH<sub>3</sub>)<sub>5</sub>]<sub>2</sub>(5MoO<sub>3</sub>, 2HPO<sub>4</sub>).

Ppt. Nearly insol. in pure H<sub>2</sub>O; more sol. in dil. H<sub>2</sub>SO<sub>4</sub> + Aq without decomp. (J.)

[CoCl(NH<sub>3</sub>)<sub>5</sub>]<sub>2</sub>(5MoO<sub>3</sub>, 2NH<sub>4</sub>PO<sub>4</sub>). Ppt. As above.

— **sulphate,** CoCl(NH<sub>3</sub>)<sub>5</sub>SO<sub>4</sub>.

*Anhydrous.* Slowly sol. in 128–131.9 pts. H<sub>2</sub>O at 16°.

+ 2H<sub>2</sub>O. Sol. in 133.4 pts. H<sub>2</sub>O at 17.3°. Rather easily sol. in hot H<sub>2</sub>O, and much more rapidly than the anhydrous salt. (J.)

[CoCl(NH<sub>3</sub>)<sub>5</sub>]<sub>2</sub>SO<sub>4</sub>(SO<sub>3</sub>H)<sub>6</sub>. Decomp. by H<sub>2</sub>O into neutral sulphate. Sol. in H<sub>2</sub>SO<sub>4</sub>.

— **tartrate,** CoCl(NH<sub>3</sub>)<sub>5</sub>(C<sub>4</sub>H<sub>4</sub>O<sub>6</sub>)<sub>2</sub> +  
2½H<sub>2</sub>O.

Moderately sol. in H<sub>2</sub>O; insol. in alcohol.

— **thiosulphate,** CoCl(NH<sub>3</sub>)<sub>5</sub>S<sub>2</sub>O<sub>3</sub>.

Nearly insol. in cold H<sub>2</sub>O; very sl. sol. in boiling H<sub>2</sub>O with partial decomp. (J.)

**Chloropurpureoiridium comps.**

See *Iridopentamine comps.*

**Chloropurpureorhodium carbonate,**

ClRh(NH<sub>3</sub>)<sub>5</sub>CO<sub>3</sub> + H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O. (Jørgensen.)

— **chloride,** ClRh(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>.

Sol. in 179 pts. H<sub>2</sub>O at 17°, and more easily in hot H<sub>2</sub>O. Sol. in conc. H<sub>2</sub>SO<sub>4</sub> or boiling NaOH + Aq without decomp. Very sl. sol. in cold dil. HCl + Aq (1 : 1). Sl. sol. in hot HCl + Aq. Insol. in alcohol. (Jørgensen, J. pr. (2) 27. 433; 34. 394.)

— **rhodium chloride,**  
3ClRh(NH<sub>3</sub>)<sub>5</sub>Cl<sub>2</sub>, 2RhCl<sub>3</sub>.

Ppt. (Jørgensen, Z. anorg. 5. 75.)

**Chloropurpleorhodium chloroplatinate,**  
 $\text{ClRh}(\text{NH}_3)_5\text{PtCl}_6$ .Insol. in cold  $\text{H}_2\text{O}$ . (J.)— **fluosilicate,**  $\text{ClRh}(\text{NH}_3)_5\text{SiF}_6$ .Very sl. sol. in cold  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH} + \text{Aq}$  as roseo salt. (J.)— **hydroxide,**  $\text{ClRh}(\text{NH}_3)_5(\text{OH})_2$ .

Known only in solution. (J.)

— **nitrate,**  $\text{ClRh}(\text{NH}_3)_5(\text{NO}_3)_2$ .Sl. sol. in cold  $\text{H}_2\text{O}$ , but more easily than the chloride. Sol. in boiling  $\text{NaOH} + \text{Aq}$  as roseo salt. (J.)— **sulphate,**  $\text{ClRh}(\text{NH}_3)_5\text{SO}_4 + 2\text{H}_2\text{O}$ .Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (J.)  
 $4\text{ClRh}(\text{NH}_3)_5\text{SO}_4 \cdot 3\text{H}_2\text{SO}_4$ . Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (J.)**Chlororhodous acid.****Ammonium chlororhodite,**  $(\text{NH}_4)_2\text{RhCl}_5 + \text{H}_2\text{O}$ .

(Gutbier, B. 1908, 41. 213.)

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Wollaston.)  
Not obtainable. (Leidié, A. ch. (6) 17. 275.) $(\text{NH}_4)_2\text{RhCl}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but less easily than Na salt; insol. in alcohol. Sol. in dil.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Claus, J. B. 1855. 423.) (Gutbier, l. c.)**Ammonium chlororhodite nitrate,**  
 $(\text{NH}_4)_2\text{Rh}_2\text{Cl}_6 \cdot 2\text{NH}_4\text{NO}_3$ .Very sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . (Leidié, C. R. 107. 234.)**Barium chlororhodite,**  $\text{Ba}_2(\text{RhCl}_5)_2$ .

Resembles the Na salt. (Bunsen, A. 146. 276.)

**Cæsium chlororhodite,**  $\text{Cs}_2\text{RhCl}_5 + \text{H}_2\text{O}$ .Difficulty sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1908, 41. 214.)**Lead chlororhodite,**  $\text{Pb}_2(\text{RhCl}_5)_2$ .Ppt. Insol. in  $\text{H}_2\text{O}$ . (Claus.) Not obtainable. (Leidié.)**Mercurous chlororhodite,**  $\text{Hg}_2\text{RhCl}_5$ .Ppt. Insol. in  $\text{H}_2\text{O}$ . (Claus.) Not obtainable. (Leidié.)**Potassium chlororhodite,**  $\text{K}_2\text{RhCl}_5 + \text{H}_2\text{O}$ .Not efflorescent. Sl. sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KCl} + \text{Aq}$ . (Gibbs.) Insol. or sl. sol. in alcohol. (Berzelius.)

Salt is anhydrous. (Leidié.)

Contains  $1\text{H}_2\text{O}$ . (Seubert and Kobbé, B. 23. 2556.)Can be cryst. from  $\text{H}_2\text{O}$  containing a little  $\text{HCl}$ . (Gutbier, B. 1908, 41. 212.) $\text{K}_2\text{RhCl}_5 + 3\text{H}_2\text{O}$ . Efflorescent. Sl. sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. to above on standing. (Claus.)

Not obtainable. (Leidié.)

Also obtained by Seubert and Kobbé. (B. 23. 2556.)

 $+1\frac{1}{2}\text{H}_2\text{O}$ . (Leidié, C. R. 111. 106.)**Rubidium chlororhodite,**  $\text{Rb}_2\text{RhCl}_5 + \text{H}_2\text{O}$ .Difficulty sol. in  $\text{H}_2\text{O}$ . (Gutbier, B. 1908, 41. 214.)**Silver chlororhodite,**  $\text{Ag}_2\text{RhCl}_5$ .Ppt. Insol. in  $\text{H}_2\text{O}$ . (Claus.)

Not obtainable. (Leidié.)

**Sodium chlororhodite,**  $\text{Na}_2\text{Rh}_2\text{Cl}_{12} + 18\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{RhCl}_5 + 9\text{H}_2\text{O}$ .Efflorescent. Sol. in 1.5 pts.  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $50^\circ$ . Insol. in alcohol. (Claus.) $+12\text{H}_2\text{O}$ . (Gutbier, B. 1908, 41. 213.)**Chlororuthenic acid.****Ammonium chlororuthenate,**  $(\text{NH}_4)_2\text{RuCl}_6$ .Easily sol. in  $\text{H}_2\text{O}$ . (Claus.)Formula is  $(\text{NH}_4)_2\text{Ru}(\text{NO})\text{Cl}_5$ . (Joly, C. R. 107. 994.)Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HCl}$ . (Howe, J. Am. Chem. Soc. 1904, 26. 549.)**Ammonium aquochlororuthenate,**  
 $(\text{NH}_4)_2\text{Ru}(\text{H}_2\text{O})\text{Cl}_5$ .

Ppt. (Howe, J. Am. Chem. Soc. 1904, 26. 548.)

**Cæsium chlororuthenate,**  $\text{Cs}_2\text{RuCl}_6$ .Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in hot dil.  $\text{HCl} + \text{Aq}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 784.)**Potassium chlororuthenate,**  $\text{K}_2\text{RuCl}_6$ .Very sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in 70% alcohol. (Claus.)Formula is  $\text{K}_2\text{Ru}(\text{NO})\text{Cl}_5$ . (Joly.)  
Very sl. sol. in cold  $\text{H}_2\text{O}$ . Insol. in presence of  $\text{KCl}$ .

Partially decomp. in hot aqueous solution. (Antony, Gazz. ch. it. 1899, 29. (2), 82.)

Easily sol. in  $\text{H}_2\text{O}$  with rapid decomp. Sol. in  $\text{HCl}$ . (Howe, J. Am. Chem. Soc. 1904, 26. 548.)**Potassium aquochlororuthenate,**  
 $\text{K}_2\text{Ru}(\text{OH}_2)\text{Cl}_5$ .Sol. in  $\text{H}_2\text{O}$ . (Howe, J. Am. Chem. Soc. 1904, 26. 547.)**Rubidium chlororuthenate,**  $\text{Rb}_2\text{RuCl}_6$ .Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in hot dil.  $\text{HCl} + \text{Aq}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 784.)



**Chlororuthenious acid.****Ammonium chlororuthenite**,  $(\text{NH}_4)_4\text{Ru}_2\text{Cl}_{10}$ .Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  or alcohol. (Claus, J. pr. 80. 232.)**Cæsium chlororuthenite**,  $\text{Cs}_2\text{RuCl}_5 + \text{H}_2\text{O}$ .Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 785.)**Potassium chlororuthenite**,  $\text{K}_4\text{Ru}_2\text{Cl}_{10}$ .Moderately sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Decomp. easily by heating. Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in 80% alcohol.**Rubidium chlororuthenite**,  $\text{Rb}_2\text{RuCl}_5 + \text{H}_2\text{O}$ .Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 786.)**Sodium chlororuthenite**,  $\text{Na}_4\text{Ru}_2\text{Cl}_{10}$ .Deliquescent. Sol. in  $\text{H}_2\text{O}$  or alcohol.**Trichlorosilicomercaptane.**

See Silicon chlorohydrosulphide.

**Chlorosmic acid.****Ammonium chlorosmate**,  $(\text{NH}_4)_2\text{OsCl}_4$ .Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and  $\text{H}_2\text{O}$  containing  $\text{HCl}$ .**Potassium chlorosmate**,  $\text{K}_2\text{OsCl}_4$ .Properties as the  $\text{NH}_4$  salt.**Potassium amino chlorosmate**, $(\text{NH}_2)\text{OsCl}_4 \cdot 2\text{KCl}$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 375.)

**Potassium amino, chlorosmate hydrogen chloride**,  $(\text{NH}_2)\text{OsCl}_4 \cdot 2\text{KCl} \cdot \text{HCl}$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 378.)

**Silver chlorosmate**,  $\text{Ag}_2\text{OsCl}_4$ .Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . (Claus and Jacoby.)**Silver chlorosmate ammonia**,  $\text{Ag}_2\text{OsCl}_4 \cdot 2\text{NH}_3$ .Sol. in much  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KOH} + \text{Aq}$ . Easily sol. in  $\text{KCN} + \text{Aq}$ . (C. and J.)**Sodium chlorosmate**,  $\text{Na}_2\text{OsCl}_4 + 2\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$  or alcohol.**Chlorosmious acid.****Ammonium chlorosmite**,  
 $(\text{NH}_4)_3\text{Os}_2\text{Cl}_{10} + 3\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$  and alcohol; insol. in ether. (Claus and Jacoby, J. pr. 90. 65.)**Potassium chlorosmite**,  $\text{K}_3\text{Os}_2\text{Cl}_{10} + 6\text{H}_2\text{O}$ .Very easily sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (C. and J.)**Chlorosmisulphurous acid.****Potassium hydrogen chlorosmisulphite**,  
 $\text{OsCl}_4(\text{SO}_2)_2 \cdot \text{K}_2\text{H}_2$ .

Ppt. (Rosenheim, Z. anorg. 1900, 24. 422.)

**Sodium chlorosmisulphite**,  
 $\text{OsCl}_4(\text{SO}_2)_2 \cdot \text{Na}_4 + 10\text{H}_2\text{O}$ .

Ppt. (Rosenheim, Z. anorg. 1900, 24. 420.)

**Chloropyroselenious acid.****Ammonium chloropyroselenite**,  $\text{NH}_4\text{Cl}$ ,  
 $2\text{SeO}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Muthmann and Schäfer, B. 26. 1008.)**Potassium chloropyroselenite**,  $\text{KCl}$ ,  $2\text{SeO}_2 + \text{H}_2\text{O}$ .As  $\text{NH}_4$  salt. (M. and S.)**Rubidium chloropyroselenite**,  $\text{RbCl}$ ,  
 $2\text{SeO}_2 + 2\text{H}_2\text{O}$ .As  $\text{NH}_4$  salt. (M. and S.)**Chlorostannic acid**,  $\text{SnO}(\text{OH})\text{Cl}$ .

(Mallet, Chem. Soc. 35. 524.)

 $\text{H}_2\text{SnCl}_4 + 6\text{H}_2\text{O}$ . Extremely deliquescent; sol. in  $\text{H}_2\text{O}$ . (Seubert, B. 20. 793.)**Ammonium chlorostannate**,  $(\text{NH}_4)_2\text{SnCl}_4$   
(pink salt).Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $14.5^\circ$ . Solution decomp. on boiling when dilute, but not when conc. (Bolley.)**Barium chlorostannate**,  $\text{BaSnCl}_4 + 5\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Lewy, A. ch. (3) 16. 308.)**Cæsium chlorostannate**,  $\text{Cs}_2\text{SnCl}_4$ .Nearly insol. in conc.  $\text{HCl} + \text{Aq}$ . (Sharples, Sill. Am. J. (2) 47. 178.)**Calcium chlorostannate**,  $\text{CaSnCl}_4 + 5\text{H}_2\text{O}$ .

Very deliquescent. (Lewy, A. ch. (3) 16. 308.)

**Cerium chlorostannate**,  $\text{CeSnCl}_4 + 9\text{H}_2\text{O}$ .Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 31. 197.)**Cobalt chlorostannate**,  $\text{CoSnCl}_4 + 6\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)**Didymium chlorostannate**,  $\text{DiCl}_2$ ,  $\text{SnCl}_4 + 10\frac{1}{2}\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Glucinum chlorostannate**,  $\text{GlSnCl}_4 + 8\text{H}_2\text{O}$ .Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Atterberg, Sv. V. A. Handl. 12. No. 4. 14.)

**Lanthanum chlorostannate**,  $4\text{LaCl}_3 \cdot 5\text{SnCl}_4 + 45\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Lithium chlorostannate**,  $\text{Li}_2\text{SnCl}_6 \cdot 8\text{H}_2\text{O}$ .

Sol. in little  $\text{H}_2\text{O}$  without decomp., but decomp. by dilution. (Chassevant, A. ch. (6) 30. 42.)

**Magnesium chlorostannate**,  $\text{MgSnCl}_6 \cdot 6\text{H}_2\text{O}$ .

Very deliquescent. (Lewy.)

**Manganous chlorostannate**,  $\text{MnSnCl}_6 \cdot 6\text{H}_2\text{O}$ .

Deliquescent in moist, efflorescent in dry air. (Jørgensen.)

**Nickel chlorostannate**,  $\text{NiSnCl}_6 \cdot 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

**Potassium chlorostannate**,  $\text{K}_2\text{SnCl}_6$ .

Sol. in  $\text{H}_2\text{O}$ .

**Sodium chlorostannate**,  $\text{Na}_2\text{SnCl}_6 \cdot 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë, Gm. K. Handb. 6<sup>te</sup> aufl. III. 149.)

**Strontium chlorostannate**,  $\text{SrSnCl}_6 \cdot 8\text{H}_2\text{O}$ .

Sl. deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Yttrium chlorostannate**,  $\text{YCl}_3 \cdot \text{SnCl}_4 \cdot 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 31.197.)

**Zinc chlorostannate**,  $\text{ZnSnCl}_6 \cdot 6\text{H}_2\text{O}$ .

(Biron, C. C. 1904, II. 410.)

**Chlorosulphobismuthous acid**.

**Cuprous chlorosulphobismuthite**,

$2\text{Cu}_2\text{S} \cdot \text{Bi}_2\text{S}_3 \cdot 2\text{BiSCl}$ .

Stable in air and insol. in  $\text{H}_2\text{O}$  at ord. temp.

Decomp. by boiling  $\text{H}_2\text{O}$ .

Decomp. by mineral acids with evolution of  $\text{H}_2\text{S}$ . (Ducatte, C. R. 1902, 134. 1212.)

**Lead chlorosulphobismuthite**,  $\text{PbS} \cdot \text{Bi}_2\text{S}_3 \cdot 2\text{BiSCl}$ .

Stable in the air. Insol. in  $\text{H}_2\text{O}$ ; decomp. by boiling  $\text{H}_2\text{O}$ ; sol. in dil. acids with decomp. and evolution of  $\text{H}_2\text{S}$ . (Ducatte.)

**Chlorosulphonic acid**,  $\text{HClSO}_3$ .

See Sulphuryl hydroxyl chloride.

**Chloropyrosulphonic acid**.

**Ammonium chloropyrosulphonate**,  $\text{ClS}_2\text{O}_6\text{NH}_4$ .

Fumes in the air.

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Traube, B. 1913, 46. 2519.)

**Sodium chloropyrosulphonate**,  $\text{ClS}_2\text{O}_6\text{Na}$ .

Fumes in the air.

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Traube.)

**Chlorosulphuric acid**,  $\text{HSO}_3\text{Cl}$ .

See Sulphuryl hydroxyl chloride.

$\text{SO}_2\text{Cl}_2$ . See Sulphuryl chloride.

**Aluminum chlorosulphate**,  $\text{Al}(\text{SO}_4)\text{Cl} \cdot 6\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Nearly insol. in abs. alcohol. (Recoura, Bull. Soc. 1902, (3) 27. 1155.)

**Chromium chlorosulphate**,  $\text{CrClSO}_4 \cdot 5\text{H}_2\text{O}$ .

Green. (Weinland, Z. anorg. 1905, 43. 253.) (Recoura, C. R. 1902, 135. 164.)

Violet. (Weinland, Z. anorg. 1905, 43. 254.)

Very sol. in  $\text{H}_2\text{O}$ . Insol. in a mixture of alcohol and acetone. (Recoura, C. R. 1902, 135. 164.)

+  $8\text{H}_2\text{O}$ . Two isomeric modifications:

(a) *Green needles*. Easily sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1906, 43. 251.)

(b) *Violet plates*. Easily sol. in  $\text{H}_2\text{O}$ . (Weinland.)

**Chlorosulphurous acid**.

**Ammonium palladios trichlorosulphite**,

$(\text{NH}_4)_2\text{PdCl}_3\text{SO}_3 \cdot \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1900, 23. 30.)

**Chlorotelluric acid**.

**Ammonium chlorotellurate**,  $(\text{NH}_4)_2\text{TeCl}_6$ .

Sol. without decomp. in a small amt. of  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$  or alcohol.

**Cæsium chlorotellurate**,  $\text{Cs}_2\text{TeCl}_6$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$ . 100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 0.05 pt. at  $22^\circ$ .

100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.05) dissolve 0.78 pt. at  $22^\circ$ .

Insol. in alcohol. (Wheeler, Sill. Am. J. 145. 267.)

**Potassium chlorotellurate**,  $\text{K}_2\text{TeCl}_6$ .

Deliquescent; decomp. by  $\text{H}_2\text{O}$  and absolute alcohol. (Berzelius.)

The most sol. in  $\text{H}_2\text{O}$  of the chloro- or bromo-tellurates. Easily sol. in dil.  $\text{HCl} + \text{Aq}$ ; conc.  $\text{HCl} + \text{Aq}$  ppts.  $\text{KCl}$ . (Wheeler, Sill. Am. J. 145. 267.)

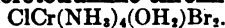
**Rubidium chlorotellurate**,  $\text{Rb}_2\text{TeCl}_6$ .

Decomp. by  $\text{H}_2\text{O}$ . Much more sol. in dil.  $\text{HCl} + \text{Aq}$  than  $\text{Cs}_2\text{TeCl}_6$ .

100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.2) dissolve 0.34 pt. at  $22^\circ$ .

100 pts.  $\text{HCl} + \text{Aq}$  (sp. gr. 1.05) dissolve, 13.99 pts. at  $22^\circ$ .

Sl. sol. in alcohol. (Wheeler.)

**Chlorotetramine chromium bromide,**

Very easily sol. in  $\text{H}_2\text{O}$ . (Cleve, 1861, (Jørgensen, J. pr. (2) 42. 210.)

— **chloride**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{Cl}_2$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. Sol. in  $\text{HCl} + \text{Aq}$ , and this solution may be boiled without decomp. (Cleve.)

Sol. in 15.7 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Jørgensen, J. pr. 42. 208.)

— **chromate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{CrO}_4$ .

Precipitate. (Cleve.)

— **fluosilicate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{SiF}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 42. 218.)

— **hydroxide**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH})_2$ .

Known only in solution. (Cleve.)

— **iodide**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{I}_2$ .

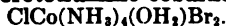
Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)_2$ .

Very easily sol. in  $\text{H}_2\text{O}$ . (Cleve); (Jørgensen, J. pr. (2) 42. 209.)

— **sulphate**,  $\text{ClCr}(\text{NH}_3)_4(\text{OH}_2)\text{SO}_4$ .

Very difficulty sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Chlorotetramine cobaltic bromide,**

More sol. in  $\text{H}_2\text{O}$  than chloride. Nearly insol. in  $\text{HBr} + \text{Aq}$  (1:1). (Jørgensen, J. pr. (2) 42. 215.)

— **chloride**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{Cl}_2$ .

Sol. in about 40 pts.  $\text{H}_2\text{O}$ , and is identical with octamine cobaltic purpureochloride of Vortmann. (Jørgensen, J. pr. (2) 42. 211.)

— **chloroplatinate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{PtCl}_6 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chromate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{CrO}_4$ .

Easily sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 42. 216.)

— **fluosilicate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{SiF}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{SiF}_6 + \text{Aq}$ . (Jørgensen, J. pr. (2) 42. 219.)

— **sulphate**,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{SO}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 42. 214.)

**Chlorotitanic acid,  $\text{TiCl}_4 \cdot 2\text{HCl} = \text{H}_2\text{TiCl}_6$ .**

Known only in solution. (Kowalewsky, Z. anorg. 1900, 25. 192.)

**Chlorous acid,  $\text{HClO}_2$ .**

Known only in aqueous solution. 100 g.  $\text{H}_2\text{O}$  at  $8.5^\circ$  and 753 mm. pressure dissolve 4.7 g.  $\text{Cl}_2\text{O}_2$ . Hydrate with 50.07–67.43%  $\text{H}_2\text{O}$ , perhaps  $\text{HClO}_2 + \text{H}_2\text{O}$ , separates out at  $0^\circ$ . (Brandan, A. 181. 340.)

Pure  $\text{HClO}_2$  is not known even in solution. (Garzarolli-Thurnlakh, A. 209. 184.)

**Chlorites.**

All chlorites are easily sol. in  $\text{H}_2\text{O}$  and alcohol, with gradual decomp.

**Ammonium chlorite.**

Known only in aqueous solution, which decomposes on evaporation or long standing.

**Barium chlorite,  $\text{Ba}(\text{ClO}_2)_2$ .**

Deliquescent; easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. on evaporation. Easily sol. in alcohol. (Millon, A. ch. (3) 7. 298.)

**Lead chlorite,  $\text{Pb}(\text{ClO}_2)_2$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ , and only sl. sol. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{KOH} + \text{Aq}$ . (Garzarolli and Hayn, A. 209. 203.)

**Lead chlorite chloride,  $6\text{Pb}(\text{ClO}_2)_3 \cdot 4\text{PbCl}_2 \cdot \text{PbO}$ .**

Rather difficulty sol. in  $\text{H}_2\text{O}$ . (Schiel, A. 109. 317.)

**Potassium chlorite,  $\text{KClO}_2$ .**

Very deliquescent and sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol of  $38^\circ$ . (Millon, A. ch. (3) 7. 323.) Sol. in  $\text{HClO}_2 + \text{Aq}$ .

**Silver chlorite,  $\text{AgClO}_2$ .**

Sol. in hot, less in cold  $\text{H}_2\text{O}$ . Easily decomp. by heating above  $100^\circ$ . Decomp. by weakest acids. (Millon, A. ch. (3) 7. 329.)

**Sodium chlorite,  $\text{NaClO}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Strontium chlorite,  $\text{Sr}(\text{ClO}_2)_2$ .**

Deliquescent and sol. in  $\text{H}_2\text{O}$ . Decomp. by slow evaporation. (Millon, A. ch. (3) 7. 327.)

**Chloroxyfulminoplatinum,**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (v. Meyer, J. pr. (2) 18. 305.)

**Chloruranic acid,  $\text{HUO}_2\text{Cl} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Mylius, B. 1901, 34. 2776.)

**Chromacichloride,  $\text{CrO}_2\text{Cl}_2$ .**

See Chromyl chloride.

**Chromatiodic acid.**

See Chromiodic acid.

**Chromic acid,  $H_2CrO_4$ .**

Very sol. in  $H_2O$ . (Moissan, C. R. 98. 1851.)

Does not exist except in solution. (Field, Chem. Soc. 61. 405.)

The composition of the hydrates formed by  $H_2CrO_4$  at different dilutions is calculated from determinations of the lowering of the fr-pt. produced by  $H_2CrO_4$  and of the conductivity and sp. gr. of  $H_2CrO_4 + Aq$ . (Jones, Am. Ch. J. 1905, 34. 333.)

See also Chromium trioxide.

**Chromates.**

Chromates of the alkali metals and of Ca, Mg, and Sr are sol. in  $H_2O$ ; the others are generally insol. or sl. sol. in  $H_2O$ , but sol. in  $HNO_3 + Aq$ .

**Aluminum chromate, basic,  $Al_2O_3 \cdot CrO_3 + 7H_2O$ .**

Easily sol. in  $NH_4OH + Aq$ , alum, or acetic acid +  $Aq$ . Insol. in  $NH_4Cl + Aq$ . (Farrie, Chem. Soc. 4. 300.)

Insol. as such as  $H_2O$ , but easily decomp. into  $H_2CrO_4$  and a basic insol. comp. Sol. in alkaline solutions and acids. Decomp. by many salts. (Eliot and Storer, Proc. Am. Acad. 5. 214.)

**Aluminum sodium chromate silicate,  $4Al_2O_3 \cdot 5Na_2O \cdot CrO_3 \cdot 7SiO_2$ .**

(Weyberg, C. B. Miner, 1904. 727.)

**Ammonium chromate, basic,  $5(NH_4)_2O \cdot 4CrO_3(?)$ .**

Easily sol. in cold  $H_2O$ . (Pohl, W. A. B. 6. 592.)

**Ammonium chromate,  $(NH_4)_2CrO_4$ .**

Very sol. in  $H_2O$ ; pptd. from aqueous solution by alcohol. (Malaguti and Sarzeau.)

100 g.  $H_2O$  dissolve 40.46 g. at  $30^\circ$ . (Schreinemakers, Chem. Weekbl. 1905, 1. 395.)

Sol. in  $H_2O$  without decomp. (Schreinemakers, C. C. 1906, II. 1067.)

Sp. gr. of  $(NH_4)_2CrO_4 + Aq$  at  $t^\circ/4^\circ$ .

$t^\circ$	$13^\circ$	$13.7^\circ$	$19.6^\circ$
% $(NH_4)_2CrO_4$	10.52	19.75	28.04
Sp. gr.	1.0633	1.1197	1.1727

(Slotte, W. Ann. 1881, 14. 18.)

Sl. sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Difficulty sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Ammonium dichromate,  $(NH_4)_2Cr_2O_7$ .**

Less sol. in  $H_2O$  than  $(NH_4)_2CrO_4$ . (Moer.)

100 g.  $H_2O$  dissolve 47.17 g at  $30^\circ$ .

(Schreinemakers, Chem. Weekbl. 1905, 1. 395.)

Sp. gr. of  $(NH_4)_2Cr_2O_7 + Aq$  at  $t^\circ/4^\circ$ .

$t^\circ$	$12^\circ$	$10.5^\circ$	$12^\circ$
% $(NH_4)_2Cr_2O_7$	6.85	13.00	19.93
Sp. gr.	1.0393	1.0782	1.1258

(Slotte, W. Ann. 1881, 14. 18.)

Sol. in alcohol. (Ranitzer, Zeit. angew. ch. 1913, 26. 456.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Ammonium trichromate,  $(NH_4)_3Cr_3O_{10}$ .**

Not deliquescent, but very sol. in  $H_2O$ . (Siewert.)

Decomp. by  $H_2O$  into chromic acid and dichromate. (Jäger and Krüss, B. 22. 2036.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Ammonium tetrachromate,  $(NH_4)_4Cr_4O_{13}$ .**

Deliquescent. Decomp. by  $H_2O$ . (Jäger and Krüss, B. 22. 2037.)

**Ammonium hexachromate,  $(NH_4)_6Cr_6O_{19} + 10H_2O(?)$** 

Very efflorescent. (Rammelsberg, Pogg. 94. 516.)

**Ammonium barium chromate,**

$BaCrO_4 \cdot (NH_4)_2CrO_4$ .

Ppt. Decomp. by  $H_2O$ . (Gröger, Z. anorg. 1908, 58. 414.)

**Ammonium cadmium chromate,  $(NH_4)_2O \cdot 4CdO \cdot 4CrO_3 + 3H_2O$ .**

Ppt. Decomp. by boiling  $H_2O$ . (Gröger, M. 1904, 25. 533.)

**Ammonium cadmium chromate ammonia,  $(NH_4)_2CrO_4 \cdot CdCrO_4 \cdot \frac{1}{2}NH_3 + 1\frac{1}{2}H_2O$ .**

Decomp. by  $H_2O$ . (Gröger, Z. anorg. 1908, 58. 418.)

$(NH_4)_2Cd(CrO_4)_2 \cdot 2NH_3$ . Insol. in cold, decomp. by hot  $H_2O$ .

Sol. in dil. acids or in  $NH_4OH + Aq$ . (Briggs, Chem. Soc. 1903, 83. 395.)

**Ammonium chromous chromate(?),**

$(NH_4)_2CrO_4 \cdot CrCrO_4 = (NH_4)_2Cr(CrO_4)_2$ .

Difficultly sol. in  $H_2O$ . Insol. in alcohol, ether, chloroform, or glacial acetic acid. Easily sol. in conc. acids, from which it is separated on dilution. Decomp. by  $NaOH + Aq$ . (Heintze, J. pr. (2) 4. 220.)

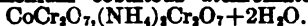
**Ammonium chromyl chromate,  $(3(NH_4)_2O \cdot 2CrO_3 \cdot 3CrO_3)$ .**

Nearly insol. in  $H_2O$ . (Pascal, C. R. 1909, 148. 1465.)

**Ammonium cobaltous chromate.**

Ppt. Easily decomp. (Briggs, Z. anorg. 1907, 58. 247.)

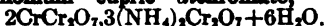
$(\text{NH}_4)_2\text{O}$ ,  $4\text{CoO}$ ,  $4\text{CrO}_3 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{H}_2\text{SO}_4$ . (Gröger, Z. anorg. 1908, 49. 202.)

**Ammonium cobaltous dichromate,**

Sl. hygroscopic; sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Krüss, Z. anorg. 1895, 8. 454.)

**Ammonium cobaltous chromate ammonia,**

Ppt.; decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 422.)

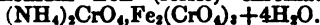
**Ammonium cupric dichromate,**

Sol. in  $\text{H}_2\text{O}$ . (Krüss, Z. anorg. 1895, 8. 455.)

**Ammonium cupric chromate ammonia,**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 420.)

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Sol. in dil. acids or in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Briggs, Chem. Soc. 1903, 83. 394.)

**Ammonium iron (ferric) chromate,**

More easily decomp. by  $\text{H}_2\text{O}$  than  $\text{K}_2\text{CrO}_4$ ,  $\text{Fe}_2(\text{CrO}_4)_3 + 4\text{H}_2\text{O}$ . (Hensgen, B. 12. 1300.)  $6\text{CrO}_3$ ,  $5\text{Fe}_2\text{O}_3$ ,  $6(\text{NH}_4)_2\text{O}$ , and  $4\text{CrO}_3$ ,  $\text{Fe}_2\text{O}_3, (\text{NH}_4)_2\text{O} + 4\text{H}_2\text{O}$ . Ppts. (Lepierre, C. R. 1894, 119. 1217.)

**Ammonium lithium chromate,  $\text{NH}_4\text{LiCrO}_4 + 2\text{H}_2\text{O}$ .**

Not deliquescent. (Rammelsberg.)

**Ammonium lead chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $\text{PbCrO}_4$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 424.)

**Ammonium magnesium chromate,**

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (v. Hauer.)

Sol. in  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 416.)

**Ammonium manganous chromate,**

Sol. in  $\text{H}_2\text{O}$ . (Heasgen, R. t. c. 3. 433.)

**Ammonium nickel chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $\text{NiCrO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1906, 51. 353.)

Can be cryst. from  $\text{H}_2\text{O}$  under  $40^\circ$ . (Briggs, Chem. Soc. 1903, 83. 392.)

**Ammonium nickel chromate ammonia,**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1906, 51. 354.)

$(\text{NH}_4)_2\text{Ni}(\text{CrO}_4)_2$ ,  $2\text{NH}_3$ . Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in dil. acids or in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Briggs, Chem. Soc. 1903, 83. 393.)

$+ 6\text{H}_2\text{O}$ . (Briggs, Proc. Chem. Soc. 1902, 18. 254.)

**Ammonium potassium chromate,  $\text{NH}_4\text{KCrO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (E. Kopp, C. N. 11. 16.)  $+ \text{H}_2\text{O}$ . (Etard, C. R. 85. 443.)  $2(\text{NH}_4)_2\text{CrO}_4$ ,  $3\text{K}_2\text{CrO}_4$ . Very sol. in  $\text{H}_2\text{O}$ . (Zehenter, M. 1897, 18. 51.)

**Ammonium silver chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $3\text{Ag}_2\text{CrO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 423.)

**Ammonium sodium chromate,  $\text{NH}_4\text{NaCrO}_4 + 2\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Zehenter, M. 1897, 18. 54.)

**Ammonium strontium chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $\text{SrCrO}_4$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 415.)

**Ammonium uranyl chromate,  $(\text{NH}_4)_2\text{CrO}_4$ ,  $2(\text{UO}_2)_2\text{CrO}_4 + 6\text{H}_2\text{O}$ .**

Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol. in acidulated  $\text{H}_2\text{O}$ . (Formánek, A. 257, 106.)  $+ 3\text{H}_2\text{O}$ . (Formánek.)

**Ammonium zinc chromate,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{ZnO}$ ,  $2\text{CrO}_3 + \text{H}_2\text{O}$ .**

Decomp. by hot  $\text{H}_2\text{O}$ . (Gröger, M. 1904, 25. 520.)

**Ammonium zinc chromate ammonia,**

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Sol. in dil. acids or in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Briggs, Chem. Soc. 1903, 83. 394.)

$4\text{ZnCrO}_4$ ,  $2(\text{NH}_4)_2\text{CrO}_4$ ,  $3\text{NH}_3 + 3\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 416.)

**Ammonium dichromate chloride mercuric chloride,  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7, 2\text{NH}_4\text{Cl}, 4\text{HgCl}_2 + 2\text{H}_2\text{O}$ .**

Ppt. Sol. in cold, more sol. in warm  $\text{H}_2\text{O}$ . (Strömholm, Z. anorg. 1912, 76. 280.)

**Ammonium dichromate chloride mercuric cyanide,  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ ,  $4\text{NH}_4\text{Cl}$ ,  $6\text{Hg}(\text{CN})_2 + 4\text{H}_2\text{O}$ .**

(Strömholm, Z. anorg. 1913, 80. 157.)

**Ammonium chromate chromyl fluoride,**  
(NH<sub>4</sub>)<sub>2</sub>CrO<sub>4</sub>, CrO<sub>2</sub>F<sub>2</sub>.Sol. in H<sub>2</sub>O. (Varenne, C. R. 91. 989.)**Ammonium chromate iodate.**

See Chromoiodate, ammonium.

**Ammonium dichromate mercuric chloride,**  
(NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, HgCl<sub>2</sub>.Cannot be recryst. from H<sub>2</sub>O or HgCl<sub>2</sub>+Aq. but from (NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>+Aq. (Jäger and Krüss, B. 22. 2044.)+H<sub>2</sub>O. (Richmond and Abel, Chem. Soc. Q. J. 3. 199.)Cannot be made to crystallize with H<sub>2</sub>O. (Jäger and Krüss.)3(NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, HgCl<sub>2</sub>. Decomp. by H<sub>2</sub>O. (J. and K.)4(NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, HgCl<sub>2</sub>. Decomp. by H<sub>2</sub>O. (J. and K.)(NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, 3HgCl<sub>2</sub>. (J. and K.)(NH<sub>4</sub>)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, 4HgCl<sub>2</sub>. (J. and K.)**Ammonium chromate phosphate.**

See Phosphochromate, ammonium.

**Ammonium chromate tellurate.**

See Chromotellurate, ammonium.

**Barium chromate, BaCrO<sub>4</sub>.**Extremely al. sol. in H<sub>2</sub>O.Calculated from electrical conductivity of BaCrO<sub>4</sub>+Aq, 1 l. H<sub>2</sub>O dissolves 3.8 mg. BaCrO<sub>4</sub> at 18°. (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)When not ignited, BaCrO<sub>4</sub> is sol. in 86,957 pts. H<sub>2</sub>O; 22,988 pts. NH<sub>4</sub>Cl+Aq (0.5% NH<sub>4</sub>Cl); 3670 pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (5% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>); 1986 pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (10% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>); 1813 pts. H<sub>2</sub>CrO<sub>4</sub>+Aq (10% Cr<sub>2</sub>). When ignited, 160,000 pts. H<sub>2</sub>O are necessary for solution. (Schweitzer, by Fresenius, Z. anal. 29. 414.)Sol. in 23,000 pts. boiling H<sub>2</sub>O. (Mescherskii, Z. anal. 21. 399.)3.5 mg. BaCrO<sub>4</sub> are dissolved in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)Easily sol. in HNO<sub>3</sub>, HCl, or chromic acid + Aq, from which it is precipitated by NH<sub>4</sub>OH, or by dilution with H<sub>2</sub>O. (Bahr.)Insol. in K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>+Aq. (Schweitzer.)Sol. in 49,381 pts. NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (0.75 % salt) at 15°; in 23,355 pts. NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq (1.5% salt) at 15°; in 45,162 pts. NH<sub>4</sub>NO<sub>3</sub>+Aq (0.5% salt) at 15°. (Fresenius, Z. anal. 29. 418.)

Easily sol. in alkali tartrates, or citrates + Aq. (Fleischer, J. pr. (2) 5. 326.)

0.22×10<sup>-4</sup> g. equiv. BaCrO<sub>4</sub> are dissolved in 1 l. of 45% alcohol at ord. temp. (Guerini, Dissert, 1912.)Insol. in acetic acid and in M<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>+Aq.

Partly sol. in a mixture of the two, except

in presence of MC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Caron and Raquet, Bull. Soc. 1906, (3) 35. 1064.)

Not completely insol. in acetic acid. (Baubigny, Bull. Soc. 1907, (4) 1. 58.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Barium dichromate, BaCr<sub>2</sub>O<sub>7</sub>+2H<sub>2</sub>O.**Decomp. by H<sub>2</sub>O with separation of BaCrO<sub>4</sub>. Sol. in H<sub>2</sub>CrO<sub>4</sub>+Aq. (Bahr, J. B. 1853. 358.)Sol. in cold H<sub>2</sub>O with formation of BaCrO<sub>4</sub> and CrO<sub>3</sub>.

Insol. in glacial acetic acid. (Mayer, B. 1903, 36. 1742.)

**Barium calcium chromate, BaCa(CrO<sub>4</sub>)<sub>2</sub>.**

(Bourgeois Bull. Soc. Min. 1879, 2. 124.)

**Barium potassium chromate, BaK<sub>2</sub>(CrO<sub>4</sub>)<sub>2</sub>.**Decomp. by H<sub>2</sub>O. (Gröger, Z. anorg. 1907, 54. 186.)Decomp. by H<sub>2</sub>O. Stable in K<sub>2</sub>CrO<sub>4</sub>+Aq, containing:

2.181 pts.	K <sub>2</sub> CrO <sub>4</sub>	per 100 pts.	H <sub>2</sub> O at	11.5°
3.395	"	"	"	27.5°
5.120	"	"	"	50.0°
7.119	"	"	"	76.0°
9.036	"	"	"	100.0°

(Barre, C. R. 1914, 158. 497.)

**Barium potassium trichromate,**Ba<sub>2</sub>K<sub>2</sub>(Cr<sub>2</sub>O<sub>7</sub>)<sub>3</sub>+3H<sub>2</sub>O.

Extremely deliquescent. (Bahr.)

**Bismuth chromates, basic.**These comps. are insol. in H<sub>2</sub>O even in presence of H<sub>2</sub>CrO<sub>4</sub>; sol. in HCl or HNO<sub>3</sub>+Aq. (Löwe, J. pr. 67. 288.)100 pts. H<sub>2</sub>O dissolve 0.00008 pt. "bismuth chromate"; 100 pts. acetic acid dissolve 0.00021 pt. "bismuth chromate"; 100 pts. HNO<sub>3</sub>+Aq (sp. gr.=1.038) dissolve 0.00024 pt. "bismuth chromate"; 100 pts. KOH+Aq (sp. gr.=1.33) dissolve 0.00016 pt. "bismuth chromate." (Pearson, Phil. Mag. (4) 11. 206.)Not insol. in dil. HNO<sub>3</sub>+Aq unless K<sub>2</sub>CrO<sub>4</sub> is present. Less sol. in hot NaOH+Aq than PbCrO<sub>4</sub>. (Storer.)

"Bismuth chromate" is insol. in acetone. (Naumann, B. 1904, 37. 4329.)

3Bi<sub>2</sub>O<sub>3</sub>, 2CrO<sub>3</sub>=2(BiO)<sub>2</sub>CrO<sub>4</sub>, Bi<sub>2</sub>O<sub>3</sub>. Insol. in H<sub>2</sub>O; sol. in HNO<sub>3</sub>+Aq.Bi<sub>2</sub>O<sub>3</sub>, CrO<sub>3</sub>=(BiO)<sub>2</sub>CrO<sub>4</sub>. Insol. in H<sub>2</sub>O; easily sol. in dil. HCl+Aq, less in dil. HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>+Aq. (Muir.)Bi<sub>2</sub>O<sub>3</sub>, 2CrO<sub>3</sub>=(BiO)<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. Insol. in H<sub>2</sub>O.+H<sub>2</sub>O.5Bi<sub>2</sub>O<sub>3</sub>, 11CrO<sub>3</sub>+6H<sub>2</sub>O. (Muir, Chem. Soc. 31. 24.)

$3\text{Bi}_2\text{O}_3, 7\text{CrO}_3$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in mineral acids, especially  $\text{HCl} + \text{Aq}$ . Partly sol. in  $\text{KOH} + \text{Aq}$ .

**Bismuth chromate, acid,  $\text{Bi}_2\text{O}_3, 4\text{CrO}_3 + \text{H}_2\text{O}$ .**

Insol. in hot or cold  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Muir, Chem. Soc. **30**. 17.)

**Bismuth potassium chromate,  $\text{Bi}_2(\text{CrO}_4)_3, \text{K}_2\text{CrO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. with hot  $\text{H}_2\text{O}$ .  $\text{Bi}_2\text{O}_3, \text{K}_2\text{O}, 6\text{CrO}_3 + \text{H}_2\text{O}$ . (Preis and Raymann, J. B. **1880**. 336.)

**Bromomolybdenum chromate.**

(Atterberg.)

**Cadmium chromate, basic,  $2\text{CdO}, \text{CrO}_3 + \text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ ; very slowly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with combination. (Malaguti and Sarzeau, A. ch. (3) **9**. 431.)

Composition as above. (Freese, B. **2**. 478.)

**Cadmium chromate,  $\text{CdCrO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids; decomp. by heating with  $\text{H}_2\text{O}$ . (Schulz, Z. anorg. **1895**, **10**. 153.)

Sol. in hot conc.  $\text{CdSO}_4 + \text{Aq}$ . (Briggs, Z. anorg. **1907**, **56**. 253.)

$+ 2\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Schulz, Z. anorg. **1895**, **10**. 153.)

**Cadmium dichromate,  $\text{CdO}, 2\text{CrO}_3 + \text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  without decomp; hygroscopic. (Schulz, Z. anorg. **1895**, **10**. 152.)

Easily sol. in  $\text{H}_2\text{O}$  but decomp. on evaporation. (Gröger, Z. anorg. **1910**, **66**. 11.)

**Cadmium trichromate,  $\text{CdCr}_2\text{O}_{10} + \text{H}_2\text{O}$ .**

Deliquescent. (Gröger, Z. anorg. **1910**, **66**. 12.)

**Cadmium chromate ammonia,  $\text{CdCrO}_4, 4\text{NH}_3 + 3\text{H}_2\text{O}$ .**

Efflorescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in alcohol and ether. (Malaguti and Sarzeau.)

**Cadmium potassium chromate,  $\text{CdK}_2(\text{CrO}_4)_2 + 2\text{H}_2\text{O}$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. **1907**, **54**. 189.)

$3\text{CdO}, \text{K}_2\text{O}, 3\text{CrO}_3 + 3\text{H}_2\text{O}$ . Ppt. (Preis and Raymann, Sitzungsber. böhm. Gesell. **1880**.)

$4\text{CdO}, \text{K}_2\text{O}, 4\text{CrO}_3 + 3\text{H}_2\text{O}$ . Ppt. Slowly decomp. by  $\text{H}_2\text{O}$ . (Gröger, M. **1904**, **25**. 533.)

**Cadmium potassium dichromate,**

$\text{CdCr}_2\text{O}_7, \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; sl. hygroscopic. (Krüss, Z. anorg. **1895**, **8**. 454.)

**Cadmium dichromate mercuric cyanide,**  
 $\text{CdCr}_2\text{O}_7, 2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Krüss, Z. anorg. **1895**, **8**. 460.)

**Cæsium chromate,  $\text{Cs}_2\text{CrO}_4$ .**

(Chabrié, C. R. **1901**, **132**. 680.)

Aq. solution sat. at  $30^\circ$  contains 47%. (Schreinemakers, C. C. **1909**, I. 11.)

**Cæsium dichromate,  $\text{Cs}_2\text{Cr}_2\text{O}_7$ .**

(Chabrié, C. R. **1901**, **132**. 680.)

Much more sol. in hot  $\text{H}_2\text{O}$ , than in cold. (Fraprie, Am. J. Sci. **1906**, (4) **21**. 309.)

Aq. solution sat. at  $30^\circ$  contains 5.2%. (Schreinemakers, C. C. **1909**, I. 11.)

**Cæsium trichromate,  $\text{Cs}_2\text{Cr}_3\text{O}_{10}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Schreinemakers, Chem. Weekbl. **1908**, **5**. 811.)

Sol. in  $\text{H}_2\text{O}$ . (Fraprie, Am. J. Sci. **1906**, (4) **21**. 315.)

**Cæsium tetrachromate,  $\text{Cs}_2\text{Cr}_4\text{O}_{12}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Schreinemakers, Chem. Weekbl. **1908**, **5**. 811.)

**Cæsium cobaltous chromate,**

$\text{Cs}_2\text{Co}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .

(Briggs, Z. anorg. **1907**, **56**. 248.)

**Cæsium magnesium chromate,**

$\text{Cs}_2\text{Mg}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .

(Briggs, Chem. Soc. **1904**, **85**, 680.)

**Cæsium nickel chromate,  $\text{Cs}_2\text{Ni}(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .**

Sol. in cold  $\text{H}_2\text{O}$  without much change, but decomp. by warm  $\text{H}_2\text{O}$ . (Briggs, Chem. Soc. **1904**, **85**. 679.)

**Calcium chromate basic,  $\text{Ca}_2\text{CrO}_3 + 3\text{H}_2\text{O}$ .**

Sol. in 230 pts.  $\text{H}_2\text{O}$  without decomp. (Mylius and Wrochem, Gm. K. **3**. I, 1385.)

**Calcium chromate,  $\text{CaCrO}_4$ .**

*Anhydrous.* Very sl. sol. in  $\text{H}_2\text{O}$ . (Sievert, J. B. **1862**. 148.)

Aq. solution sat. at  $18^\circ$  contains 2.3%  $\text{CaCrO}_4$ ; sp. gr. = 1.023. (Mylius and Wrochem, B. **1900**, **33**. 3688.)

Insol. in acetone. (Naumann, B. **1904**, **37**. 4329.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Aq. solution sat. at  $18^\circ$  contains 4.4%  $\text{CaCrO}_4$ ; sp. gr. = 1.044. (Mylius and Wrochem, B. **1900**, **33**. 3688.)

$+ \text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$0^\circ$	$8^\circ$	$13^\circ$	$18^\circ$	$25^\circ$
% $\text{CaCrO}_4$	11.5	10.8	10.3	9.6	9.1

$t^\circ$	$40^\circ$	$60^\circ$	$75^\circ$	$90^\circ$	$100^\circ$
% $\text{CaCrO}_4$	7.8	5.7	4.6	3.6	3.1

(Mylius and Wrochem, Gm.-K. **3**. I, 1386.)

Sp. gr. of solution containing 9.6% by wt.  $\text{CaCrO}_4$  at  $18^\circ = 1.096$ . (Mylius and Wrochem, B. 1900, **33**, 3688.)  
 $+2\text{H}_2\text{O}$ . Sol. in 241.3 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ . (Niewert.)  
 Sol. in 34 pts.  $\text{H}_2\text{O}$ . (Schwarz, Dingl. **198**, 159.)

Solubility of two modifications in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
 a modification.

$t^\circ$	$0^\circ$	$20^\circ$	$30^\circ$	$45^\circ$
$\text{CaCrO}_4$	14.75	14.22	13.89	12.53

$\beta$  modification.

$t^\circ$	$0^\circ$	$14^\circ$	$18^\circ$	$19.5^\circ$	$30^\circ$	$40^\circ$
$\text{CaCrO}_4$	9.8	10	10.3	10.4	10.4	10.4

(Mylius and Wrochem. Gm.-K. **3**, I, 1387.)

a modification. Sp. gr. of the solution containing 14.3% by wt.  $\text{CaCrO}_4$  at  $18^\circ = 1.149$ . (Mylius and Wrochem, B. 1900, **33**, 3688.)

$\beta$  modification. Sp. gr. of the solution containing 10.3% by wt.  $\text{CaCrO}_4$  at  $18^\circ = 1.105$ . (Mylius and Wrochem, B. 1900, **33**, 3688.)

Easily sol. in  $\text{H}_2\text{O}$  containing  $\text{CrO}_3$ .

Insol. in absolute alcohol.

50 cc. of alcohol (29%) dissolve 0.608 g.  $\text{CaCrO}_4$ ; 50 cc. of alcohol (53%) dissolve 0.44 g.  $\text{CaCrO}_4$ . (Fresenius, Z. anal. **30**, 672.)

Sol. in acids and in dilute alcohol. (Caron and Raquet, Bull. Soc. 1906, (3) **35**, 1064.)

**Calcium dichromate**,  $\text{CaCr}_2\text{O}_7 + 3\text{H}_2\text{O}$ .

Very deliquescent. (Bahr, J. pr. **60**, 60.)

In sat. solution at  $18^\circ$ , 61%  $\text{CaCr}_2\text{O}_7$  is present. (Mylius and Wrochem, Gm.-K. **3**, I, 1387.)

Sol. in acetone. (Naumann, B. 1904, **37**, 4328.)

**Calcium potassium chromate**,  $\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ .

(Barre, C. R. 1914, **158**, 495.)

$+ \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Duncan.) Insol. in  $\text{H}_2\text{O}$  when ignited.

$+ 2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ , even after ignition. Insol. in alcohol. (Duncan, J. B. **1860**, 313.)

Formed below  $45^\circ$ . (Barre, C. R. 1914, **158**, 495.)

Sol. in cold  $\text{H}_2\text{O}$ . Sl. sol. in sat.  $\text{K}_2\text{CrO}_4 + \text{Aq}$ . (Gröger, Z. anorg. 1907, **54**, 187.)

Two modifications. Solubility of a modification is somewhat less than that of the  $\beta$  modification. (Wyrouboff, Bull. Soc. Min. 1891, **14**, 255.)

Solubility of two modifications in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$0^\circ$	$15^\circ$
Solubility of a	23.06	25.06
" " $\beta$	23.01	24.45

(Rakowski, C. C. **1909**, I, 133.)

$4\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ .

$5\text{CaCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ . Sol. in much  $\text{H}_2\text{O}$ . (Bahr.)

**Calcium chromate potassium sulphate**,

$\text{CaCrO}_4$ ,  $\text{K}_2\text{SO}_4 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Hannay, Chem. Soc. **32**, 399.)

$\text{CaCrO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{K}_2\text{CrO}_4$ . As above. (H.)

**Cerous chromate**.

Insol. in  $\text{H}_2\text{O}$ .

**Calcium strontium chromate**,  $\text{CaSr}(\text{CrO}_4)_2$ .

(Bourgeois, Bull. Soc. Min. 1879, **2**, 123.)

**Ceric dichromate**,  $\text{CeO}_2$ ,  $2\text{CrO}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids; decomp. completely by boiling  $\text{H}_2\text{O}$ . (Bricout, C. R. 1894, **118**, 145.)

**Chromic chromate**,  $\text{Cr}_2\text{O}_3 = \text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3$ .

Insol. as such in  $\text{H}_2\text{O}$ , but decomp. thereby into  $\text{CrO}_3$  and  $\text{Cr}_2\text{O}_3$ ; decomp. by alkaline and many saline solutions. Easily sol. in dil. acids if recently pptd, but with difficulty if dried at a high temp. (Eliot and Storer, Proc. Am. Acad. **6**, 207.)

$\text{Cr}_2\text{O}_{12} = \text{Cr}_2\text{O}_3$ ,  $3\text{CrO}_3$ . Sol. in  $\text{HCl} + \text{Aq}$ . Very slowly sol. in  $\text{HNO}_3 + \text{Aq}$ . Slowly decomp. by  $\text{H}_2\text{SO}_4$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily decomp. by  $\text{KOH} + \text{Aq}$ .

Does not exist. (Eliot and Storer, l.c.)

$\text{Cr}_2\text{O}_{12} = 3\text{Cr}_2\text{O}_3$ ,  $2\text{CrO}_3$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ ; difficulty sol. in acetic acid. Easily sol. in  $\text{KOH} + \text{Aq}$ . (Traube, A. **66**, 108.)

Existence doubtful.

$\text{Cr}_2\text{O}_3 = 2\text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3$ . Insol. in all acids, even aqua regia; slowly attacked by a boiling conc. solution of alkali hydroxides. (Geuther and Merz, A. **118**, 62.)  $\text{Cr}_2\text{O}_3$ , according to Wöhler.

**Chromic cupric chromate**,  $\text{CuCr}_2\text{O}_6$ ,  $\text{Cr}_2\text{O}_3 + 12\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{HCl}$  and  $\text{HNO}_3$ . (Rosenfeld, B. 1879, **12**, 957.)

$6\text{CuO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{CrO}_3 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Rosenfeld, B. 1879, **12**, 958.)

**Chromic potassium chromate**,  $\text{Cr}_2\text{H}_2(\text{CrO}_4)_2$ ,  $\text{K}_2\text{CrO}_4(?)$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or acetic acid. Not attacked by cold  $\text{HNO}_3 + \text{Aq}$ ; sl. oxidized when hot. Insol. in cold, easily sol. in hot  $\text{H}_2\text{SO}_4$ . Sl. sol. in  $\text{SO}_3 + \text{Aq}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Tommasi, Bull. Soc. (2) **17**, 396.)

**Chromous potassium chromate**,

$\text{K}_2\text{CrO}_4(\text{CrO}_2)_2 = \text{K}_2\text{Cr}(\text{CrO}_4)_2(?)$ .

Sat. cold solution in  $\text{H}_2\text{O}$  contains 9% of the salt. Insol. in alcohol and ether. (Heintze, J. pr. (2) **4**, 212.)



**Cobaltous chromate, basic**,  $3\text{CoO} \cdot \text{CrO}_3 + 4\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Malaguti and Sarzeau, A. ch. (3) 9. 431.)

True formula is  $2\text{CoO} \cdot \text{CrO}_3 + 2\text{H}_2\text{O}$ . (Freese, Pogg. 140. 252.)

$4\text{CoO} \cdot 3\text{CrO}_3 + 2\text{H}_2\text{O}$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1906, 49. 203.)

**Cobaltous chromate,  $\text{CoCrO}_4$ .**

Much more sol. in  $\text{H}_2\text{O}$  than  $\text{NiCrO}_4$ . Easily sol. in hot dil.  $\text{HNO}_3 + \text{Aq.}$  (Briggs, Z. anorg. 1909, 63. 327.)  
 $+ 2\text{H}_2\text{O}$ . Ppt. (Briggs, Z. anorg. 1909, 63. 328.)

**Cobaltous dichromate,  $\text{CoCr}_2\text{O}_7 + \text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Briggs, Z. anorg. 1907, 56. 247.)

**Cobaltous potassium chromate, basic.**

$\text{K}_2\text{O} \cdot 4\text{CoO} \cdot 4\text{CrO}_3 + 3\text{H}_2\text{O}$ .

Sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Gröger, Z. anorg. 1906, 49. 199.)

**Cobaltous potassium chromate,  $\text{K}_2\text{Co}(\text{CrO}_4)_2 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1906, 49. 200.)

**Cupric chromate, basic**,  $3\text{CuO} \cdot \text{CrO}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  and in  $\text{NH}_4\text{OH} + \text{Aq.}$  Decomp. by  $\text{KOH} + \text{Aq.}$  (Malaguti and Sarzeau, A. ch. (3) 9. 434.)

$7\text{CuO} \cdot 2\text{CrO}_3 + 5\text{H}_2\text{O}$ . Ppt. (Rosenfeld, B. 13. 1469.)

$7\text{CuO} \cdot \text{CrO}_3 + 5\text{H}_2\text{O}$ . Ppt. (R.)

**Cobaltous dichromate mercuric cyanide**,  $\text{CoCr}_2\text{O}_7 \cdot 2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .

Very stable. Sol. in  $\text{H}_2\text{O}$ . (Krüss, Z. anorg. 1895, 8. 458.)

**Cupric chromate,  $\text{CuCrO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; very sol. in chromic acid and in other acids; decomp. by boiling with  $\text{H}_2\text{O}$ . (Schulz, Z. anorg. 1895, 10. 152.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

**Cupric dichromate, basic**,  $\text{CuCr}_2\text{O}_7 \cdot 2\text{CuO}$ . (Stanley, C. N. 54. 194.)

**Cupric dichromate,  $\text{CuCr}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

Deliquescent. Very easily sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq.}$  and alcohol. (Dröge, A. 101. 39.)

Aqueous solution is decomp. by boiling. (Malaguti and Sarzeau, A. ch. (3) 9. 456.)

Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$  without decomp. (Schulz, Z. anorg. 1895, 10. 150.)

**Cupric tetrachromate,  $\text{CuCr}_4\text{O}_{12} + 2\text{H}_2\text{O}$ .**

Deliquescent. Decomp. when its solution in  $\text{H}_2\text{O}$  is concentrated. (Gröger, Z. anorg. 1910, 66. 15.)

**Cupric lead chromate,  $2(\text{PbCrO}_4, \text{PbO}), (2\text{CuCrO}_4, \text{CuO})$ .**

Min. *Vauquelinite*. Sol. in acids.

**Cupric potassium chromate, basic**,  $\text{KCu}_2(\text{OH})(\text{CrO}_4)_2 + \text{H}_2\text{O}$ .

Ppt. (Gröger, M. 1903, 24. 485.)

$3\text{CuO} \cdot \text{K}_2\text{O} \cdot 3\text{CrO}_3 + 2\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Knop, A. 70. 52.)

Does not exist. (Rosenfeld, B. 13. 1472.)

$4\text{CuO} \cdot \text{K}_2\text{O} \cdot 4\text{CrO}_3 + \text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Gerhardt.)  
 $+ 3\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Gröger, Dissert. 1880.)

**Cupric potassium chromate ammonia**,  $\text{K}_2\text{Cu}(\text{CrO}_4)_2 \cdot 2\text{NH}_3$ .

Very sol. in dil.  $\text{NH}_3 + \text{Aq.}$ ; decomp. by  $\text{H}_2\text{O}$ . (Briggs, Chem. Soc. 1904, 85. 672.)

**Cupric chromate ammonia,  $\text{CuCrO}_4 \cdot 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Parravano and Pasta, Gazz. ch. it. 1907, 37. (2), 255.)

$4\text{CuCrO}_4 \cdot 3\text{NH}_3 + 5\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  and  $\text{NH}_4\text{OH} + \text{Aq.}$ ; insol. in organic solvents; easily sol. in  $\text{AgNO}_3 + \text{Aq.}$  (Schuyten, C. C. 1900, I. 399.)

$2\text{CuCrO}_4 \cdot 7\text{NH}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Very sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Briggs, Chem. Soc. 1904, 85. 673.)

$3\text{CuO} \cdot 2\text{CrO}_3 \cdot 10\text{NH}_3 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ ; al. sol. or insol. in alcohol, ether, or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Malaguti and Sarzeau.)

Decomp. by hot  $\text{H}_2\text{O}$ ; insol. in alcohol. (Böttger.)

**Cupric dichromate ammonia,  $\text{CuCr}_2\text{O}_7 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Parravano and Pasta, Gazz. ch. it. 1907, 37. (2) 255.)

**Cupric dichromate mercuric cyanide**,  $\text{CuCr}_2\text{O}_7 \cdot \text{Hg}(\text{CN})_2 + 5\text{H}_2\text{O}$ .

Not hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Krüss, Z. anorg. 1895, 8. 461.)

**Didymium chromate,  $\text{Di}_2(\text{CrO}_4)_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ , easily in dil. acids. (Friedrichs and Smith, A. 191. 353.)  
 $+ 7\text{H}_2\text{O}$ . (Cleve.)

**Didymium potassium chromate**,  $\text{Di}_2(\text{CrO}_4)_3 \cdot \text{K}_2\text{CrO}_4$ .

Precipitate. Decomp. by  $\text{H}_2\text{O}$ . (Cleve.)

**Dysprosium chromate**,  $Dy_2(CrO_4)_3 \cdot 10H_2O$ .

Very sl. sol. in  $H_2O$ . 1.0002 pt. is sol. in 100 pts.  $H_2O$  at  $25^\circ$ . (Jantsch, B. 1911, 44. 1276.)

**Glucinum chromate, basic**,  $GlCrO_4 \cdot 13GlO + 23H_2O$ .

Ppt. Insol. in  $H_2O$ . (Creusberg, Dingl. 163. 449.)

$GlCrO_4 \cdot 6Gl(OH)_2$ . Ppt. Insol. in  $H_2O$ . (Glassmann, B. 1907, 40. 2603.)

**Glucinum chromate**,  $GlCrO_4 \cdot H_2O$ .

Decomp. by  $H_2O$  with separation of the basic chromate. (Glassmann, B. 1907, 40. 2603.)

**Gold (auric) chromate**,  $Au_2(CrO_4)_3 \cdot CrO_3$ .

Ppt. (Orloff, Ch. Z. 1907, 31. 1182.)

**Indium chromate**.

Ppt. (Meyer.)

**Indium dichromate**.

Very sol. in  $H_2O$ . Known only in solution.

**Iron (ferric) chromate, basic**.

Decomp. by  $H_2O$ . (Maus.)

$Fe_2O_3 \cdot CrO_3$ . Insol. in  $H_2O$ , but decomp. thereby, or by saline solutions; easily sol. in acids. Sol. in  $H_2CrO_4 + Aq$ . (Eliot and Storer, Proc. Am. Acad. 5. 216.)

**Iron (ferric) dichromate**.

Sol. in  $H_2O$  and alcohol. (Maus, Pogg. 9. 132.)

**Iron (ferric) potassium chromate, basic**,

$2CrO_3 \cdot 6Fe_2O_3 \cdot 3K_2O$ .

$4CrO_3 \cdot 3Fe_2O_3 \cdot 4K_2O$ .

$10CrO_3 \cdot 6Fe_2O_3 \cdot 7K_2O$ .

$11CrO_3 \cdot 3Fe_2O_3 \cdot 4K_2O + 9H_2O$ .

$9CrO_3 \cdot 2Fe_2O_3 \cdot 6K_2O + 6H_2O$ .

$9CrO_3 \cdot 2Fe_2O_3 \cdot 6K_2O + 10H_2O$ .

$10CrO_3 \cdot 3Fe_2O_3 \cdot 6K_2O + 5H_2O$ .

$7CrO_3 \cdot 2Fe_2O_3 \cdot 2K_2O + 7H_2O$ .

$4CrO_3 \cdot Fe_2O_3 \cdot K_2O + 4H_2O$ .

$6CrO_3 \cdot 2Fe_2O_3 \cdot 3K_2O$ .

$16CrO_3 \cdot 4Fe_2O_3 \cdot 5K_2O + 8H_2O$ .

Above compounds are ppts. insol. in  $H_2O$ , alcohol and ether. (Lepierre, C. R. 1894, 119, 1215-18.)

**Iron (ferric) potassium chromate**,

$Fe_3(CrO_4)_3 \cdot K_2CrO_4 + 4H_2O$ .

Decomp. by much  $H_2O$ , conc.  $HCl$ , or  $NH_4OH + Aq$ . Not decomp. by alcohol. (Hemagen, B. 12. 130C.)

**Iron (ferric) sodium chromate, basic**,

$5CrO_3 \cdot 7Fe_2O_3 \cdot 4Na_2O$ .

Ppt. (Lepierre, C. R. 1894, 119, 1217.)

**Lanthanum chromate**,  $La_2(CrO_4)_3$ .

Sl. sol. in cold, more easily in hot  $H_2O$ ; easily sol. in acids. (Frerichs and Smith, A. 191. 355.)

$+8H_2O$ . Ppt. (Cleve.)

**Lanthanum potassium chromate**.

(Cleve.)

**Lead chromate, basic**,  $2PbO \cdot CrO_3$  (*chrome red*).

Insol. in  $H_2O$ ; acetic acid dissolves out  $\frac{1}{2}$  the  $PbO$ . Sol. in  $KOH + Aq$ . (Badams, Pogg. 3. 221.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$3PbO \cdot CrO_3$ . (Hermann, Pogg. 38. 162.)  $+H_2O$ . Ppt. (Strömholm, Z. anorg. 1904, 38. 443.)

Min. *Melanochroite*, *Phanicroite*. Sol. in acids.

$PbO$ ,  $PbCrO_4$ . Ppt. (S.)

**Lead chromate**,  $PbCrO_4$ .

Insol. in  $H_2O$ . Pptd. from  $Pb(NO_3)_2$  in presence of 70,000 pts.  $H_2O$ . (Harting.)

Calculated from electrical conductivity of  $PbCrO_4 + Aq$ , 1 l.  $H_2O$  dissolves 0.2 mg.  $PbCrO_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

1 l.  $H_2O$  dissolves  $1.2 \times 10^{-4}$  g.  $PbCrO_4$  at  $25^\circ$ . (Hevesy, Z. anorg. 1913, 82. 328.)

Sol. in dil.  $H_2SO_4 + Aq$  (Storer); sl. sol. in dil.  $HNO_3 + Aq$ .

Sol. in 560 pts.  $HNO_3 + Aq$  of 1.12 sp. gr.; in 150 pts.  $HNO_3 + Aq$  of 1.225 sp. gr.; in 130 pts.  $HNO_3 + Aq$  of 1.265 sp. gr.; in 80 pts.  $HNO_3 + Aq$  of 1.395 sp. gr. (Storer's Dict.)

Solubility of  $PbCrO_4$  in  $HNO_3 + Aq$ . at  $18^\circ$ .

(Millimols. per l.)

0.1N	0.2N	0.3N	0.4N
0.506	0.844	1.13	1.44

(Beck and Stegmüller, l.c.)

Easily decomp. by hot  $HCl + Aq$ . (Freosinus.)

Solubility of  $PbCrO_4$  in  $HCl + Aq$ .

(Millimols. per l.)

t°	0.1N	0.2N	0.3N	0.4N	0.5N	0.6N
18	0.186	0.393	0.654	1.07	1.56	2.25
25	0.239	0.485	0.839	1.32	4.06	2.95
37	0.357	0.744	1.31	2.10	3.28	4.69

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34. 446.)

Insol. in  $HC_2H_3O_2 + Aq$ .

Easily sol. in  $KOH$ , or  $NaOH + Aq$ . 1 l.  $KOH + Aq$  ( $\frac{1}{2}$  normal) dissolves 11.9 g.  $PbCrO_4$  at  $15^\circ$ ; 16.2 g. at  $60^\circ$ ; 26.1 g. at  $80^\circ$ ;

38.5 g. at 102. (Lachaud and Lepierre, Bull. Soc. (3) 6. 230.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Brett, 1837.)

Sol. in  $\text{K}_2\text{Cr}_2\text{O}_7 + \text{Aq.}$ ; almost completely insol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Min. *Crocoite*. Sol. in hot  $\text{HCl} + \text{Aq.}$ ; diffculty sol. in  $\text{HNO}_3 + \text{Aq.}$ ; sol. in  $\text{KOH} + \text{Aq.}$

**Lead dichromate,  $\text{PbCr}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ . As above. (Preis and Raymann, B. 13. 340.)

**Lead lithium chromate,  $\text{PbCrO}_4$ ,  $\text{Li}_2\text{CrO}_4$ .**

(Lachaud and Lepierre, C. R. 110. 1035.)

**Lead potassium chromate,  $\text{PbCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ .**

Insol. in hot or cold  $\text{H}_2\text{O}$  or in alcohol. Dil. acids dissolve out  $\text{K}_2\text{CrO}_4$ . (Lachaud and Lepierre, C. R. 110. 1035.)

Decomp. by  $\text{H}_2\text{O}$ . Stable in contact with solutions containing:

8.950 pts.	$\text{K}_2\text{CrO}_4$	per 100 pts.	$\text{H}_2\text{O}$	at	10°
8.077	"	"	"	"	27.5°
7.629	"	"	"	"	37.5°
7.150	"	"	"	"	50.0°
6.145	"	"	"	"	76.0°
4.940	"	"	"	"	100.0°

(Barre, C. R. 1914, 158. 497.)

**Lead sodium chromate,  $\text{PbCrO}_4$ ,  $\text{NaCrO}_4$ .**

Sol. in  $\text{H}_2\text{O}$  (?). (Lachaud and Lepierre.)

$\text{PbCrO}_4$ ,  $2\text{PbO}$ ,  $\text{Na}_2\text{CrO}_4$ . (L. and L.)

**Lithium chromate,  $\text{Li}_2\text{CrO}_4$ .**

100 cc. of solution sat. at 18° contain 85 g. anhydrous salt. (Kohlrausch, B. A. B. 1897. 90.)

99.94 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at 30°. (Schreinemakers, C. C. 1906. II, 1486.)

+  $2\text{H}_2\text{O}$ . Very easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 128. 323.)

100 g.  $\text{H}_2\text{O}$  dissolve 111 g. salt at 20°. (Von Weimarn, C. C. 1911. II, 1300.)

Sp. gr. of solution sat. at 18° = 1.574, and contains 52.6%  $\text{LiCrO}_4$ . (Mylius and Wrochem, B. 1897, 30. 1718.)

**Lithium dichromate,  $\text{Li}_2\text{Cr}_2\text{O}_7$ .**

130.4 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at 30°. (Schreinemakers, C. C. 1906. II, 1486.)

+  $2\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Lithium potassium chromate,  $\text{K}_2\text{CrO}_4$ ,**

$\text{Li}_2\text{CrO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Hydroscopic. (Zehenter, M. 1897, 18. 54.)

**Magnesium chromate,  $\text{MgCrO}_4$ .**

Sol. in  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ ; insol. in  $\text{HNO}_3$ . (Dufau, C. R. 1896, 123. 888.)

Sp. gr. of  $\text{MgCrO}_4 + \text{Aq}$  sat. at  $t^\circ/4^\circ$ .

$t^\circ$	13.6°	14.5°	13.6°
% $\text{MgCrO}_4$	12.31	21.86	27.71
Sp. gr.	1.0886	1.1641	1.2170

(Slotte, W. Ann. 1881, 14. 19.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

+  $7\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Vauquelin.)

100 cm. of solution sat. at 18° contain 60 g.  $\text{MgCrO}_4$ . (Kohlrausch, B. A. B. 1897. 90.)

Sp. gr. of solution sat. at 18° = 1.422, and contains 42%  $\text{MgCrO}_4$ . (Mylius and Wrochem, B. 1897, 30. 1718.)

+  $5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Wyrouboff, Bull. Soc. Min. 12. 60.)

**Magnesium dichromate,  $\text{Mg}_2\text{Cr}_2\text{O}_7$ .**

Sol. in  $\text{H}_2\text{O}$ .

Sl. sol. in alcohol. (Reinitzer, Zeit. angew. 1913, 28. 456.)

**Magnesium potassium chromate,  $\text{MgCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 28.2 pts. at 20°; 34.3 pts. at 60°. (Schweitzer.)

Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in sat.  $\text{K}_2\text{CrO}_4 + \text{Aq.}$  (Gröger, Z. anorg. 1907, 54. 188.)

Insol. in alcohol.

+  $6\text{H}_2\text{O}$ . Efflorescent. (Briggs, Chem. Soc. 1904, 85. 679.)

**Magnesium rubidium chromate,**

$\text{MgRb}_2(\text{CrO}_4)_2 + 6\text{H}_2\text{O}$ .

(Briggs, Chem. Soc. 1904, 85. 679.) (Barker, Chem. Soc. 1911, 99. 1327.)

**Magnesium sodium chromate.**

(Stanley, C. N. 54. 194.)

**Manganous chromate,  $2\text{MnO}$ ,  $\text{CrO}_2 + \text{H}_2\text{O}$ .**

Ppt. Sol. in dil.  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq.}$  (Warrington and Reinsch, Schw. J. 3. 378.)

**Manganous potassium chromate,  $\text{MnCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ . (Gröger, Z. anorg. 1905, 44. 459.)

$2\text{MnCrO}_4$ ,  $\text{K}_2\text{CrO}_4 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Henagen, R. t. c. 3. 433.)

**Mercurous chromate, basic,  $4\text{Hg}_2\text{O}$ ,  $3\text{CrO}_2$ .**

Very sl. sol. in cold, more in boiling  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  Decomp. by  $\text{HCl} + \text{Aq.}$  Sl. sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Does not exist. (Richter, B. 15. 1489.)

$3\text{Hg}_2\text{O}$ ,  $\text{CrO}_2$ . Sol. in  $\text{HNO}_3 + \text{Aq.}$  (Richter.)

$3\text{Hg}_2\text{O}$ ,  $2\text{CrO}_3$ . Ppt. (Fichter, Z. anorg. 1912, 76. 350.)

**Mercurous chromate,  $\text{Hg}_2\text{CrO}_4$ .**

Very sl. sol. in cold, more readily in hot  $\text{H}_2\text{O}$ . Sl. sol. in dil.  $\text{HNO}_3$ +Aq; sol. in conc.  $\text{HNO}_3$ ; sol. in  $\text{KCN}$ +Aq; insol. in  $\text{Hg}_2(\text{NO}_3)_2$ +Aq. (Rose, Pogg. 53. 124.)

Less sol. in  $\text{K}_2\text{CrO}_4$ +Aq. than in  $\text{H}_2\text{O}$ . (Fichter, Z. anorg. 1912, 76. 349.)  
Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Mercuric chromate, basic,  $2\text{HgO}$ ,  $\text{CrO}_3$ .**

Sol. in  $\text{HCl}$ , and in  $\text{HNO}_3$ +Aq. (Geuther.)  
 $3\text{HgO}$ ,  $\text{CrO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Millon.)

The only true compound. All others are mixtures of  $\text{HgO}$  or  $\text{HgCrO}_4$  with this compound. (Cox, Z. anorg. 1904, 40. 155.)

$4\text{HgO}$ ,  $\text{CrO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 18. 365.)

$7\text{HgO}$ ,  $2\text{CrO}_3$ . Easily sol. in warm  $\text{HNO}_3$ , when freshly precipitated. Easily sol. in  $\text{HCl}$ +Aq. (Geuther, A. 106. 247.)

Does not exist. (Freese, B. 2. 477.)

$5\text{HgO}$ ,  $\text{CrO}_3$ . Easily sol. in  $\text{HCl}$ +Aq. Very sl. sol. in  $\text{HNO}_3$ +Aq. Decomp. by  $\text{H}_2\text{O}$  into—

$6\text{HgO}$ ,  $\text{CrO}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Jäger and Krüss, B. 22. 2049.)

**Mercuric chromate,  $\text{HgCrO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  and acids into basic salt. (Geuther.)

Sol. in acids. Sol. in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$ +Aq. Sol. in  $\text{Hg}(\text{NO}_3)_2$ , or  $\text{HgCl}_2$ +Aq.

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Mercuric dichromate,  $\text{HgCr}_2\text{O}_7$ .**

Ppt. (Gawalowski, C. C. 1906. II, 1307.)

**Mercurous potassium chromate,**

$\text{Hg}_2\text{K}_2(\text{CrO}_4)_2$ .

Ppt.; decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1907, 64. 191.)

**Mercuric chromate, basic, ammonia,  $12\text{HgO}$ ,  $3\text{CrO}_3$ ,  $2\text{NH}_3$ + $3\text{H}_2\text{O}$ .**

(Gröger, Z. anorg. 1908, 58. 420.)

**Mercuric chromate ammonia,  $\text{HgCrO}_4$ ,  $2\text{NH}_3$ + $\text{H}_2\text{O}$ .**

(Gröger, Z. anorg. 1908, 58. 419.)

**Mercuric chromate sulphide,  $2\text{HgCrO}_4$ ,  $\text{HgS}$ .**

Not attacked by weak acids. (Palm, C. C. 1863. 121.)

**Nickel chromate, basic,  $4\text{NiO}$ ,  $\text{CrO}_3$ + $6\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{NH}_4\text{OH}$ +Aq. (Malaguti and Sarzeau, A. ch. (3) 9. 451.)

$3\text{NiO}$ ,  $\text{CrO}_3$ + $6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH}$ +Aq. (Freese, J. B. 1869. 271.)

$2\text{NiO}$ ,  $\text{CrO}_3$ + $6\text{H}_2\text{O}$ . As above. (Schmidt, A. 156. 19.)

$5\text{NiO}$ ,  $2\text{CrO}_3$ + $12\text{H}_2\text{O}$ . As above. (Schmidt.)

**Nickel chromate,  $\text{NiCrO}_4$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ .

Nearly insol. in hot dil.  $\text{HNO}_3$ . Slowly sol. in conc.  $\text{HNO}_3$  and aqua regia.

Somewhat sol. in  $\text{NH}_3$ +Aq. (Briggs, Z. anorg. 1909, 63. 326.)

**Nickel dichromate,  $2\text{NiCr}_2\text{O}_7$ + $3\text{H}_2\text{O}$ .**

Slowly sol. in cold, rapidly sol. in hot  $\text{H}_2\text{O}$ .  
Deliquescent. (Briggs, Z. anorg. 1907, 56. 246.)

**Nickel potassium chromate,  $\text{NiCrO}_4$ ,  $\text{K}_2\text{CrO}_4$ + $2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1906, 51. 353.)

+ $6\text{H}_2\text{O}$ . Efflorescent. (Briggs, Chem. Soc. 1904, 85. 678.)

**Nickel rubidium chromate,  $\text{NiRb}(\text{CrO}_4)_2$ + $6\text{H}_2\text{O}$ .**

Sl. efflorescent at ord. temp. (Briggs, Chem. Soc. 1904, 85. 678.)

**Nickel chromate ammonia,  $\text{NiCrO}_4$ ,  $6\text{NH}_3$ + $4\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Quite easily sol. in  $\text{NH}_4\text{OH}$ +Aq of 0.96 sp. gr. (Schmidt.) Insol. in alcohol or ether.

**Potassium chromate,  $\text{K}_2\text{CrO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , etc.**

System:  $\text{K}_2\text{O}$ ,  $\text{CrO}_3$ ,  $\text{H}_2\text{O}$  at  $0^\circ$

100 g. of the sat. solution contain		Solid phase
g. $\text{K}_2\text{O}$	g. $\text{CrO}_3$	
31.18	...	
26.06	0.54	$\text{K}_2\text{CrO}_4$
19.31	4.27	"
17.73	5.50	"
17.06	11.77	"
17.18	11.91	"
17.62	18.71	"
17.63	18.72	"
17.61	18.91	$\text{K}_2\text{CrO}_4$ + $\text{K}_2\text{Cr}_2\text{O}_7$
17.79	19.10	"
17.80	19.10	"
10.90	11.93	$\text{K}_2\text{Cr}_2\text{O}_7$
8.07	8.93	"
1.87	3.13	"
1.41	3.00	"
1.42	3.01	"
0.97	3.94	"
0.78	22.38	"
1.02	38.83	"
1.26	40.10	"
1.36	40.41	"
1.22	41.70	"

System:  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $0^\circ$ —Continued

100 g. of the sat. solution contain		Solid phase
g. $K_2O$	g. $CrO_3$	
1.28	41.75	$K_2Cr_2O_7$
1.40	42.10	"
1.23	42.11	"
1.33	42.16	"
1.31	42.28	"
1.38	42.48	"
1.40	42.68	"
1.47	42.93	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
1.47	42.95	"
1.47	43.09	"
1.25	44.52	$K_2Cr_2O_{10}$
1.27	44.95	"
1.18	45.84	"
1.17	46.84	"
1.36	47.22	$K_2Cr_2O_{10} + K_2Cr_2O_{13}$
1.36	47.31	"
1.40	47.67	"
1.24	48.23	$K_2Cr_2O_{13}$
1.35	51.66	"
1.10	53.81	"
1.08	55.63	"
1.16	56.93	"
0.98	57.63	"
1.16	59.46	"
0.91	59.87	"
0.81	60.16	"
0.70	61.76	$K_2Cr_2O_{13} + CrO_3$
0.62	61.77	"
0.57	61.78	"
0.67	61.86	"
...	61.51	$CrO_3$
...	61.52	"
...	61.55	"
...	61.57	"

(Koppel and Blumenthal, Z. anorg. 1907, 53, 245.)

System:  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $20^\circ$ 

100 g. of the sat. solution contain		Solid phase
g. $K_2O$	g. $CrO_3$	
2.21	42.92	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
2.20	43.28	"
2.10	44.02	$K_2Cr_2O_{10}$
2.02	45.28	"
2.01	46.24	"
2.00	48.46	$K_2Cr_2O_{10} + K_2Cr_2O_{13}$
1.94	48.62	$K_2Cr_2O_{13}$
1.62	49.01	"
0.62	62.80	$K_2Cr_2O_{13} + CrO_3$

(Koppel and Blumenthal, Z. anorg. 1907, 53, 243.)

System:  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $30^\circ$ 

100 g. of the sat. solution contain		Solid phase
g. $K_2O$	g. $CrO_3$	
46.8	...	$KOH, 2H_2O$
26.89	0.94	$K_2Cr_2O_4$
22.25	3.06	"
19.52	6.99	"
18.65	13.72	"
18.60	17.00	"
18.70	17.03	"
19.12	20.30	"
19.35	21.00	$K_2Cr_2O_4 + K_2Cr_2O_7$
15.04	16.85	$K_2Cr_2O_7$
14.77	16.51	"
12.28	14.57	"
11.20	13.11	"
4.98	10.48	"
3.07	19.34	"
2.42	28.21	"
2.35	33.77	"
2.30	36.78	"
2.30	40.41	"
2.50	44.50	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
2.25	49.95	$K_2Cr_2O_{10} + K_2Cr_2O_{13}$
1.35	53.39	$K_2Cr_2O_{13}$
0.69	62.81	$K_2Cr_2O_{13} + CrO_3$
...	62.52	$CrO_3$

(Koppel and Blumenthal, Z. anorg. 1907, 53, 235.)

System:  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $60^\circ$ 

100 g. of the sat. solution contain		Solid phase
g. $K_2O$	g. $CrO_3$	
50.0	...	$KOH, H_2O$
32.98	0.53	$K_2Cr_2O_4$
21.05	9.15	"
20.70	8.99	"
20.25	14.43	"
20.32	16.56	"
20.67	21.94	"
20.72	22.00	"
20.68	23.49	$K_2Cr_2O_4 + K_2Cr_2O_7$
20.55	23.74	$K_2Cr_2O_7$
14.53	20.82	"
13.36	20.93	"
10.01	21.24	"
10.01	21.24	"
8.39	26.95	"
7.65	31.49	"
7.54	32.92	"
6.86	39.64	"
7.06	49.84	$K_2Cr_2O_7 + K_2Cr_2O_{10}$
6.51	50.40	$K_2Cr_2O_{10}$
5.33	52.70	"
5.49	52.79	"
5.06	53.42	"
5.12	53.58	"
5.30	53.70	"

System:  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at  $60^\circ$ —Continued

100 g. of the sat. solution contain		Solid phase
g. $K_2O$	g. $CrO_3$	
5.01	54.09	$K_2Cr_2O_{10} + K_2Cr_4O_{13}$
4.06	54.73	
3.29	54.91	" $K_2Cr_4O_{13}$
2.95	55.43	
3.01	56.41	"
2.50	58.05	
2.31	58.69	"
2.00	60.69	
2.05	61.25	"
1.70	61.27	
1.79	61.29	"
1.57	62.57	
1.27	65.77	$K_2Cr_4O_{13} + CrO_3$
...	65.12	

(Koppel and Blumenthal, Z. anorg. 1907, 53, 240.)

System:  $K_2O$ ,  $CrO_3$ ,  $H_2O$  at the cryohydric pt.

Cryohydric pt.	100 g. of the solution contain		Solid phase
	g. $K_2O$	g. $CrO_3$	
-11.5°	17.18	18.11	$K_2CrO_4 + K_2Cr_2O_7$
-30.0°	1.18	42.51	
-39.0°	0.79	45.69	$K_2Cr_2O_7 + K_2Cr_4O_{13}$

(Koppel and Blumenthal, Z. anorg. 1907, 53, 263-5.)

B.-pt. of solutions of  $CrO_3 + K_2O + Aq.$ 

B.-pt.	100 g. of the solution contain		Solid phase
	g. $K_2O$	g. $CrO$	
109°	30.01	11.92	$K_2CrO_4$
105.8	23.8	25.3	
106.8	24.3	30.5	$K_2CrO_4 + K_2Cr_2O_7$
104.8	16.4	35.6	
114.0	16.8	59.2	$K_2Cr_2O_7 + K_2Cr_4O_{13}$
127.0	...	71.2	

(Koppel and Blumenthal, Z. anorg. 1907, 53, 255.)

Potassium chromate,  $K_2CrO_4$ .Easily sol. in  $H_2O$ .

Sol. in 2 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)  
 100 pts.  $H_2O$  at  $15^\circ$  dissolve 43.837 pts.  $K_2CrO_4$ , and solution has sp. gr. of 1.3032. (Michel and Krafft, A. ch. (3) 41. 478.)

1 pt. dissolves in 2.07 pts.  $H_2O$  at  $15.5^\circ$ . (Thomson.)1 pt. dissolves in 1.75 pts.  $H_2O$  at  $17.5^\circ$ , and in 1.67 pts.  $H_2O$  at  $100^\circ$ . (Mosser.)100 pts.  $H_2O$  dissolve at—

0°	10°	20°	30°
58.90	60.92	62.94	64.96 pts. $K_2CrO_4$ ,
40°	50°	60°	70°
66.98	69.00	71.02	73.04 pts. $K_2CrO_4$ ,
80°	90°	100°	
75.06	77.08	79.10	pts. $K_2CrO_4$ .

(Alluard, C. R. 59. 500.)

100 pts.  $H_2O$  dissolve at—

0°	10°	27.37°	42.1°
61.5	62.1	66.3	70.3 pts. $K_2CrO_4$ ,
63.6°	93.6°	106.1°	
74.9	79.7	81.8	pts. $K_2CrO_4$ .

(Nordenskjöld and Lindström, Pogg. 136, 314.)

100 pts.  $K_2CrO_4 + Aq$  sat. at  $10-12^\circ$  contain 37.14 pts. salt. (v. Hauer, J. pr. 103, 114.)100 pts.  $H_2O$  at  $19.5^\circ$  dissolve 62.3 pts.  $K_2CrO_4$ , and solution has sp. gr. of 1.3787. (Schiff, A. 109. 326.)Sat.  $K_2CrO_4 + Aq$  contains at—

34°	53°	79°
39.7	40.3	41.8% $K_2CrO_4$ .

96°	120°	157°
42.6	44.0	45.4% $K_2CrO_4$ .

(Étard, A. ch. 1894, (7) 2. 550.)

100 cc. sat.  $K_2CrO_4 + Aq.$  contain 53 g.  $K_2CrO_4$  at  $18^\circ$ . (Kohlrausch, B. A. B. 1897, 90.)100 pts.  $H_2O$  dissolve 64.91 pts.  $K_2CrO_4$  at  $30^\circ$  or 100 g. of solution contain 39.36 g.  $K_2CrO_4$ . (Schreinemakers, Chem. Weekbl. 1905, 1. 837.)100 g.  $H_2O$  dissolve:

54.57 g. $K_2CrO_4$ at -11.37° (cryohydric pt.)	
57.11 g. " " 0°	
65.13 g. " " 30°	
74.60 g. " " 60°	
88.80 g. " " 105.8° (b-pt. of sat. sol.)	

(Koppel, Z. anorg. 1907, 53. 262.)

64.62 g.  $K_2CrO_4$  are sol. in 100 g.  $H_2O$  at  $25^\circ$ . (Amadori, Real. Att. Linc. 1912, (5) 21, I. 667.)

Sp. gr. of  $K_2CrO_4$  + Aq at 19.5°.

% $K_2CrO_4$	Sp. gr.	% $K_2CrO_4$	Sp. gr.	% $K_2CrO_4$	Sp. gr.
1	1.0080	15	1.1287	28	1.2592
2	1.0161	16	1.1380	29	1.2700
3	1.0243	17	1.1474	30	1.2808
4	1.0325	18	1.1570	31	1.2921
5	1.0408	19	1.1667	32	1.3035
6	1.0492	20	1.1765	33	1.3151
7	1.0576	21	1.1864	34	1.3268
8	1.0663	22	1.1964	35	1.3386
9	1.0750	23	1.2066	36	1.3505
10	1.0837	24	1.2169	37	1.3625
11	1.0925	25	1.2274	38	1.3746
12	1.1014	26	1.2379	39	1.3868
13	1.1104	27	1.2485	40	1.3991
14	1.1195	..	....	..	....

(Kremers, and Schiff, calculated by Gerlach, Z. anal. 8. 288.)

$K_2CrO_4$  dissolved in 2 pts.  $H_2O$  has sp. gr., 1.28; 3 pts., 1.21; 4 pts., 1.18; 5 pts., 1.15; 6 pts., 1.12; 7 pts., 1.11; 8 pts., 1.10. (Moser.)

Sp. gr. of sat. solution at 8° = 1.368. (Anthon, 1837.)

Sp. gr. of sat.  $K_2CrO_4$  + Aq containing 24.26%  $K_2CrO_4$  = 1.2335 at 18°/4°. (Slotte, W. Ann. 1881, 14. 18.)

Sp. gr. of  $K_2CrO_4$  + Aq at 25°.

Concentration of $K_2CrO_4$ + Aq.	Sp. gr.
1-normal	1.0935
1/3- "	1.0475
1/4- "	1.0241
1/5- "	1.0121

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sat.  $K_2CrO_4$  + Aq boils at 107°. (Kremers.)

Sat.  $K_2CrO_4$  + Aq boils at 104.2° under 718 mm. pressure. (Alluad.)

Freezing point of sat.  $K_2CrO_4$  + Aq = -12.5°. (Rüdorff.)

By dissolving  $K_2CrO_4$  in 2 pts.  $H_2O$ , the temp. is lowered 10°. (Moser.)

100 pts. sat. solution of  $K_2CrO_4$  and  $K_2SO_4$  contain 37.14 pts. of the two salts at 10-12°. (v. Hauer, J. pr. 103. 114.)

Solubility of  $K_2CrO_4$  +  $K_2SO_4$  in  $H_2O$  at 25°. (G. per 100 g.  $H_2O$ .)

$K_2CrO_4$	$K_2SO_4$	$K_2CrO_4$	$K_2SO_4$
63.09	0.76	20.83	5.75
61.39	1.17	14.65	7.12
58.40	1.84	7.81	8.98
51.81	2.36	4.36	10.25
40.93	3.33	1.94	10.86
27.36	4.82	....	....

(Amadori, Real. Att. Linc. 1912, (5) 21, I. 667.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

100 g. sat. solution in glycol at 15.4° contain 1.7 g.  $K_2CrO_4$ . (de Coninck, C. C. 1906, II. 183.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II, 1014.)

+4 $H_2O$ . Easily sol. in  $H_2O$  and in  $NH_4OH$  + Aq. (Weech, Dissert. 1909.)

Potassium dichromate,  $K_2Cr_2O_7$ .

Sol. in  $H_2O$ , with slight absorption of heat. Less sol. in  $H_2O$  than  $K_2CrO_4$ .

Sol. in 9.6 pts.  $H_2O$  at 17.3°. (Thompson.)  
10 " " 18.7°. (Moser.)

100 pts.  $H_2O$  at 15° dissolve 9.126 pts.  $K_2Cr_2O_7$ , and solution has sp. gr. = 1.0618. (Michel and Krafft, A. ch. (3) 41. 478.)

100 pts.  $H_2O$  dissolve pts.  $K_2Cr_2O_7$ . A = according to Alluad (C. R. 59. 500); K = according to Kremers (Pogg. 92. 497).

t°	A	K	t°	A	K
0	4.6	4.97	60	45.0	50.5
10	7.4	8.5	70	56.7	....
20	12.4	13.1	80	68.6	73.0
30	18.4	...	90	81.1	....
40	25.9	29.1	100	94.1	102.00
50	35.0	...	..	...	....

Solubility in  $H_2O$  at high temperatures.  
100 pts.  $H_2O$  dissolve pts.  $K_2Cr_2O_7$  at t°.

t°	Pts. $K_2Cr_2O_7$	t°	Pts. $K_2Cr_2O_7$
117	128.3	148	200.6
129	153.8	180	262.7

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

Solubility of  $K_2Cr_2O_7$  in  $H_2O$  at t°.

t°	% $K_2Cr_2O_7$	t°	% $K_2Cr_2O_7$
-1	4.1	92	42.8
+1	4.3	97	44.0
6	5.6	104	48.0
7	6.1	120	52.0
12	7.2	130	54.4
15	8.5	150	60.8
20	10.4	157	62.8
29	14.2	178	66.6
36	16.6	215	76.9
57	28.2	291	89.7
61	30.2	312	91.8
65	32.0	360	97.4
70	34.4	...	....

(Étard, A. ch. 1894, (7) 2. 550.)

100 g.  $H_2O$  dissolve 10.1 g.  $K_2Cr_2O_7$  at 15.5°. (Greenish and Smith, Pharm. J. 1901, 66. 774.)

100 pts.  $H_2O$  at 30° dissolve 18.12 pts.  $K_2Cr_2O_7$ . (Schreinemakers, Chem. Weekbl. 1905 1. 837.)

100 g.  $H_2O$  dissolve:

4.50 g.  $K_2Cr_2O_7$  at  $-0.63^\circ$  (cryohydric pt.)

4.64 g. " "  $0^\circ$

18.13 g. " "  $30^\circ$

45.44 g. " "  $60^\circ$

108.2 g. " "  $104.8^\circ$  (b-pt. of sat. sol.)

(Koppel, Z. anorg. 1907, 53. 263.)

100 c.c. sat. solution contain 11.43 g.  $K_2Cr_2O_7$  at 20°. (Sherrill and Eaton, J. Am. Chem. Soc. 1907, 29. 1643.)

100 g. sat.  $K_2Cr_2O_7$  contain:

5.52 g.  $K_2Cr_2O_7$  at  $4.81^\circ$

15.17 " "  $30.10^\circ$

17.77 " "  $35.33^\circ$

(Le Blanc and Schmandt, Z. phys. Ch. 1911, 77. 614.)

100 g. sat.  $K_2Cr_2O_7$  + Aq. at  $35.03^\circ$  contains 17.72 g.  $K_2Cr_2O_7$ . (Le Blanc, Z. phys. Ch. 1913, 86. 335.)

$K_2Cr_2O_7$  + Aq sat. at  $8^\circ$  has sp. gr. 1.065. (Anthon, 1887.)

Sp. gr. of  $K_2Cr_2O_7$  + Aq at  $19.5^\circ$ .

% $K_2Cr_2O_7$	Sp. gr.	% $K_2Cr_2O_7$	Sp. gr.
1	1.007	9	1.065
2	1.015	10	1.073
3	1.022	11	1.080
4	1.030	12	1.085
5	1.037	13	1.097
6	1.043	14	1.102
7	1.050	15	1.110
8	1.056	..	...

(Kremers, calculated by Gerlach, Z. anal. 8. 288.)

Sp. gr. of  $K_2Cr_2O_7$  + Aq containing 4.71%  $K_2Cr_2O_7$  = 1.0325 at  $11^\circ/4^\circ$ ; containing 6.97%  $K_2Cr_2O_7$  = 1.0493 at  $10.6^\circ/4^\circ$ . (Slotte, W. Ann. 1881, 14. 18.)

Sat.  $K_2Cr_2O_7$  + Aq boils at  $104^\circ$  (Kremers);  $103.4^\circ$ . (Alluard.)

Insol. in alcohol.

Sl. sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol. (Reinitzer, Zeit. angew. Ch. 1913, 26. 456.)

100 g. sat. solution in glycol contain 6 g.  $K_2Cr_2O_7$ . (de Coninck, Bull. acad. roy. Belg. 1905, 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899. II, 1014.)

**Potassium trichromate,  $K_2Cr_2O_{10}$ .**

Easily sol. in  $H_2O$  and alcohol. (Bothe, J. pr. 46. 184.)

Not deliquescent; decomp. by  $H_2O$  in chromic acid and  $K_2Cr_2O_7$ . (Jäger and Krüss, B. 22. 2041.)

**Potassium tetrachromate,  $K_2Cr_2O_{13}$ .**

Very deliquescent, and easily sol. in  $H_2O$ . (Schwarz, Dingl. 186. 31.)

Not deliquescent. Decomp. by  $H_2O$ . (Jäger and Krüss, B. 22. 2042.)

**Potassium samarium chromate,**

$K_2Sm_2(CrO_4)_4 + 6H_2O$ .

Precipitate. (Cleve.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Potassium sodium chromate,  $3K_2CrO_4$ ,  $Na_2CrO_4$ .**

Sol. in  $H_2O$ . (v. Hauer, J. pr. 83. 359.)

64.2 pts. are sol. in 100 pts.  $H_2O$  at  $14^\circ$ . (Zehenter, M. 1897, 18. 49.)

**Potassium strontium chromate,  $K_2Sr(CrO_4)_2$ .**

Ppt. Decomp. by  $H_2O$ . (Gröger, Z. anorg. 1907, 54. 187.)

Decomp. by  $H_2O$ . Stable in contact with solutions containing:

at  $11.5^\circ$ , 2.914 pts.  $K_2CrO_4$  per 100 pts.  $H_2O$ .

at  $27.5^\circ$ , 4.123 " " " " " "

at  $50^\circ$ , 5.942 " " " " " "

at  $76^\circ$ , 7.920 " " " " " "

at  $100^\circ$ , 9.784 " " " " " "

(Barre, C. R. 1914, 158. 496.)

**Potassium thallium chromate,  $K_2CrO_4$ ,**

$Tl_2CrO_4$ .

(Lachaud and Lepierre, Bull. Soc. (3) 6. 232.)

+  $2H_2O$ . Rapidly hydrolyzed by  $H_2O$  unless a large excess of the  $CrO_4$  ion is present.

Readily sol. in dil. mineral acids.

Difficulty sol. in  $K_2Cr_2O_7$  + Aq. (Hawley, J. Am. Chem. Soc. 1907, 29. 304.)

**Potassium uranyl chromate,  $K_2CrO_4$ ,**

$2(UO_2)CrO_4 + 6H_2O$ .

Decomp. by boiling with  $H_2O$ . Sol. in acidified  $H_2O$ . (Formánek, A. 257. 103.)

$K_2CrO_4$ ,  $(UO_2)CrO_4 + H_2O$ ;  $2K_2CrO_4$ ,

$3(UO_2)CrO_4 + 7H_2O$ ;  $3K_2CrO_4$ ,  $4(UO_2)CrO_4$ ,

+  $7H_2O$ ; and  $K_2CrO_4$ ,  $3(UO_2)CrO_4 + 14H_2O$ .

Precipitates. (Wiesner, C. C. 1882. 777.)

**Potassium ytterbium chromate, basic,**

$2KYb(CrO_4)_2 + Yb(OH)_3 + 15\frac{1}{2}H_2O$

Ppt. (Cleve, Z. anorg. 1902, 32. 151.)



**Potassium yttrium chromate**,  $K_2CrO_4$ ,  
 $Y_2(CrO_4)_3 + xH_2O$ .  
 Ppt. (Cleve.)

**Potassium zinc chromate, basic**,  $K_2O$ ,  $5ZnO$ ,  
 $4CrO_3 + 6H_2O$ , or  $K_2O$ ,  $4ZnO$ ,  $3CrO_3$ ,  
 $+ 3H_2O$ .

Slightly sol. in cold, decomp. by hot  $H_2O$ .  
 (Wöhler.)

$K_2O$ ,  $4ZnO$ ,  $3CrO_3 + 3H_2O$ . Insol. in cold,  
 decomp. by hot  $H_2O$ . (Gröger, M. 1904,  
 25. 520.)

**Potassium zinc chromate**,  $K_2Zn(CrO_4)_2 +$   
 $2H_2O$ .

Ppt. Decomp. by  $H_2O$ . (Gröger, Z.  
 anorg. 1907, 54. 189.)

**Potassium dichromate chloride mercuric**  
**chloride**,  $K_2Cr_2O_7 \cdot 2KCl \cdot 4HgCl_2 + 2H_2O$ .

Solution in  $H_2O$  sat. at  $20.5^\circ$  contains  
 6.78% salt. Salt is much more sol. in hot  
 $H_2O$ . (Strömholm, Z. anorg. 1912, 75. 278.)

**Potassium chromate iodate**.

See Chromoiodate, potassium.

**Potassium chromate magnesium sulphate**,  
 $K_2CrO_4$ ,  $MgSO_4 + 9H_2O$ .

Sol. in  $H_2O$ . (Étard, C. R. 85. 443.)

**Potassium chromate [mercuric chloride]**,  
 $K_2CrO_4$ ,  $2HgCl_2$ .

Easily sol. in  $H_2O$ . Sol. in dil.  $HCl + Aq$ .  
 (Darby.)

**Potassium dichromate mercuric chloride**,  
 $K_2Cr_2O_7$ ,  $HgCl_2$ .

Ether or absolute alcohol dissolves out  
 $HgCl_2$ . (Millon, A. ch. (3) 13. 388.)

Can be crystallized from  $H_2O$ . (Jäger and  
 Krüss, B. 22. 2046.)

**Potassium chromate mercuric cyanide**,  
 $2K_2CrO_4$ ,  $3Hg(CN)_2$ .

Easily sol. in  $H_2O$ .

$+ H_2O$ . (Dexter.)

Formula is  $K_2CrO_4$ ,  $2Hg(CN)_2$ . (Clarke  
 and Sterne, Am. Ch. J. 3. 352.)

**Potassium dichromate mercuric cyanide**,  
 $K_2Cr_2O_7$ ,  $Hg(CN)_2 + 2H_2O$ .

Sol. in  $H_2O$ . (Wyruboff, J. B. 1880. 309.)

**Potassium chromate phosphate**.

See Phosphochromate, potassium.

**Potassium chromate sulphate**,  $K_2CrO_4$ ,  
 $6K_2SO_4$ .

Easily sol. in  $H_2O$ . (Boutron-Chalard.)

**Potassium chromate tellurate**.

See Chromotellurate, potassium.

**Rubidium chromate**,  $Rb_2CrO_4$ .

Sol. in  $H_2O$ . (Piccard, J. pr. 86. 455.)

# Solubility in $H_2O$ at $t^\circ$ .

$t^\circ$	% $Rb_2CrO_4$
— 7	36.65
0	38.27
10.3	40.22
20	42.42
30	44.11
40	46.13
50	47.44
60.4	48.90

(Schreinemakers and Filippo, Chem. Weekbl.  
 1906, 3. 157.)

**Rubidium dichromate**,  $Rb_2Cr_2O_7$ .

Sol. in  $H_2O$ . (Grandeau, A. ch. (3) 67  
 227.)

Very al. sol. in  $H_2O$ : 5% at  $10^\circ$ , 8% at  
 $26^\circ$ , 35% at  $60^\circ$ . (Wyruboff, Bull. Soc.  
 Min. 1881, 4. 129.)

100 pts.  $H_2O$  dissolve 10.46 pts.  $Rb_2Cr_2O_7$   
 at  $30^\circ$ . The solution contains 9.47% salt.  
 (Schreinemakers and Filippo, Chem. Weekbl.  
 1906, 3. 157.)

Two forms of crystals. Figures denote pts.  
 salt per 100 pts.  $H_2O$ .

$t^\circ$	14°	26°	43°
Monoclinic form	4.45	8.00	16.52
Triclinic form	4.40	7.91	16.57

(Wyruboff, Bull. Soc. 1906, (4) 3. 7.)

Solubility of monoclinic and triclinic forms.

Temp.	Pts. of salt in 100 pts. $H_2O$		Temp.	Pts. of salt in 100 pts. $H_2O$	
	Monoclinic	Triclinic		Monoclinic	Triclinic
18°	5.42	4.96	40°	13.22	12.90
24°	6.94	6.55	50°	18.94	18.77
30°	9.08	8.70	60°	28.1	27.3

(Stortenbeker, C. C. 1907, II. 1588.)

**Rubidium dichromate chloride mercuric**  
**chloride**,  $Rb_2Cr_2O_7$ ,  $2RbCl$ ,  $4HgCl_2 +$   
 $2H_2O$ .

Sol. in  $H_2O$ .

Solution sat. at  $20.5^\circ$  contains 5.35% salt.  
 (Strömholm, Z. anorg. 1912, 75. 284.)

**Silver (argentous) chromate**,  $Ag_2CrO_4$ .

Sol. in dil. acids. (Wöhler and Rauten-  
 berg.)

Existence very doubtful.

**Silver chromate**,  $Ag_2CrO_4$ .

Absolutely insol. in  $H_2O$ . Sol. in acids,  
 ammonia, and alkali chromates +  $Aq$ . (War-  
 ington, A. 27. 12.)

Appreciably sol. in cold, and still more in  
 hot  $H_2O$ . (Meineke, A. 261. 341.)

100 ccm.  $H_2O$  dissolve 0.064 grain  $Ag_2CrO_4$ ,  
 at  $100^\circ$ ; 100 ccm.  $H_2O$  containing 50 grains

of the following salts dissolve the given amts. of  $\text{Ag}_2\text{CrO}_4$  at  $100^\circ$ :  $\text{NaNO}_3$ , 0.064 grain;  $\text{KNO}_3$ , 0.192 grain;  $\text{NH}_4\text{NO}_3$ , 0.320 grain;  $\text{Mg}(\text{NO}_3)_2$ , 0.256 grain. (Carpenter, J. S. C. I. 5. 286.)

According to electrical conductivity of  $\text{Ag}_2\text{CrO}_4 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 28 mg.  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

1 l.  $\text{H}_2\text{O}$  dissolves 25 mg.  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

25 mg. are contained in 1 l. of sat. solution at  $18^\circ$ . Solubility increases unusually rapidly with temp. (Kohlrausch, Z. phys. Ch. 1906, 64. 168.)

Sol. in 26,378 pts. cold  $\text{H}_2\text{O}$  and 9116 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Koninck and Nihoul, Zeit. angew. Ch. 1891, 5. 295.)

1 l.  $\text{H}_2\text{O}$  dissolves  $1.2 \times 10^{-4}$  gram. atoms of silver at  $25^\circ$ . (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.029 g.  $\text{Ag}_2\text{CrO}_4$  at  $25^\circ$ . (Schäfer, Z. anorg. 1905, 45. 310.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0256 g.  $\text{Ag}_2\text{CrO}_4$  at  $18^\circ$ ; 0.0341 g. at  $27^\circ$ ; 0.0534 g. at  $50^\circ$ . (Whitby Z. anorg. 1910, 67. 108.)

Sol. in hot  $\text{NH}_4\text{OH} + \text{Aq}$  of sp. gr. 0.94 (15.63%  $\text{NH}_3$ ); sl. sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$  of sp. gr. 0.91 (24.99%  $\text{NH}_3$ ). (Margosches, Z. anorg. 1904, 41. 73.)

Solubility of  $\text{Ag}_2\text{CrO}_4$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

Mols. $\text{NH}_4\text{OH}$ per l.	Mols. $\times 10^3$ $\text{Ag}_2\text{CrO}_4$ per l.
0.01	2.004
0.02	4.169
0.04	8.595
0.08	17.58

(Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1662.)

Sl. sol. in very conc.  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Practically insol. in  $\text{AgNO}_3 + \text{Aq}$ . (Margosches.)

Solubility of  $\text{Ag}_2\text{CrO}_4$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

Mols. $\text{HNO}_3$ per l.	Milliat. per l.		Solid Phase
	Cr	Ag	
0.01	3.157	6.315	$\text{Ag}_2\text{CrO}_4$
0.015	3.730	....	"
0.02	4.177	8.356	"
0.025	4.567	....	"
0.03	5.200	....	"
0.04	5.803	11.62	"
0.05	6.380	....	"
0.06	6.833	....	"
0.07	7.333	....	"
0.075	7.477	14.85	" + $\text{Ag}_2\text{Cr}_2\text{O}_7$
0.08	7.260	15.45	"
0.10	5.647	19.01	"
0.13	4.293	23.89	"
0.14	3.948	25.63	"

(Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1663.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

11.65% alcohol dissolves 0.0129 g.  $\text{Ag}_2\text{CrO}_4$  at ord. temp. (Guerini, Dissert. 1912.)

Insol. in  $\text{H}_2\text{O}$  containing acetic acid in presence of large excess of  $\text{AgNO}_3$ . (Gooch and Weed, Am. J. Sci. 1908, (4) 26. 85.)

Practically insol. in glacial acetic acid but somewhat sol. in dil. acetic acid. It behaves in a similar manner toward propionic, lactic and other organic acids. The red modification is more sol. than the greenish-black. (Margosches, Z. anorg. 1906, 51. 233.)

Silver dichromate,  $\text{Ag}_2\text{Cr}_2\text{O}_7$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Warington.)

Decomp. by boiling with  $\text{H}_2\text{O}$  into  $\text{CrO}_3$  and  $\text{Ag}_2\text{CrO}_4$ . (Jäger and Krüss, B. 22. 2050.)

Decomp. by cold  $\text{H}_2\text{O}$ . (Autenrieth, B. 1902, 35. 2061.)

1 pt. is sol. in 12,000 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Mayer, B. 1903, 36. 1741.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 7.3 \times 10^{-3}$  atoms Ag per l. Decomp. by  $\text{HNO}_3 + \text{Aq}$  (less than 0.06 N) with separation of  $\text{Ag}_2\text{CrO}_4$ . (Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1674.)

Solubility of  $\text{Ag}_2\text{Cr}_2\text{O}_7$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

Mols. $\text{HNO}_3$ per l.	Milliat. per l.		Solid Phase
	Cr	Ag	
0	32.20	5.390	$\text{Ag}_2\text{CrO}_4 + \text{Ag}_2\text{Cr}_2\text{O}_7$
0.01	25.06	6.131	"
0.02	20.21	7.148	"
0.04	13.59	9.529	"
0.06	11.10	11.10	$\text{Ag}_2\text{Cr}_2\text{O}_7$
0.08	11.10	11.10	"
0.08 + 0.1 $\text{AgNO}_3$	6.624	....	"

(Sherrill and Russ, J. Am. Chem. Soc. 1907, 29. 1664.)

Silver uranyl chromate,  $2\text{Ag}_2\text{CrO}_4, \text{UO}_2\text{CrO}_4$ .

Ppt. (Formánek, A. 257. 110.)

Silver chromate ammonia,  $\text{Ag}_2\text{CrO}_4, 4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Mitscherlich, Pogg. 12. 141.)

Silver dichromate mercuric cyanide,

$\text{Ag}_2\text{Cr}_2\text{O}_7, \text{Hg}(\text{CN})_2$ .

Sol. in cold  $\text{H}_2\text{O}$ ; very sol. in hot  $\text{H}_2\text{O}$  without decomp. (Krüss, Z. anorg. 1895, 8. 456.)

$\text{Ag}_2\text{Cr}_2\text{O}_7, 2\text{Hg}(\text{CN})_2$ . Scarcely sol. in cold, more readily in hot  $\text{H}_2\text{O}$ . Sol. in hot  $\text{HNO}_3 + \text{Aq}$ , separating on cooling. (Darby, Chem. Soc. 1. 24.)

Sodium chromate, basic,  $\text{Na}_2\text{CrO}_4 + 13\text{H}_2\text{O}$ .

Sol. without decomp. in  $\text{H}_2\text{O}$ . Sat. solution at  $30^\circ$  contains 41.3%

$\text{Na}_2\text{CrO}_4$ . (Schreinemakers, Z. phys. Ch. 1906, **55**, 93.)

Deliquescent.

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	0°	10°	20.5°
% $\text{Na}_2\text{CrO}_4$	33.87	35.58	38.05

$t^\circ$	27.7°	35°	37°
% $\text{Na}_2\text{CrO}_4$	40.09	44.09	45.13

(Mylius and Funk, Gm.-K. **3**, I, 1379.)

$\text{Na}_2\text{CrO}_4 + \text{Aq}$  sat. at  $18^\circ$  contains 37.50%  $\text{Na}_2\text{CrO}_4$ , and has sp. gr. = 1.446. (Mylius and Funk, B. 1900, **33**, 3688.)

Sodium chromate,  $\text{Na}_2\text{CrO}_4$ .

100 ccm. of solution sat. at  $18^\circ$  contain 54 g.  $\text{Na}_2\text{CrO}_4$ . (Kohlrausch, B. A. B. **1897**, 90.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{CrO}_4$
70	55.15
80	55.53
100	55.74

(Mylius and Funk, Gm.-K. **3**, I, 1379.)

$\text{Na}_2\text{CrO}_4 + \text{Aq}$  sat. at  $18^\circ$  contains 40.10%  $\text{Na}_2\text{CrO}_4$ , and has sp. gr. = 1.432. (Mylius and Funk, B. 1900, **33**, 3686.)

See also +4, 6, and  $10\text{H}_2\text{O}$ .

Sp. gr. of  $\text{Na}_2\text{CrO}_4 + \text{Aq}$  at  $t^\circ/4^\circ$ .

$t^\circ$	17.4°	17.1°	20.7°
% $\text{Na}_2\text{CrO}_4$	5.76	10.62	14.81
Sp. gr.	1.0576	1.1125	1.1644

(Slotte, W. Ann. 1881, **14**, 18.)

+ $4\text{H}_2\text{O}$ . Sat. solution at  $30^\circ$  contains 46.62%  $\text{Na}_2\text{CrO}_4$ . (Schreinemakers, Z. phys. Ch. 1906, **55**, 93.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{CrO}_4$	$t^\circ$	% $\text{Na}_2\text{CrO}_4$
25.6	46.08	49.5	50.93
31.5	47.05	54.5	52.28
36	47.98	59.5	53.39
40	48.97	65	55.23
45	50.20		

(Mylius and Funk, Gm.-K. **3**, I, 1379.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{CrO}_4$	Mols. $\text{H}_2\text{O}$ to 1 mol anhydrous salt	Mols. anhydrous salt to 100 mols. $\text{H}_2\text{O}$
28.9	46.47	10.37	9.64
29.7	46.54	10.34	9.67
31.2	47.08	10.12	9.88

(Salkowski, B. 1901, **34**, 1948.)

+ $6\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{CrO}_4$	Mols. $\text{H}_2\text{O}$ to 1 mol. anhydrous salt	Mols. anhydrous salt to 100 mols. $\text{H}_2\text{O}$
17.7	43.65	11.60	8.62
19.2	44.12	11.40	8.77
21.2	44.64	11.16	8.96
23.2	45.27	10.88	9.19
24.7	45.75	10.77	9.37
26.6	46.28	10.45	9.57

(Salkowski, B. 1901, **34**, 1948.)

+ $10\text{H}_2\text{O}$ . Deliquescent. (Kopp, A. **42**, 99.) Easily sol. in  $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $23^\circ$ . (Berthelot.)

Sp. gr. of solution sat. at  $18^\circ$  = 1.409, and contains 38.1%  $\text{Na}_2\text{CrO}_4$ . (Mylius and Funk, B. 1897, **30**, 1718.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{CrO}_4$
0	24.04
10	33.41
18.5	41.65
19.5	44.78
21	47.40

(Mylius and Funk, Gm.-K. **3**, I, 1379.)

Sp. gr. of solution at  $18^\circ$  containing 40.1%  $\text{Na}_2\text{CrO}_4$  = 1.432. (Mylius, B. 1900, **33**, 3688.)

Sl. sol. in alcohol. (Moser.)

100 g. absolute methyl alcohol dissolve 0.345 g.  $\text{Na}_2\text{CrO}_4$  at  $25^\circ$ . (de Bruyn, Z. phys. Ch. **10**, 783.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)

Sodium dichromate,  $\text{Na}_2\text{Cr}_2\text{O}_7$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{CrO}_4$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{Cr}_2\text{O}_7$
93°	81.19
98°	81.25

(Mylius and Funk, Gm.-K. **3**, I, 1380.)

Sp. gr. of aqueous solution containing—  
1 5 10 15 20 25%  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  
1.007 1.035 1.071 1.105 1.141 1.171

30 35 40 45 50 %  $\text{Na}_2\text{Cr}_2\text{O}_7$ ,  
1.208 1.245 1.280 1.313 1.343

(Stanley, C. N. **54**, 194.)

Sp. gr. of sat. solution containing 63.92%  $\text{Na}_2\text{Cr}_2\text{O}_7$  at  $18^\circ$  = 1.745. (Mylius and Funk, B. 1900, **33**, 3688.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 829.)

Sol. in acetone. (Naumann, B. 1904, **37**, 4328.)  
+2H<sub>2</sub>O. Deliquescent.

100 pts. H<sub>2</sub>O dissolve at—  
0° 15° 30° 80° 100° 139°  
107.2 109.2 116.6 142.8 162.8 209.7 pts. salt.

(Stanley, C. N. **54**, 194.)

Solubility in H<sub>2</sub>O at t°

t°	% Na <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>
0	61.98
17	63.82
34.5	67.36
52	71.76
72	76.90
81	79.80

(Mylius and Funk, Gm.-K. **3**, I, 1380.)

100 g. H<sub>2</sub>O at 30° dissolve 197.6 g. Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, or sat. solution at 30° contains 66.4% Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. (Schreinemakers, Z. phys. Ch. 1906, **55**, 97.)

100 ccm. of a solution of sodium dichromate in alcohol contain 5.133 g. Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> + 2H<sub>2</sub>O at 19.4°. The solution decomp. rapidly. (Reinitzer, Zeit. angew. Ch. 1913, **26**, 456.)

The composition of the hydrates formed by Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> at different dilutions is calculated from determinations of the lowering of the fr.=pt. produced by Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> and of the conductivity and sp. gr. of Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>+Aq. (Jones, Am. ch. J. 1905, **34**, 317.)

**Sodium trichromate**, NaCr<sub>2</sub>O<sub>10</sub>.

Deliquescent. Very sol. in H<sub>2</sub>O. (Stanley, C. N. **54**, 194.)

+H<sub>2</sub>O. Sat. solution at 30° contains 80% Na<sub>2</sub>Cr<sub>2</sub>O<sub>10</sub>. (Schreinemakers, Z. phys. Ch. 1906, **55**, 94.)

Solubility in H<sub>2</sub>O at t°.

t°	0°	15°	55°	99°
% Na <sub>2</sub> Cr <sub>2</sub> O <sub>10</sub>	80.03	80.44	82.68	85.78

(Mylius and Funk, Gm.-K. **3**, I, 1380.)

Sp. gr. of sat. solution containing 80.6% Na<sub>2</sub>Cr<sub>2</sub>O<sub>10</sub> at 18° = 2.059. (Mylius and Funk, B. 1900, **33**, 3688.)

**Sodium tetrachromate**, Na<sub>2</sub>Cr<sub>4</sub>O<sub>18</sub>+4H<sub>2</sub>O.

Solubility in H<sub>2</sub>O at t°.

t°	0°	16°	22°
% Na <sub>2</sub> Cr <sub>4</sub> O <sub>18</sub>	72.19	74.19	76.01

(Mylius and Funk, Gm.-K. **3**, I, 1380.)

Deliquescent.

Sat. solution at 18° contains 74.6% Na<sub>2</sub>Cr<sub>4</sub>O<sub>18</sub> and has sp. gr. = 1.926. (Mylius and Funk, B. 1900, **33**, 3688.)

**Sodium uranyl chromate**, Na<sub>2</sub>CrO<sub>4</sub>, 2(UO<sub>2</sub>)CrO<sub>4</sub>+10H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O. (Formánek, A. **257**, 108.)

100 pts. of the solution in H<sub>2</sub>O contain 52.52 pts. of the anhydrous salt at 20°. (Rimbach, B. 1904, **37**, 482.)

**Sodium chromate silicate**, Na<sub>2</sub>O, Cr<sub>2</sub>O<sub>3</sub>, 2SiO<sub>2</sub>+14H<sub>2</sub>O.

Not decomp. by HCl+Aq. (Singer, Dissert. **1910**.)

2Na<sub>2</sub>O, 3Cr<sub>2</sub>O<sub>3</sub>, 6SiO<sub>2</sub>. Not decomp. by boiling conc. acids except HF. (Weyberg, C. B. Miner, 1908, 519.)

5Na<sub>2</sub>O, 2Cr<sub>2</sub>O<sub>3</sub>, 11SiO<sub>2</sub>. (Weyberg.)

3Na<sub>2</sub>O, 2Cr<sub>2</sub>O<sub>3</sub>, 9.5SiO<sub>2</sub>. (Weyberg.)

**Strontium chromate**, SrCrO<sub>4</sub>.

Somewhat sol. in H<sub>2</sub>O. Sol. in 840 pts. H<sub>2</sub>O (Meschevski, Z. anal. **21**, 399); sol. in 831.8 pts. H<sub>2</sub>O at 15°. (Fresenius, Z. anal. **29**, 419.)

100 cc. H<sub>2</sub>O dissolve 0.4651% at 10°; 1% at 20°; 2.417% at 50°; 3% at 100°. (Reichard, Ch. Z. 1903, **27**, 877.)

Easily sol. in HCl, HNO<sub>3</sub>, or H<sub>2</sub>CrO<sub>4</sub>+Aq.

Sol. in 512 pts. 0.5% NH<sub>4</sub>Cl+Aq at 15°.

Sol. in 63.7 pts. 1% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq at 15°.

Sol. in 348.8 pts. solution containing 0.75% NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, 4 drops HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and 6 drops

(NH<sub>4</sub>)<sub>2</sub>CrO<sub>4</sub>+Aq. (Fresenius.)

100 ccm. NH<sub>4</sub>Cl+Aq sat. at bpt. dissolve 1 g. SrCrO<sub>4</sub>. (Dumesnil, A. ch. 1900, (7) **20**, 125.)

50 ccm. alcohol (29%) dissolve 0.0066 g. SrCrO<sub>4</sub>.

50 ccm. alcohol (53%) dissolve 0.001 g. SrCrO<sub>4</sub>. (Fresenius, Z. anal. **30**, 672.)

**Strontium dichromate**, SrCr<sub>2</sub>O<sub>7</sub>.

Easily sol. in H<sub>2</sub>O.

**Strontium trichromate**, SrCr<sub>3</sub>O<sub>10</sub>+3H<sub>2</sub>O.

Very deliquescent, and sol. in H<sub>2</sub>O. (Preis and Raymann, B. **13**, 340.)

**Strontium chromate mercuric hydrogen chloride**, SrCrO<sub>4</sub>, 2HgCl<sub>2</sub>, HCl.

According to Strömholm is SrCl<sub>2</sub>, SrCr<sub>2</sub>O<sub>7</sub>, 4HgCl<sub>2</sub>+H<sub>2</sub>O.

Recryst. from H<sub>2</sub>O. (Imbert and Belugon, Bull. Soc., 1897, (3) **17**, 471.)

2SrCrO<sub>4</sub>, 6HgCl<sub>2</sub>, HCl. (Imbert and Belugon.)

**Thallous chromate**, TlCrO<sub>4</sub>.

100 pts. H<sub>2</sub>O dissolve 0.03 pt. at 60°. (Rupp and Zimmer, Z. anorg. 1902, **33**, 157.)

Ppt. Insol. in cold moderately conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq, or in very dil. HNO<sub>3</sub>+Aq, and very sl. sol. on boiling therewith. Dil. NH<sub>4</sub>OH, and Na<sub>2</sub>CO<sub>3</sub>+Aq have the same action. Attacked by very dil. HCl+Aq. Sol. in hot conc. HCl+Aq. Decomp. by dil. H<sub>2</sub>SO<sub>4</sub>+Aq. (Carstanjen.)

1 l. KOH+Aq (112 g. per l.) dissolves about 3.5 g.  $\text{Ti}_2\text{CrO}_4$  on boiling, which separates out on cooling.

Boiling conc. KOH+Aq (31% KOH) dissolves 18 g.  $\text{Ti}_2\text{CrO}_4$  per litre. (Lepierre and Lachaud, C. R. 113. 196.)

**Thalious dichromate,  $\text{Ti}_2\text{Cr}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ , etc. Has the same properties as  $\text{Ti}_2\text{CrO}_4$ .

**Thalious trichromate,  $\text{Ti}_2\text{Cr}_3\text{O}_{10}$ .**

Sol. in 2814 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 438.7 pts. at  $100^\circ$ . (Crookes.)

**Thallic chromate.**

Ppt.

**Thorium chromate, basic,  $\text{Th}(\text{OH})_2\text{CrO}_4$ .**

Ppt.; unstable in solution. (Palmer, Am. Ch. J. 1895, 17. 278.)

**Thorium chromate,  $\text{Th}(\text{CrO}_4)_2 + \text{H}_2\text{O}$ .**

Ppt. Sol. in HCl and  $\text{NH}_4\text{Cl}$ +Aq. 1 pt. is sol. in 284 pts.  $\text{H}_2\text{O}$  at  $22^\circ$ . (Palmer, Am. Ch. J. 1895, 17. 375 and 278.)

+ $3\text{H}_2\text{O}$ . Ppt. (Haber, M. 1897, 18. 689.)  
+ $8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Chydenius, Pogg. 119. 54.)

**Tin (stannous) chromate.**

Ppt. Sol. in dil. acids. (Berzelius.)

**Tin (stannic) chromate.**

Ppt. (Leykauf, J. pr. 19. 127.)

**Uranyl chromate, basic,  $\text{UO}_3, 2(\text{UO}_2)\text{CrO}_4 + 8\text{H}_2\text{O}$ .**

Ppt. (Orloff, Ch. Z. 1907, 31. 375.)

$\text{UO}_3, (\text{UO}_2)\text{CrO}_4 + 6\text{H}_2\text{O}$ . (Orloff.)

**Uranyl chromate,  $(\text{UO}_2)\text{CrO}_4 + 3\text{H}_2\text{O}$ .**

1 pt. is sol. in 13.3 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; slowly sol. in alcohol to give a solution which is decomp. on boiling. (Orloff, Ch. Z. 1907, 31. 375.)

+ $11\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Formánek, A. 257. 108.)

**Yttrium chromate.**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Berlin.)

**Zinc chromate, basic,  $4\text{ZnO}, \text{CrO}_3 + 3\text{H}_2\text{O}$ .**

(Gröger, Z. anorg. 1911, 70. 135.)

+ $5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in hot  $\text{H}_2\text{CrO}_4$ +Aq; slowly sol. in  $\text{NH}_4\text{OH}$ +Aq. (Malaguti and Sarzeau, A. ch. (3) 9. 431.)

$3\text{ZnO}, \text{CrO}_3 + 2\text{H}_2\text{O}$ . (Gröger.)

$2\text{ZnO}, \text{CrO}_3 + \text{H}_2\text{O}$ . (Briggs, Z. anorg. 1907, 56. 254.)

+ $1\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{CrO}_4$ +Aq. (Prüssen and Phillipona, A. 149. 92.)

+ $2\text{H}_2\text{O}$ . Ppt. Not wholly insol. in  $\text{H}_2\text{O}$ . (Prüssen and Phillipona.)

$3\text{ZnO}, 2\text{CrO}_3 + \text{H}_2\text{O}$ . (Gröger.)

**Zinc chromate,  $\text{ZnCrO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; very sol. in acids; decomp. by boiling with  $\text{H}_2\text{O}$ . (Schulze, Z. anorg. 1895, 10. 154.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+ $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1911, 70. 135.)

**Zinc dichromate,  $\text{ZnCr}_2\text{O}_7 + 3\text{H}_2\text{O}$ .**

Hygrosopic.

Very sol. in  $\text{H}_2\text{O}$  and sl. decomp. by boiling. (Schulze, Z. anorg. 1895, 10. 153.)

**Zinc trichromate,  $\text{ZnCr}_3\text{O}_{10} + 3\text{H}_2\text{O}$ .**

Deliquescent; very sol. in  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1910, 66. 10.)

**Zinc chromate ammonia,  $\text{ZnCrO}_4, \text{NH}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Gröger, Z. anorg. 1908, 58. 417.)

$\text{ZnCrO}_4, 4\text{NH}_3 + 5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ +Aq. Insol. in alcohol and ether. (Malaguti and Sarzeau, A. ch. (3) 9. 431.)

+ $3\text{H}_2\text{O}$ . Efflorescent. Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in dil. acids and  $\text{NH}_4\text{OH}$ +Aq. (Bieler, A. 151. 223.)

$2\text{ZnO}, 3\text{CrO}_3, 10\text{NH}_3 + 10\text{H}_2\text{O}$ . Ppt. (Malaguti and Sarzeau.)

**Zinc dichromate mercuric cyanide,  $\text{ZnCr}_2\text{O}_7, 2\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . Stable in aqueous solution at  $100^\circ$ . (Krüss, Z. anorg. 1895, 8. 460.)

**Perchromic acid**

See Perchromic acid.

**Chromicomolybdic acid,  $\text{Cr}_2\text{O}_3, 12\text{MoO}_3 + 28\text{H}_2\text{O}$ .**

Slowly sol. in  $\text{H}_2\text{O}$ . (Hall, J. Am. Chem. Soc. 1907, 29. 708.)

**Ammonium chromicomolybdate,  $3(\text{NH}_4)_2\text{O}, \text{Cr}_2\text{O}_3, 12\text{MoO}_3 + 20\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Strüve, J. pr. 61. 457; Hall, J. Am. Chem. Soc. 1907, 29. 695.)

+ $26\text{H}_2\text{O}$ . (Marckwald, Dissert, 1895.)

**Ammonium barium chromicomolybdate,**

$(\text{NH}_4)_2\text{O}, 22\text{BaO}, \text{Cr}_2\text{O}_3, 12\text{MoO}_3 + 20\text{H}_2\text{O}$ .

(Hall, J. Am. Chem. Soc. 1907, 29. 707.)

**Barium chromicomolybdate**,  $4\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$ ;  $4\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$ ;  $5\text{BaO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$ .

Ppts. (Hall, J. Am. Chem. Soc. 1907, 29, 705.)

**Lead chromicomolybdate**,  $4\text{PbO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$ , and  $+24\text{H}_2\text{O}$ .

Ppts. (Hall, J. Am. Chem. Soc. 1907, 29, 706.)

**Mercurous chromicomolybdate**,  $8\text{Hg}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 16\text{H}_2\text{O}$ .

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29, 707.)

**Potassium chromicomolybdate**,  $\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $3\text{MoO}_3$ .

Sol. in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ . (Bradbury, Z. anorg. 1894, 7, 46.)

$3\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O}$ . Sol. in 38.51 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . (Strüve; Hall.)  $+24\text{H}_2\text{O}$ . (Hall.)

$4\text{K}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$ . (Hall, J. Am. Chem. Soc. 1907, 29, 709.)

$7\text{K}_2\text{O}$ ,  $2\text{Cr}_2\text{O}_3$ ,  $24\text{MoO}_3 + 32\text{H}_2\text{O}$ . (Hall.)

**Silver chromicomolybdate**,  $5\text{Ag}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 17\text{H}_2\text{O}$ .

Ppt. (Hall.)

**Sodium chromicomolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{Cr}_2\text{O}_3$ ,  $12\text{MoO}_3 + 21\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Strüve.)

**Chromic sulphuric acid.**

See Sulphochromic acid.

**Chromicyanhydric acid,**

$\text{H}_2\text{Cr}(\text{CN})_2(?)$ .

Insol. in  $\text{H}_2\text{O}$ . (Kaiser, A. Suppl. 3, 163.)

**Ammonium chromicyanide**,  $(\text{NH}_4)_2\text{Cr}(\text{CN})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Kaiser, A. Suppl. 3, 163.)

**Cupric chromicyanide**,  $\text{Cu}_2[\text{Cr}(\text{CN})_2]_2$ .

Ppt. Insol. in dil. or conc. acids, except on heating. Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Kaiser.)

**Lead chromicyanide, basic**,  $3\text{Pb}(\text{CN})_2$ ,  $2\text{Cr}(\text{CN})_2$ ,  $\text{Pb}(\text{OH})_2$ .

Ppt. Sol. in  $\text{HNO}_3$ ,  $\text{NaOH} + \text{Aq}$ , or  $\text{Pb}$  salts  $+ \text{Aq}$ . (Kaiser.)

**Potassium chromicyanide**,  $\text{K}_2\text{Cr}(\text{CN})_2$ .

Very sol. in  $\text{H}_2\text{O}$ .

100 pts. cold  $\text{H}_2\text{O}$  dissolve 30.9 pts. salt.

Insol. in absolute alcohol, but somewhat sol. in dil. alcohol.

Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. (Kaiser, A. Suppl. 3, 170.)

**Silver chromicyanide**,  $\text{Ag}_2\text{Cr}(\text{CN})_2$ .

Insol. in all solvents, excepting  $\text{KCN} + \text{Aq}$ . (Kaiser.)

Sol. in large excess of  $\text{HCl} + \text{Aq}$ . Sl. sol. in cold, easily sol. in hot conc.  $\text{HNO}_3$ . Very sol. in conc.  $\text{H}_2\text{SO}_4$ . Insol. in hot or cold acetic acid. (Cruser, Dissert. 1896.)

**Chromisulphocyanhydric acid.**

$\text{H}_2\text{Cr}(\text{SCN})_2$ .

Known only in aqueous solution.

**Ammonium chromisulphocyanide**,

$(\text{NH}_4)_2\text{Cr}(\text{SCN})_2 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Rüssler, A. 141, 185.)

**Barium chromisulphocyanide**,  $\text{Ba}_2[\text{Cr}(\text{SCN})_2]_2 + 16\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (R.)

**Lead chromisulphocyanide**,  $\text{Pb}_2[\text{Cr}(\text{SCN})_2]_2 + 4\text{PbO}_2\text{H}_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby into— $\text{Pb}_2[\text{Cr}(\text{SCN})_2]_2 + 4\text{PbO}_2\text{H}_2 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

**Potassium chromisulphocyanide**,  $\text{K}_2\text{Cr}(\text{SCN})_2 + 4\text{H}_2\text{O}$ .

Sol. in 0.72 pt.  $\text{H}_2\text{O}$ , and 0.94 pt. alcohol.

**Silver chromisulphocyanide**,  $\text{Ag}_2\text{Cr}(\text{SCN})_2$ .

Insol. in  $\text{H}_2\text{O}$  or conc.  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

**Sodium chromisulphocyanide**,  $\text{Na}_2\text{Cr}(\text{SCN})_2 + 7\text{H}_2\text{O}$ .

Deliquescent; sol. in  $\text{H}_2\text{O}$ .

**Chromium,**

*Two modifications*—(a) Not attacked by  $\text{H}_2\text{O}$ . Easily sol. in cold  $\text{HCl} + \text{Aq}$ . Sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Deville.) Easily sol. in a hot mixture of 1 pt  $\text{H}_2\text{SO}_4$  and 20 pts.  $\text{H}_2\text{O}$ . (Regnault, A. ch. 62, 357.) Easily sol. in warm conc.  $\text{H}_2\text{SO}_4$ . (Gmelin.) Very slowly sol. in hot  $\text{HNO}_3 + \text{Aq}$ . (Vauquelin.) Insol. in dil. or conc.  $\text{HNO}_3 + \text{Aq}$ . (Deville.) Very slowly (Richter), not at all (Berzelius) sol. in hot aqua regia. Easily sol. in  $\text{HF} + \text{Aq}$ .

(β) Insol. in all acids, even aqua regia (Fremy); probably contains Si.

Pure Cr is sol. in conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and dil.  $\text{HNO}_3$ ; sol. in  $\text{HgCl}_2 + \text{Aq}$ .

Insol. in fuming  $\text{HNO}_3$ , and aqua regia. (Moissan, C. R. 1894, 119, 187.)

Cr prepared by aluminothermic method is sol. in haloid acids to form chromic and chromous salts, even in absence of air. (Doring, J. pr. 1902, (2) 66, 65; 1906, (2) 73, 393.)

Aluminothermic Cr is active in contact

with HCl, HBr, HI, HF,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_2\text{C}_2\text{O}_4$ , i. e., sol. in cold conc. or warm dil. acids. Is inactive in contact with conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{Cr}_2\text{O}_4$ ,  $\text{HClO}_3$ ,  $\text{HClO}_4$ ,  $\text{H}_3\text{PO}_4$ , KOH, citric, formic, acetic and tartaric acids. Cause attributed to a different electric state. (Hittorff, Z. phys. Ch. 1898, 25, 729.)

#### Chromium ammonia compounds.

See—

Bromotetramine chromium compounds,  $\text{BrCr}(\text{NH}_3)_4\text{X}_2$ .

Bromopurpleochromium compounds,  $\text{BrCr}(\text{NH}_3)_4\text{X}_2$ .

Chlorotetramine chromium compounds,  $\text{ClCr}(\text{NH}_3)_4\text{X}_2$ .

Chloropurpleochromium compounds,  $\text{ClCr}(\text{NH}_3)_4\text{X}_2$ .

Diamine chromium sulphocyanides,  $\text{Cr}(\text{NH}_3)_2(\text{SCN})_2\text{M}$ .

Erythrochromium compounds,  $(\text{HO})\text{Cr}_2(\text{NH}_3)_{10}\text{X}_2$ .

Iodopurpleochromium compounds,  $\text{ICr}(\text{NH}_3)_4\text{X}_2$ .

Iodotetramine chromium compounds,  $\text{ICr}(\text{NH}_3)_4\text{X}_2$ .

Luteochromium compounds,  $\text{Cr}(\text{NH}_3)_6\text{X}_3$ .

Rhodochromium compounds,  $(\text{HO})\text{Cr}_2(\text{NH}_3)_{10}\text{X}_2$ .

Rhodosechromium compounds,  $(\text{HO})_2\text{Cr}_2(\text{NH}_3)_8\text{X}_2$ .

Roseochromium compounds,  $\text{Cr}(\text{NH}_3)_4(\text{OH})_2\text{X}_2$ .

Xanthochromium compounds,  $(\text{HO})_3\text{Cr}(\text{NH}_3)_3\text{X}_3$ .

#### Chromium arsenide, $\text{CrAs}$ .

Insol. in mineral acids. (Dieckmann, Z. anorg. 1914, 86, 294.)

$\text{Cr}_2\text{As}_3$ . Insol. in mineral acids. (Dieckmann.)

#### Chromium azoimide, $\text{CrN}_3$ .

Pptd. by addition of alcohol and ether. Insol. in  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1900, (2) 61, 410.)

#### Chromium boride, $\text{CrB}$ .

Insol. in HCl, dil.  $\text{H}_2\text{SO}_4$ , HF, HF+ $\text{HNO}_3$ . Sl. sol. in  $\text{HNO}_3$  and in aqua regia. (Wedekind, B. 1907, 40, 299.)

Sol. in cold dil. or conc. HCl, HF, and  $\text{H}_2\text{SO}_4$ . (Jassonneix, C. R. 1906, 143, 1151.)

$\text{Cr}_2\text{B}_3$ . Sol. in conc. or dil. HF, HCl,  $\text{H}_2\text{SO}_4$ ; insol. in  $\text{HNO}_3$  or alkalis+aq. (Jassonneix.)

#### Chromous bromide, $\text{CrBr}_2$ .

Sol. in  $\text{H}_2\text{O}$ . Not deliquescent in dry air. (Moissan, C. R. 92, 1051.)

#### Chromic bromide, $\text{CrBr}_3$ .

Anhydrous. Insol. in  $\text{H}_2\text{O}$ , but dissolves at once in presence of the least trace of  $\text{CrBr}_3$ . (Bauck, A. 111, 382.)

+ $6\text{H}_2\text{O}$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .  $\text{H}_2\text{O}$  dissolves more than 2 pts. crystals at ord. temp. Very sol. in alcohol. Insol. in ether. (Recoura, C. R. 110, 1029.)

Blue modification. Insol. in alcohol. (Recoura, C. R. 110, 1193.)

Very hygroscopic. Easily sol. in alcohol and acetone. Insol. in ether. (Werner, A. 1902, 322, 343.)

+ $8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Varenne, C. R. 93, 727.)

#### Chromium molybdenyl bromide,

$\text{CrMo}_3\text{O}_7\text{Br}_4$ .

Apparently wholly insol. in dil. acids. Sol. in hot conc. HCl+aq with decomp.

Insol. in  $\text{M}_2\text{CrO}_4$ +aq. (Atterberg.) + $2\text{H}_2\text{O}$ . Apparently wholly insol. in dil. acids.

Sol. in hot conc. HCl+aq with decomp.

Insol. in  $\text{M}_2\text{CrO}_4$ +aq. (Atterberg.)

#### Chromic rubidium bromide, $\text{CrBr}_3 \cdot 2\text{RbBr} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Werner, A. 1902, 322, 345.)

#### Chromic bromide ammonia.

See Bromotetramine chromium bromide.

#### Chromous bromide hydrazine,

$\text{CrBr}_2 \cdot 2\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Insol. in alcohol, ether and similar solvents. (Traube, B. 1913, 46, 1507.)

#### Chromium carbide, $\text{Cr}_3\text{C}$ .

(Moissan, C. R. 1894, 119, 187.)

$\text{Cr}_3\text{C}_2$ . Does not decomp.  $\text{H}_2\text{O}$  at ordinary temp. or at  $100^\circ$ ; insol. in conc. HCl,  $\text{HNO}_3$  and aqua regia; sol. in dil. HCl (slowly); insol. in fused KOH; sol. in fused  $\text{KNO}_3$ . (Moissan, Bull. Soc. 1894, (3) 117, 1016.)

#### Chromium iron carbide, $3\text{Fe}_3\text{C} \cdot 2\text{Cr}_3\text{C}_2$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in gaseous hydrazine; insol. in  $\text{HNO}_3$  and aqua regia. (Williams, C. R. 1898, 127, 484.)

#### Chromium tungsten carbide, $\text{CW}_3 \cdot 3\text{Cr}_3\text{C}_2$ .

Not attacked by acids.

Slowly attacked by fused KOH or alkali carbonates. Rapidly decomp. by fused alkali nitrates or  $\text{KClO}_3$ . (Moissan, C. R. 1903, 137, 294.)

#### Chromous chloride, $\text{CrCl}_2$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  with evolution of much heat. (Moberg, J. pr. 29, 175.)

Practically insol. in ether. Moderately sol. in absolute alcohol, methyl alcohol, and acetaldehyde. (Rohland, Z. anorg. 1899, 21. 39.)

+1½H<sub>2</sub>O. (Moissan, A. ch. (5) 25. 40.)

+2H<sub>2</sub>O. (Knight and Rich, Chem. Soc. 1911, 99. 89.)

+3H<sub>2</sub>O. (Knight and Rich.)

**Chromous hydrogen chloride**, 3CrCl<sub>2</sub>, 2HCl + 13H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O. (Recoura, C. R. 100. 1227.)

Sl. sol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 827.)

**Chromic chloride**, CrCl<sub>3</sub>.

*Anhydrous.*—*Peach-blossom-colored modification.* Insol. in pure H<sub>2</sub>O (Peligot), but by long continued boiling of the finely divided salt with H<sub>2</sub>O, traces are dissolved with decomp. Not decomp. by boiling conc. H<sub>2</sub>SO<sub>4</sub>, or other acids, even aqua regia.

Easily sol. with evolution of heat in H<sub>2</sub>O containing only 1/10,000 pt. CrCl<sub>3</sub>. (Peligot, J. pr. 36. 150.) Also sol. in presence of traces of SnCl<sub>2</sub> (5 mg. SnCl<sub>2</sub> cause 1 g. CrCl<sub>3</sub> to dissolve), FeCl<sub>3</sub>, Cu<sub>2</sub>Cl<sub>2</sub>, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, and other reducing substances; chlorides without reducing properties have no effect. (Pelouze, A. ch. (3) 14. 251.) TiCl<sub>3</sub> and SO<sub>2</sub> have similar solvent action. (Ebelmen, A. ch. (3) 20. 390); also Zn + dil. acids. (Moberg.)

Insol. in dil. alkalies + Aq; very slowly decomp. by boiling conc. alkalies or alkali carbonates + Aq. (Fellenberg, Pogg. 50. 76.)

Difficulty sol. in methyl acetate. (Nau-mann, B. 1909, 42. 3790.)

Insol. in CS<sub>2</sub>. (Arctowski, Z. anorg. 1894, 6. 257.)

Insol. in acetone. (Eidmann, C. C. 1899. II, 1014.)

Practically insol. in absolute ethyl alcohol, methyl alcohol, acetaldehyde and ether. (Rohland, Z. anorg. 1899, 21. 39.)

*Yellow.* Sl. sol. in benzonitrile. (Nau-mann, B. 1914, 47. 1369.)

*Violet modification.* Very sol. in H<sub>2</sub>O to form a green solution. (Moberg, J. pr. 44. 325.)

The violet mod. is almost insol. in H<sub>2</sub>O but if 1/10,000 pt. chromous chloride is present, it is readily sol. (Rohland, Z. anorg. 1899, 21. 39.)

+4H<sub>2</sub>O. Sl. deliquescent. Very sol. in H<sub>2</sub>O, alcohol, and ethyl acetate. (Godeffroy, Bull. Soc. (2) 43. 229.)

+6H<sub>2</sub>O. Deliquescent. Sol. in H<sub>2</sub>O, but probably decomp. to CrOCl<sub>2</sub>.

Practically insol. in ether. Moderately sol. in absolute ethyl alcohol, methyl alcohol and acetaldehyde. (Rohland, Z. anorg. 1899, 21. 39.)

"Monochlorochromic chloride" is sol. in ether and fuming HCl(1:1). (Bjerrum, B. 1906, 39. 1599.)

*Green modification.*

Solubility in H<sub>2</sub>O at 25°.

25 g. green CrCl<sub>3</sub> + 6H<sub>2</sub>O and 10 g. H<sub>2</sub>O.

Time	Total Solu-bility in %	Composition of the sat. solution	
		% violet salt	% green salt
¼ hr.	58.36	8.30	91.70
¼ hr.	...	12.57	87.43
4 hrs.	63.27	24.80	75.20
1 day	68.50	37.64	62.36
2 days	...	40.90	59.10
3 "	68.95	42.78	57.22
11 "	...	42.84	57.16
13 "	...	42.39	57.61
19 "	68.58	42.62	57.38

(Olie, Z. anorg. 1906, 51. 55.)

Solubility of green CrCl<sub>3</sub> + 6H<sub>2</sub>O in H<sub>2</sub>O at 32°.

10 g. CrCl<sub>3</sub> + 6H<sub>2</sub>O and 4 g. H<sub>2</sub>O.

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7'	63.69	12.87	87.13	Almost
45'	66.24	21.43	78.57	all
2½ 5'	69.53	34.53	65.47	dis-
48 <sup>h</sup>	69.33	45.27	54.73	solved
* 11 dys.	70.81	45.27	54.73	

\* First 8 days at 35°.

(Olie, Z. anorg. 1907, 53. 276.)

Solubility of green CrCl<sub>3</sub> + 6H<sub>2</sub>O in H<sub>2</sub>O at 35°.

10 g. CrCl<sub>3</sub> + 6H<sub>2</sub>O and 3.3 g. H<sub>2</sub>O.

Time	Total solubil-ity in %	Composition of the dissolved substance	
		% violet salt	% green salt
8'	65.85	16.47	83.53
38'	66.74	25.02	74.98
1 <sup>h</sup>	66.21	25.45	74.55
2 <sup>h</sup> 10'	68.90	31.47	68.53
4 <sup>h</sup>	70.79	36.28	63.72
23 <sup>h</sup>	71.34	42.95	57.05
72 <sup>h</sup>	70.79	42.88	57.12

(Olie, l. c.)

If a solution saturated with the green hexa-hydrate below 32° is cooled, the decahydrate separates out; if the solution is saturated above 32°, both the decahydrate and hexa-hydrate separate out on cooling. (Olie, l. c.)



**Violet modification.**Solubility in  $H_2O$  at  $25^\circ$ .25 g. violet  $CrCl_3 + 6H_2O$  and 10 cm. of a 35% solution of green  $CrCl_3 + 6H_2O$ .

Time	Total Solubility in %	Composition of the sat. solution	
		% violet salt	% green salt
$1\frac{1}{2}$ hr.	65.49	84.05	15.95
5 "	...	84.47	15.53
29 "	...	78.16	21.84
2 dys.	70.47	73.19	26.81
4 "	...	68.71	31.29
5 "	76.38	60.66	39.34
5 dys, 6 hrs.	...	60.36	39.64
6 dys.	...	65.10	34.90
8 "	73.26	65.80	34.20
10 "	...	58.06	41.92
12 "	71.14	41.40	58.60

(Olie, Z. anorg. 1906, 51. 57.)

Solubility in  $H_2O$  at  $25^\circ$ .25 g. violet  $CrCl_3 + 6H_2O$  and 10 g.  $H_2O$ .

Time	Total Solubility in %	Composition of the sat. solution	
		% violet salt	% green salt
$\frac{1}{2}$ hr.	61.99	98.47	1.53
$4\frac{1}{2}$ hrs.	...	96.70	3.30
1 dy.	63.88	91.54	8.46
2 "	...	83.37	16.63
4 "	70.68	69.11	30.89
5 "	...	62.20	37.80
7 "	72.11	62.72	37.28
8 "	...	54.63	45.37
12 "	...	46.39	53.61
13 "	...	47.66	52.34
26 "	70.62	48.55	51.45

(Olie, l. c.)

+ $6\frac{1}{2}H_2O$ . *Green modification.* 100 pts.  $H_2O$  dissolve 130 pts. salt at  $15^\circ$ . Sol. in alcohol. (Recoura, C. R. 102. 518.)

*Grayish-blue modification.* Very sol. in  $H_2O$ . (Recoura, C. R. 102. 548.)

+ $10H_2O$ . Very deliquescent; melts in crystal  $H_2O$  at  $6-7^\circ$ . Very sol. in  $H_2O$ , alcohol, and ethyl acetate. (Godeffroy.)

Easily sol. in  $H_2O$ ; can be recryst. from  $H_2O$ . Sol. in alcohol and ether. (Werner, B. 1906, 39. 1827.)

**Green modification.**Solubility of green  $CrCl_3 + 10H_2O$  in  $H_2O$  at  $29^\circ$ .14.2 g.  $CrCl_3 + 10H_2O$  and 2.5 g.  $H_2O$ .

Time	Total solubility in %	Composition of the dissolved substance		Solid phase
		% violet salt	% green salt	
7'	61.35	8.71	91.29	$CrCl_3 + 10H_2O$
20'	62.46	9.90	90.10	"
$1^h 55'$	65.04	25.05	74.95	"
$4^h 30'$	67.41	32.90	67.10	$CrCl_3 + 6H_2O$
$24^h$	69.44	42.93	57.07	all dissolved
$28^h$	...	31.78	68.22	$CrCl_3 + 10H_2O$
$29^h$	67.59	33.65	66.36	$CrCl_3 + 6H_2O$
$48^h$	69.42	42.17	57.83	"
$72^h$	68.69	43.80	56.20	"

(Olie, Z. anorg. 1907, 53. 275.)

The composition of the hydrates formed by  $CrCl_3$  at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by  $CrCl_3$  and of the conductivity and sp. gr. of  $CrCl_3 + Aq.$  (Jones, Am. Ch. J. 1905, 34. 310.)

**Chromic glucinum chloride**,  $CrCl_3, GlCl_3 + H_2O$ .

Sol. in  $H_2O$  with decomp. (Neumann, A. 244. 329.)

**Chromic lithium chloride**,  $CrCl_3, 2LiCl + 4H_2O$ .

Very hygroscopic.

Sol. in ice water but solution soon decomp.

Easily sol. in alcohol. (Werner, B. 1901, 34. 1603.)

$[Cr(OH_2)_3]Li_2 + 4H_2O$ .

Very hygroscopic. Sol. in ice cold  $H_2O$  and in alcohol. (Werner, B. 1901, 34. 1604.)

**Chromic magnesium chloride**,  $CrCl_3, MgCl_2 + H_2O$ .

Decomp. by  $H_2O$ . (Neumann.)

**Chromic phosphoric chloride**,  $CrCl_3, PCl_3$ .

Decomp. by  $H_2O$ . (Cronander.)

**Chromium platinum chloride.**

See chloroplatinate, chromium.

**Chromic potassium chloride**,  $CrCl_3, KCl$ .

Decomp. by  $H_2O$ .

$CrCl_3, 2KCl + H_2O$ . (Neumann, A. 244. 329.)

$CrCl_3, 3KCl$ . Easily sol. in  $H_2O$  with decomp. (Fremy, A. ch. (3) 12. 361.)

**Chromic rubidium chloride**,  $\text{CrCl}_3 \cdot 2\text{RbCl} + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Neumann, A. 244. 329.)

Slowly sol. in cold, rapidly sol. in hot  $\text{H}_2\text{O}$  with decomp. (Werner, B. 1901, 34. 1603.)

$\text{CrCl}_3 \cdot 3\text{RbCl} + 8\text{H}_2\text{O}$ . Unstable. Decomp. by alcohol. (Werner, B. 1906, 39. 1830.)

**Chromic sodium chloride**,  $\text{CrCl}_3 \cdot \text{NaCl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{CrCl}_3 \cdot 3\text{NaCl}$ . Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Chromic thallium chloride**,  $\text{CrCl}_3 \cdot 3\text{TlCl}$ .

Sol. with decomp. in  $\text{H}_2\text{O}$ . (Neumann, A. 244. 329.)

**Chromic chloride ammonia.**

See Chlorotetramine chromium chloride.

**Chromous chloride hydrazine**,  $\text{CrCl}_2 \cdot 2\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Insol. in alcohol, ether and similar solvents. (Traube, B. 1913, 46. 1506.)

**Chromic chloride ferric oxide.**

$\text{Fe}_2\text{O}_3$  is easily sol. in dil., difficultly sol. in conc.  $\text{CrCl}_3 + \text{Aq}$ . (Béchamp, A. ch. (3) 57. 311.)

**Chromous fluoride**,  $\text{CrF}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ , hot  $\text{H}_2\text{SO}_4$  or dil.  $\text{HNO}_3$ . Sol. in boiling  $\text{HCl}$ . Insol. in alcohol. (Poulenc, C. R. 1893, 116. 254.)

**Chromic fluoride**,  $\text{CrF}_3$ .

Perfectly sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 30. 827.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

$+3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Werner and Costachescu, B. 1908, 41. 4243.)

$+3\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Poulenc, C. R. 1893, 116. 255.)

$+6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Werner and Costachescu, B. 1908, 41. 4242.)

$+9\text{H}_2\text{O}$ . *Violet modification*. Very sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Sol. in  $\text{HCl}$ , and  $\text{KOH} + \text{Aq}$ . (Fabris, Gazz. ch. it. 20. 582.)

**Chromium hezafluoride**,  $\text{CrF}_6$ .

Decomp. by  $\text{H}_2\text{O}$  with evolution of heat. (Berzelius.)

Correct composition is  $\text{CrO}_2\text{F}_2$ . (Oliveri, Gazz. ch. it. 16. 218.)

**Chromic cobaltous fluoride**,  $\text{CrF}_3 \cdot \text{CoF}_2 + 7\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 60.)

**Chromic cupric fluoride**,  $\text{CrCuF}_5 + 5\text{H}_2\text{O}$ .

Can be cryst. from  $\text{HF} + \text{Aq}$ . (Higley, J. Am. Chem. Soc. 1904, 26. 630.)

**Chromic nickel fluoride**,  $\text{CrF}_3 \cdot \text{NiF}_2 + 7\text{H}_2\text{O}$ .

Somewhat more sol. in  $\text{H}_2\text{O}$  than  $\text{CrF}_3 \cdot \text{CoF}_2 + 7\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 61.)

**Chromic potassium fluoride**,  $\text{CrF}_3 \cdot 3\text{KF}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Christensen, J. pr. (2) 35. 161.)

$\text{CrF}_3 \cdot 2\text{KF} + \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Christensen.)

**Chromic sodium fluoride**,  $\text{CrF}_3 \cdot 2\text{NaF} + \text{H}_2\text{O}$ .

(Wagner, B. 19. 896.)

**Chromic thallous fluoride**,  $2\text{CrF}_3 \cdot 3\text{TlF}$ .

Sol. in hot  $\text{H}_2\text{O}$ , less sol. in cold. Sl. sol. in  $\text{HF}$ . (Ephraim, Z. anorg. 1909, 61. 242.)

**Chromic zinc fluoride**,  $\text{CrF}_3 \cdot \text{ZnF}_2 + 7\text{H}_2\text{O}$ .

Can be cryst. from  $\text{HF} + \text{Aq}$ . (Higley, J. Am. Chem. Soc. 1904, 26. 630.)

Colloidal solution is perfectly clear. (Biltz, B. 1902, 35. 4433.)

**Chromous hydroxide**,  $\text{CrO}_2\text{H}_2$ .

Decomp. by  $\text{H}_2\text{O}$ , especially if hot. (Ponligot, A. ch. (3) 12. 539.)

Slowly sol. in cold conc. acids, even aqua regia; almost insol. in dil. acids. (Moberg, J. pr. 43. 119.)

**Chromic hydroxide**,  $\text{Cr}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ , probably  $\text{Cr}_2\text{O}_3\text{H}_2$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Easily sol. in cold  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ ; much less sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ ; the presence of  $\text{NH}_4\text{Cl}$  has no influence upon solubility in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fresenius.) Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  if it has been thoroughly washed.

Insol. in  $\text{KCN} + \text{Aq}$ , but sl. sol. in  $\text{KCN} + \text{HCN} + \text{Aq}$ . (Rodgers, 1834.)

Gradually sol. in dil.  $\text{FeCl}_3 + \text{Aq}$ ; after three months, 2 mols.  $\text{Cr}_2\text{O}_3\text{H}_2$  are dissolved by 1 mol.  $\text{FeCl}_3$  without pptn. of  $\text{Fe}_2\text{O}_3\text{H}_2$ . (Béchamp, A. ch. (3) 57. 296.)

Alsl sol. in  $\text{CrCl}_3 + \text{Aq}$ ; in four months,  $1\frac{1}{2}$  mols.  $\text{Cr}_2\text{O}_3\text{H}_2$  are dissolved by 1 mol.  $\text{CrCl}_3$ . (Béchamp.)

Sol. in  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$ , and clear solution formed as long as 3 mols.  $\text{HNO}_3$  are present for 8 mols.  $\text{Cr}_2\text{O}_3$ . (Ordway, Sill. Am. J. (2) 27. 197.)

Chromic hydroxide, pptd. by alkalis is easily sol. in excess of the reagent; after being dried in a vacuum, however, it is insol. in alkalis. (Herz, Z. anorg. 1901, 28. 344.)

Freshly pptd. it is sol. in aq. alkali, but it is readily changed into a modification which is insol. (Herz, Z. anorg. 1902, 31. 352.)

The solubility of chromic hydroxide in an

aqueous solution of red chromic chloride is not directly proportional to the concentration of the latter—a basic chloride is probably formed. (Fischer, Z. anorg. 1904, 40. 43.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in amylamine + Aq; not pptd. in presence of alkali tartrates, sugar, etc.

$\text{Cr}_2\text{O}_3\text{H}_2 + 4\text{H}_2\text{O}$ . Difficultly sol. in acids.

$\text{Cr}_2\text{O}_3\text{H}_2 + \text{H}_2\text{O}$ . Extremely hygroscopic.

Exists in a soluble modification, obtained by dialysis; solution can be diluted with pure  $\text{H}_2\text{O}$ , but gelatinizes with traces of salts. (Graham, Roy. Soc. Trans. 1861. 183.)

$\text{Cr}_2\text{O}_3(\text{OH})_2$ . Insol. in boiling dil.  $\text{HCl}$  + Aq.

$\text{Cr}_2\text{O}(\text{OH})_2$ , (Guignet's green). Scarcely sol. in boiling  $\text{HCl}$  + Aq. (Salvétat, C. R. 48. 295.)

Guignet gave formula as  $2\text{Cr}_2\text{O}_3 + 3\text{H}_2\text{O}$ .

### Chromochromic hydroxide, $\text{Cr}_2\text{O}_4, \text{H}_2\text{O}(\text{?})$ .

Slightly attacked by acids. (Peligot, A. ch. (3) 12. 539.)

### Chromous iodide, $\text{CrI}_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Moissan, A. ch. (5) 25. 401.)

### Chromic iodide, $\text{CrI}_3(\text{?})$ .

Insol. in cold, sol. in hot  $\text{H}_2\text{O}$ , but no separation occurs on cooling. (Berlin.)

+  $9\text{H}_2\text{O}$ . Hygroscopic. Sol. in alcohol and acetone. Insol. in  $\text{CHCl}_3$ . (Higley, J. Am. Chem. Soc. 1904, 26. 628.)

### Chromous iodide hydrazine, $\text{CrI}_2, 2\text{N}_2\text{H}_4$ .

(Traube, B. 1913, 46. 1507.)

### Chromium nitride, $\text{CrN}$ .

Insol. in dil. acids and alkalis, conc.  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{HF}$  + Aq, even on heating. Slowly sol. in hot aqua regia or cold  $\text{H}_2\text{SO}_4$ . Sol. in cold solutions of alkali hypochlorites. (Ufer, A. 112. 281.)

Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , and aqua regia. (Féree, Bull. Soc. 1901, (3) 25. 618.)

Unacted upon by acids at ordinary temperatures. (Smits, Chem. Soc. 1897, 72. (2) 33.)

$\text{Cr}_2\text{N}_3$ . Slowly attacked by conc.  $\text{HNO}_3$ , and by  $\text{HNO}_3 + \text{HCl}$ . All other reagents are without action. (Henderson and Galletly, J. Soc. Chem. Ind. 1908, 27. 387.)

$\text{CrN}_3$ . See Chromium azoimide.

### Chromous oxide, $\text{CrO}$ .

Insol. in  $\text{HNO}_3$  and dil.  $\text{H}_2\text{SO}_4$  + Aq.

Sol. in  $\text{HCl}$ . (Féree, Bull. Soc. 1901, (3) 25. 619.)

### Chromic oxide, $\text{Cr}_2\text{O}_3$ .

When ignited is nearly insol. in acids, but dissolves in  $\text{H}_2\text{SO}_4$  by long boiling. Insol. in liquid  $\text{HCl}$ . (Gore.)

Insol. in acetone. (Fidmann, C. C. 1899. II, 1014.)

Solubility in (calcium succate + sugar) + Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 1.07 g.  $\text{Cr}_2\text{O}_3$ ; 1 l. solution containing 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 0.56 g.  $\text{Cr}_2\text{O}_3$ ; 1 l. solution containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 0.20 g.  $\text{Cr}_2\text{O}_3$ . (Bodenbender, J. B. 1865. 600.)

See also Chromic hydroxide.

+  $\text{H}_2\text{O}$ . The compound to which Bunsen gave the formula  $\text{Cr}_2\text{O}_4$ . Insol. in acids, but easily attacked by  $\text{HNO}_3$ . (Féree, Bull. Soc. 1901, (3) 25. 620.)

### Chromochromic oxide, $\text{Cr}_2\text{O}_4 = \text{CrO}, \text{Cr}_2\text{O}_3$ .

Known only in form of hydroxide, which see.

+  $3\text{H}_2\text{O}$ . Stable in dry air. Decomp. in moist air. (Baugé, C. R. 1898, 127. 552.)

$\text{Cr}_2\text{O}_4$ , or  $\text{Cr}_2\text{O}_5$  (?). Insol. in acids or in aqua regia. (Bunsen, Pogg. 91. 622.)

Not obtainable. (Geuther, A. 118. 66.)

Formula is  $\text{Cr}_2\text{O}_3 + \text{H}_2\text{O}$ . (Féree.)

### Chromium trioxide, $\text{CrO}_3$ .

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ , to form solution of  $\text{H}_2\text{CrO}_4$  or  $\text{H}_2\text{Cr}_2\text{O}_7$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	0°	15°	50°	99°
% $\text{CrO}_3$	62.08	62.38	64.55	67.39

(Mylius and Funk, Gm. K. 3. 1, 1332.)

Sat.  $\text{CrO}_3$  + Aq contains at:

0°	20°	60°
61.54	62.52	65.12% $\text{CrO}_3$ .

(Koppel and Blumenthal, Z. anorg. 1907, 53. 228.)

The system  $\text{CrO}_3 - \text{H}_2\text{O}$  has been studied at temp. from 0° to -74°. In the limits of concentration investigated, from 0—71.2%  $\text{CrO}_3$ , no hydrate of  $\text{CrO}_3$  cryst. from the aq. solution. (Kremann, M. 1911, 32. 622.)

Sat.  $\text{CrO}_3$  + Aq contains at:

82°	100°	115°
66	67.4	68.4% $\text{CrO}_3$ .

(Kremann, M. 1911, 32. 620.)

Solubility in H<sub>2</sub>O at°.

t°	% by wt. CrO <sub>3</sub>	Solid phase.
-0.9°	3.6	Ice
-1.9	7.8	"
-3.7	11.5	"
-4.8	14.1	"
-10.95	24.9	"
-11.7	25.2	"
-18.75	33.5	"
-25.25	39.2	"
-43.5	49.1	"
-60	53.3	"
-20	61.7	CrO <sub>3</sub>
0	62.24	"
+24.8	62.88	"
40	63.50	"
65	64.83	"
90	68.5	"
122	70.7	"
193-196	100	"

(Büchner and Prins, Z. phys. Ch. 1912, 81, 114.)

Sp. gr. of CrO<sub>3</sub>+Aq at t°.

t°	Sp. gr.	% CrO <sub>3</sub>
16.0	1.0606	8.25
18.0	1.0679	8.79
14.5	1.0694	8.79
19.5	1.0957	12.34
19.0	1.1569	19.33
20.9	1.20269	31.83
20.1	1.20264	31.83
12.0	1.20714	31.83
35.0	1.20940	32.59
18.6	1.21914	32.59
15.2	1.22106	32.59
9.7	1.22384	32.59
22.0	1.3441	37.77
19.2	1.3448	37.82
22.0	1.34416	37.82
....	1.7028	62.23

(Zettnow, Pogg. 143. 474.)

Sp. gr. of CrO<sub>3</sub>+Aq (H<sub>2</sub>CrO<sub>4</sub>+Aq). M = according to Mendelejeff at 15°; Z = according to Zettnow, calculated by Gerlach (Z. anal. 27. 300).

% CrO <sub>3</sub>	M	Z	% CrO <sub>3</sub>	M	Z
5	1.036	1.037	35	1.324	1.312
10	1.076	1.076	40	1.383	1.373
15	1.119	1.118	45	1.445	1.440
20	1.166	1.162	50	1.510	1.512
25	1.215	1.208	55	1.579	1.587
30	1.268	1.258	60	...	1.656

B-pt. of CrO<sub>3</sub>+Aq at ord. pressure.

B-pt.	G. CrO <sub>3</sub> in 100 g. of the solution.
102°	10.81
104	24.08
107	36.47
110.5	45.15
116	54.56
120	61.54
127	71.24 sat. solution

(Koppel and Blumenthal, Z. anorg. 1907, 63, 254.)

Sol. in H<sub>2</sub>SO<sub>4</sub>; the solubility is least when the acid contains 66% H<sub>2</sub>SO<sub>4</sub> (Schrötter); 84.5% H<sub>2</sub>SO<sub>4</sub> (Bolley).

Very sol. in H<sub>2</sub>SO<sub>4</sub> of 1.85 sp. gr. Sl. sol. in cold KHSO<sub>4</sub>+Aq. (Fritzsche.)

The statement that CrO<sub>3</sub> is insol. in acids is incorrect. 2.85 g. (ignited) are sol. in HNO<sub>3</sub> to the extent of 2.58 g. 0.81 g. (ignited) are sol. in HNO<sub>3</sub> to the extent of 0.77 g. (Jovitschitsch, M. 1909, 30. 48.)

Practically insol. in POCl<sub>3</sub>. (Walden, Z. anorg. 1910, 68. 312.)

Sl. sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in alcohol with decomp.

Sol. in anhydrous ether.

Sol. in acetic anhydride. (Fry, J. Am. Chem. Soc. 1911, 33. 702.)

Sol. in acetone. (Naumann, B. 1904, 4328.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Chromium oxide, Cr<sub>2</sub>O<sub>3</sub>=2Cr<sub>2</sub>O<sub>3</sub>, CrO<sub>3</sub>.

Cr<sub>2</sub>O<sub>15</sub>=3Cr<sub>2</sub>O<sub>3</sub>, 2CrO<sub>3</sub>.

CrO<sub>2</sub>=Cr<sub>2</sub>O<sub>3</sub>, CrO<sub>3</sub>.

Cr<sub>2</sub>O<sub>12</sub>=Cr<sub>2</sub>O<sub>3</sub>, 3CrO<sub>3</sub>.

Cr<sub>2</sub>O<sub>18</sub>=Cr<sub>2</sub>O<sub>3</sub>, 4CrO<sub>3</sub>.

See Chromate, chromium.

Chromium peroxide, Cr<sub>2</sub>O<sub>7</sub>(?)

More sol. in ether than in H<sub>2</sub>O. Ether solution is somewhat more stable than aqueous solution. (Aschoff, J. pr. 81. 401.)

Formula is CrO<sub>3</sub>, H<sub>2</sub>O<sub>2</sub>. (Moissan, C. R. 97. 96.)

Chromium peroxide ammonia, CrO<sub>4</sub>, 3NH<sub>3</sub>.

Sol. in H<sub>2</sub>O with partial decomp.

Sl. sol. in NH<sub>4</sub>OH+Aq.

Sol. with decomp. in 20% acetic acid. (Hofmann, B. 1905, 38. 3060.)

Chromium tetroxide potassium cyanide, CrO<sub>4</sub>, 3KCN.

Sol. in H<sub>2</sub>O. Insol. in other ordinary solvents. (Wiede, B. 1899, 32, 381.)

**Chromic oxychloride.**

From  $\text{Cr}_2\text{O}_3$ . Sol. in  $\text{H}_2\text{O}$  as long as 1 mol.  $\text{CrCl}_3$  is present for  $2\frac{1}{2}$  mols.  $\text{Cr}_2\text{O}_3\cdot\text{H}_2\text{O}$ . (Ordway, *Sill. Am. J.* (2) **27**, 197.)

$\text{Cr}_2\text{O}_3$ ,  $2\text{CrCl}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Kletsinsky, *Zeit. Ch.* **1866**, 277.)

$\text{Cr}_2\text{O}_3$ ,  $\text{CrCl}_3 = \text{CrOCl}$ . *Anhydrous*. Only partly sol. in  $\text{H}_2\text{O}$ .

+  $3\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Peligot.)

$\text{Cr}_2\text{O}_3$ ,  $4\text{CrCl}_3 + 6\text{H}_2\text{O} = \text{Cr}_2\text{OCl}_4 + 2\text{H}_2\text{O}$ . (Peligot, *J. pr.* **37**, 38.)

+  $9\text{H}_2\text{O} = \text{Cr}_2\text{OCl}_4 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Moberg); =  $\text{Cr}_2(\text{OH})_2\text{Cl}_4 + 2\text{H}_2\text{O}$ . (Schiff, *A.* **124**, 157.)

$\text{Cr}_2\text{O}_3$ ,  $7\text{CrCl}_3 = \text{Cr}_2\text{OCl}_7$ . Very sol. in  $\text{H}_2\text{O}$  with decomp. (Besson and Fournier, *C. R.* **1909**, **148**, 1194.)

$\text{Cr}_2\text{O}_3$ ,  $8\text{CrCl}_3 + 24\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  (Moberg); =  $\text{Cr}_2(\text{OH})_2\text{Cl}_8 + 4\text{H}_2\text{O}$ . (Schiff, *l. c.*)

$(\text{CrO}_2)_2\text{Cl}_2$ . (Pascal, *C. R.* **1909**, **148**, 1464.)

$\text{Cr}_2\text{O}_3\text{Cl}_4$ . Insol. in  $\text{H}_2\text{O}$ . (Pascal, *C. R.* **1909**, **148**, 1464.)

From  $\text{CrO}_3$ .

See Chromyl chloride.

**Chromic oxychloride potassium chloride,  $\text{CrOCl}_3$ ,  $2\text{KCl}$ .**

Decomp. in the air.

Sol. in conc.  $\text{HCl}$  without decomp. (Weinland, *B.* **1906**, **39**, 4043.)

**Chromic oxychloride rubidium chloride,  $\text{CrOCl}_3$ ,  $2\text{RbCl}$ .**

Decomp. in the air.

Sol. in conc.  $\text{HCl}$  without decomp. (Weinland, *B.* **1906**, **39**, 4045.)

**Chromium oxyfluoride,  $\text{CrO}_2\text{F}_2$ .**

See Chromyl fluoride.

**Chromium phosphide,  $\text{CrP}$ .**

Insol. in acids, but a trace dissolves in aqua regia. Insol. in  $\text{HF} + \text{Aq}$ . (Berzelius.)

Not attacked by acids or by aqua regia. (Granger, *C. N.* **1898**, **77**, 228.)

Insol. in all acids except a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Maronneau, *C. R.* **1900**, **130**, 658.)

Insol. in mineral acids. (Dieckmann, *Z. anorg.* **1914**, **86**, 295.)

Insol. in aqua regia. (Granger, *C. R.* **1897**, **124**, 191.)

$\text{Cr}_2\text{P}_3$ . Insol. in mineral acids. (Dieckmann, *Z. anorg.* **1914**, **86**, 295.)

**Chromous selenide,  $\text{CrSe}$ .**

(Moissan, *C. R.* **90**, 817.)

**Chromic selenide,  $\text{Cr}_2\text{Se}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Moissan, *C. R.* **90**, 817.)

**Chromic potassium selenide,  $\text{K}_2\text{Cr}_2\text{Se}_4$ .**

Insol. in  $\text{HCl}$ . Easily sol. in conc.  $\text{HNO}_3$ . (Milbauer, *Z. anorg.* **1904**, **42**, 451.)

**Chromium silicide,  $\text{Cr}_3\text{Si}$ .**

Sol. in fused  $\text{KNO}_3$ ; insol. in cold  $\text{HCl}$  and aqua regia.

Insol. in  $\text{HF} + \text{Aq}$ . (Moissan, *C. R.* **1895**, **121**, 625.)

$\text{CrSi}_2$ . Sol. in  $\text{HF}$ . Insol. in  $\text{HCl}$  and aqua regia. (Chalmot, *Am. Ch. J.* **1897**, **19**, 69.)

$\text{Cr}_3\text{Si}_2$ . Insol. in dil.  $\text{HCl}$ ; sol. in warm conc.  $\text{HCl}$  and in  $\text{HF}$ ; insol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Lebeau, *C. R.* **1903**, **136**, 1330.)

$\text{Cr}_3\text{Si}$ . Sol. in  $\text{HF}$ ; insol. in other acids; sol. in fused  $\text{KOH}$  and fused alkali nitrates and carbonates. (Zettel, *C. R.* **1898**, **126**, 834.)

**Chromous sulphide,  $\text{CrS}$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{K}_2\text{S} + \text{Aq}$ . (Peligot.)

Easily sol. in acids. (Moissan, *C. R.* **90**, 817.)

Sol. in cold conc. acids.

Sol. in molten alkalis. (Mourlot, *C. R.* **1895**, **121**, 944.)

Min. *Daubreilite*.

**Chromic sulphide,  $\text{Cr}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or alkali sulphides +  $\text{Aq}$ . Sl. attacked by  $\text{HCl} + \text{Aq}$ . (W. Müller, *Pogg.* **127**, 404.)

$\text{HNO}_3 + \text{Aq}$  decomposes or not according to method of preparation. Easily decomp. by aqua regia.

Insol. in caustic alkalis +  $\text{Aq}$ .

Insol. in  $\text{K}_2\text{S} + \text{Aq}$ . (Berzelius.)

**Chromochromic sulphide,  $\text{Cr}_2\text{S}_4 = \text{CrS}$ ,  $\text{Cr}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Gröger, *W. A. B.* **81**, (2) 531.)

**Chromic zinc sulphide,  $\text{Cr}_2\text{ZnS}_4$ .**

(Gröger, *W. A. B.* **1880**, **81**, 534.)

**Chromicyanhydric acid.****Cadmium chromicyanide,  $\text{Cd}_2[\text{Cr}(\text{CN})_6]_2$ .**

Readily sol. in an excess of  $\text{KCN}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by conc.  $\text{HCl}$ ,  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Slowly decomp. by cold, rapidly by hot dil.  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . Quickly dissolved by aqua regia. Decomp. by boiling with  $\text{Na}_2\text{O}_2$ , by  $\text{NaOH} + \text{Aq}$  and by  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Slowly decomp. by boiling acetic acid. (Cruser and Miller, *J. Am. Chem. Soc.* **1906**, **28**, 1136.)

**Cobaltous chromicyanide,  $\text{Co}_2[\text{Cr}(\text{CN})_6]_2$ .**

Sol. in cold, readily sol. in hot conc.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Sl. sol. even in boiling conc.

**HNO<sub>2</sub>.** Slowly sol. in cold dil. H<sub>2</sub>SO<sub>4</sub>, HCl or HNO<sub>3</sub>. Readily sol. in boiling dil. HCl or H<sub>2</sub>SO<sub>4</sub>. Decomp. but not entirely dissolved by aqua regia. Readily sol. in an excess of KCN. Decomp. by NH<sub>4</sub>OH, NaOH or Na<sub>2</sub>CO<sub>3</sub>+Aq. Decomp. by boiling with Na<sub>2</sub>O<sub>2</sub>. Insol. in cold or boiling acetic acid. (Cruser and Miller.)

**Cuprous chromicyanide, Cu<sub>2</sub>Cr(CN)<sub>4</sub>.**

Sol. in KCN, cold conc. or boiling dil. HNO<sub>3</sub>+Aq. Slowly sol. in cold conc. H<sub>2</sub>SO<sub>4</sub>, still more slowly sol. in dil. H<sub>2</sub>SO<sub>4</sub>, but rapidly sol. in hot dil. and conc. H<sub>2</sub>SO<sub>4</sub>. Readily decomp. by aqua regia. Decomp. by dil. or conc. HCl, slowly going into solution in the cold, but quickly on boiling. (Cruser and Miller.)

**Cupric chromicyanide, Cu<sub>2</sub>[Cr(CN)<sub>6</sub>].**

Slowly sol. in cold dil. HCl, HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>; on boiling the first two readily dissolve it, but the H<sub>2</sub>SO<sub>4</sub> dissolves it only slowly. Sol. in aqua regia or cold conc. H<sub>2</sub>SO<sub>4</sub>. Readily sol. in cold or hot conc. HCl. Decomp. by cold, dissolved by boiling HNO<sub>3</sub>. Decomp. by boiling Na<sub>2</sub>O<sub>2</sub>+Aq. Decomp. by NH<sub>4</sub>OH, NaOH or Na<sub>2</sub>CO<sub>3</sub>+Aq. Readily sol. in an excess of KCN+Aq. Insol. in cold acetic acid. (Cruser and Miller.)

**Nickel chromicyanide, Ni<sub>2</sub>[Cr(CN)<sub>6</sub>].**

Slowly sol. in cold, readily sol. in hot dil. HCl, HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>. Slowly sol. in cold, readily sol. in hot conc. H<sub>2</sub>SO<sub>4</sub>, HCl or HNO<sub>3</sub>. Slowly decomp. by cold, rapidly by boiling aqua regia. Readily sol. in excess of KCN. Sol. in NH<sub>4</sub>OH+Aq. Decomp. by NaOH, Na<sub>2</sub>CO<sub>3</sub>+Aq or Na<sub>2</sub>O<sub>2</sub>+Aq. Insol. in cold, sl. sol. in boiling acetic acid. (Cruser and Miller.)

**Potassium thalious chromicyanide, K<sub>2</sub>TiCr(CN)<sub>6</sub>.**

(Fischer and Benzian, Ch. Z. 1902, 26. 50.)

**Thalious chromicyanide, Ti<sub>2</sub>Cr(CN)<sub>6</sub>.**

Easily sol. in H<sub>2</sub>O. (Fischer and Benzian, Ch. Z. 1902, 26. 50.)

**Zinc chromicyanide, Zn<sub>2</sub>[Cr(CN)<sub>6</sub>].**

Insol. in H<sub>2</sub>O. Sol. in excess of NH<sub>4</sub>OH, NaOH and KCN+Aq. Decomp. by Na<sub>2</sub>CO<sub>3</sub>+Aq. Sol. in cold dil. HCl. Slowly sol. in dil. H<sub>2</sub>SO<sub>4</sub>, and in dil. HNO<sub>3</sub>. By boiling with dil. acids a clear solution is quickly obtained. (Cruser, Dissert. 1906.)

**Chromisulphocyanhydric acid.**

**Cæsium chromisulphocyanide, Cs<sub>2</sub>Cr(SCN)<sub>6</sub>+2H<sub>2</sub>O.**

Less sol. in H<sub>2</sub>O than K salt. (Osann, Dissert. 1907.)

**Lithium chromisulphocyanide, Li<sub>2</sub>Cr(SCN)<sub>6</sub>+H<sub>2</sub>O.**

Extremely deliquescent. (Osann.)

**Rubidium chromisulphocyanide, Rb<sub>2</sub>Cr(SCN)<sub>6</sub>+4H<sub>2</sub>O.**

Appreciably less sol. in H<sub>2</sub>O and alcohol than the K salt. (Osann.)

**Chromocyanidric acid, H<sub>2</sub>Cr(CN)<sub>6</sub>.**

Decomp. rapidly on air. Sol. in H<sub>2</sub>O (Moissan, A. ch. (6) 4. 144.)

**Potassium chromocyanide, K<sub>2</sub>Cr(CN)<sub>6</sub>.**

Very sol. in H<sub>2</sub>O; 100 pts. H<sub>2</sub>O dissolve 32.33 pts. at 20°. Much more sol. in hot H<sub>2</sub>O. Insol. in alcohol, ether, benzene, or chloroform. (Moissan, A. ch. (6) 4. 136.)

Above salt was K<sub>2</sub>Cr(CN)<sub>6</sub>. (Christensen.) +3H<sub>2</sub>O. (Christensen, J. pr. (2) 31. 166.)

**Chromoiodic acid, CrO<sub>3</sub>, HIO<sub>3</sub>+2H<sub>2</sub>O.**

Deliquescent. (Berg, C. R. 104. 1514.)

**Ammonium chromiodate, CrO<sub>3</sub>, NH<sub>4</sub>IO<sub>3</sub>+H<sub>2</sub>O.**

Moderately sol. in H<sub>2</sub>O. (Berg.)

**Lithium chromiodate, CrO<sub>3</sub>, LiIO<sub>3</sub>+H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Berg.)

**Magnesium chromiodate.**

Sol. in H<sub>2</sub>O. (Berg.)

**Potassium chromiodate, CrO<sub>3</sub>, KIO<sub>3</sub>.**

Sol. in H<sub>2</sub>O. (Berg.)

+H<sub>2</sub>O=KCrIH<sub>2</sub>O<sub>7</sub>. Sl. decomp. by H<sub>2</sub>O. (Blomstrand, J. pr. (2) 40. 331.)

**Silver chromiodate, CrO<sub>3</sub>, AgIO<sub>3</sub>.**

Sl. attacked by cold, rapidly decomp. by hot H<sub>2</sub>O. (Berg, C. R. 111. 42.)

**Sodium chromiodate, CrO<sub>3</sub>, NaIO<sub>3</sub>+H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Berg.)

**Chromosulphocyanhydric acid.**

**Sodium chromosulphocyanide, Na<sub>2</sub>Cr(SCN)<sub>6</sub>+10, or 11H<sub>2</sub>O.**

Unstable.

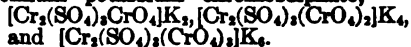
Decomp. by H<sub>2</sub>O. (Koppel, Z. anorg. 1905, 45. 360.)

**Chromosulphuric acid, H<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.**

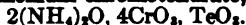
Sol. in H<sub>2</sub>O in all proportions, but solution is easily decomp. on standing or boiling. (Recoura, Bull. Soc. (3) 9. 586.)

H<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>. As above.

H<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>. As above.

**Ammonium chromosulphate,**Sol. in  $\text{H}_2\text{O}$  after a few minutes. (Recoura.)**Chromium potassium chromosulphate,**Sol. in  $\text{H}_2\text{O}$ . (Recoura, Bull. Soc. 1897, (3) 17. 934.)**Potassium chromosulphate,  $\text{K}_2\text{Cr}_2(\text{SO}_4)_4 \cdot 4\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  in a few minutes. (Recoura, Bull. Soc. (3) 9. 590.)**Sodium chromosulphate,  $\text{Na}_2\text{Cr}_2(\text{SO}_4)_4 \cdot 10\text{H}_2\text{O}$ .**

As K salt. (Recoura.)

**Chromotelluric acid.****Ammonium chromotellurate,**Sol. in  $\text{H}_2\text{O}$ . (Berg, C. R. 1911, 152. 1588.)**Potassium chromotellurate,**Sl. sol. in cold  $\text{H}_2\text{O}$  without decomp.Sol. in boiling  $\text{H}_2\text{O}$ . (Berg, Bull. Soc. 1911, (4) 9. 583.)**Chromous acid,  $\text{H}_2\text{Cr}_2\text{O}_4 = \text{Cr}_2\text{O}_3, \text{H}_2\text{O}$ .**

Chromic hydroxide shows slightly acid properties, and salts corresponding to the above acid are known.

**Aluminum ferrous magnesium chromite (chrome iron ore),  $(\text{Fe}, \text{Mg})\text{O}, (\text{Cr}_2, \text{Al}_2)\text{O}_3$ .**Insol. in  $\text{H}_2\text{O}$  or acids, even a mixture of  $\text{H}_2\text{SO}_4$  and  $\text{HF}$ . (Ebelmen.)**Barium chromite,  $\text{BaCr}_2\text{O}_4$ .**Insol. in  $\text{H}_2\text{O}$ . (Gerber, Bull. Soc. (2) 27. 436.)**Barium tetrachromite,  $\text{BaO}, 4\text{Cr}_2\text{O}_3$ .**Undecomp. by steam at red heat; insol. in  $\text{HCl}, \text{H}_2\text{SO}_4, \text{HNO}_3$ ; sol. in fused  $\text{KOH} + \text{KNO}_3$ ; decomp. in the air. (Dufau, C. R. 1896, 122. 1126.)**Cadmium chromite,  $\text{CdCr}_2\text{O}_4$ .**

Not attacked by acids. (Viard, C. R. 109. 142.)

**Calcium chromite,  $\text{CaCr}_2\text{O}_4$ .**Insol. in  $\text{H}_2\text{O}$ . (Gerber, Bull. Soc. (2) 27. 436.)Insol. in  $\text{HCl}, \text{HF}, \text{HNO}_3, \text{H}_2\text{SO}_4$ ; sol. in gaseous  $\text{HCl}$  and  $\text{HF}$  at red heat; sol. in fused  $\text{KOH}, \text{KNO}_3, \text{KClO}_3, \text{K}_2\text{CO}_3$ . (Dufau, C. R. 1895, 121. 690.) $2\text{CaO}, \text{Cr}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}, \text{KOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ ; slowly decomp. by  $\text{H}_2\text{CO}_3$ , or  $\text{M}_2\text{CO}_3 + \text{Aq}$ ; insol. in sugar solution. (Pelouse, A. ch. (3) 33. 9.) $4\text{CaO}, \text{Cr}_2\text{O}_3$ . Attacked by  $\text{H}_2\text{O}$ . (Moissan, C. R. 1894, 119. 188.)**Cobaltous chromite,  $\text{CoCr}_2\text{O}_4$ .**

(Elliot, Dissert, Göttingen, 1862.)

**Cuprous chromite,  $\text{Cu}_2\text{O}, \text{Cr}_2\text{O}_3$ .**Insol. in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.4). (Wöhler, Z. phys. Ch. 1908, 62. 445.)**Cupric chromite basic,  $5\text{CuO}, 4\text{Cr}_2\text{O}_3$ .**

(Wöhler, Z. phys. Ch. 1908, 62. 445.)

**Cupric chromite,  $\text{CuCr}_2\text{O}_4$ .**Not attacked by  $\text{HNO}_3 + \text{Aq}$ . (Persoz, A. ch. (3) 25. 283.)Not attacked by conc.  $\text{HCl}$ .

Insol. in dil. acids. (Wöhler, Z. phys. Ch. 1908, 62. 446.)

 $\text{CuO}, 3\text{Cr}_2\text{O}_3$ . (Rosenfeld, B. 1879, 12. 958.)**Glucinum chromite,  $\text{GlCr}_2\text{O}_4$ .**Insol. in  $\text{H}_2\text{O}$ . (Mallard, C. R. 105. 1260.)**Iron (ferrous) chromite (chrome iron ore).**

See Chromite, aluminum ferrous magnesium.

**Iron (ferroferric) chromite,  $\text{FeO}, \text{Fe}_2\text{O}_3, \text{Cr}_2\text{O}_3$ .**Not attacked by  $\text{HCl} + \text{Aq}$ . (Ebelmen.)**Iron (ferrous) magnesium chromite.**Insol. in  $\text{HCl} + \text{Aq}$ . Scarcely attacked by  $\text{H}_2\text{SO}_4$ .**Lead chromite,  $\text{PbCr}_2\text{O}_4$ .**Ppt. Insol. in  $\text{KOH} + \text{Aq}$ . (Chancel, C. R. 43. 927.)**Lithium chromite,  $\text{Li}_2\text{Cr}_2\text{O}_4$ .**

Very sl. sol. in acids. (Weyberg, C. C. 1906, II. 1659.)

**Magnesium chromite,  $\text{MgO}, 2\text{Cr}_2\text{O}_3$ .**Insol. in  $\text{H}_2\text{O}$ . (Nichols, Sill. Am. J. (2) 47. 16.) $\text{MgCr}_2\text{O}_4$ . Insol. in acids or alkalies, except boiling  $\text{H}_2\text{SO}_4$ . (Schweitzer, J. pr. 39. 259.)

Could not be obtained. (Viard, Bull. Soc. (3) 5. 934.)

Easily attacked by boiling  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Less easily by  $\text{HCl}$  or  $\text{HF} + \text{Aq}$  not attacked by boiling  $\text{HNO}_3$ . (Dufau, C. R. 1896, 123. 886.) $2\text{MgO}, \text{Cr}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$  or acids. (Nichols.) $5\text{MgO}, 4\text{Cr}_2\text{O}_3$ . Insol. in acids. (Viard, C. R. 112. 1003.) $3\text{MgO}, 2\text{Cr}_2\text{O}_3$ . As above. (V.)

**Manganese chromite,  $MnCr_2O_4$ .**

Entirely insol. in acids. (Ebelmen, A. ch. (3) 33. 44.)

**Zinc chromite,  $ZnCr_2O_4$ .**

Insol. in acids and alkalis. (Viard, C. R. 109. 142.)

+ $xH_2O$ . (Chancel, C. R. 43. 927.)  
 $3ZnO, 2Cr_2O_3$ . As above. (Viard, C. R. 112. 1003.)

$6ZnO, 5Cr_2O_3$ . As above. (V.)  
 $8ZnO, 3Cr_2O_3$ . (Gröger, M. 1904, 25, 520.)

**Chromovanadic acid.**

Ammonium chromovanadate,  $2(NH_4)_2O, 2CrO_3, V_2O_5 + 7H_2O$ .

Sol. in  $H_2O$ . (Ditte, C. R. 102. 1105.)

**Chromyl amide,  $CrO_2(NH_2)_2$ .**

Sol. in  $H_2O$ . (Ohly, C. N. 1899, 80. 134.)

**Chromyl subchloride,  $(CrO_2)_2Cl_2$ .**

Deliquescent, sol. in  $H_2O$  with decomp., insol. in dry ether. (Pascal, C. R. 1909, 148, 1463.)

**Chromyl chloride (chlorochromic acid):  $CrO_2Cl_2$ .**

Decomp. by  $H_2O$  with evolution of much heat. Sol. in glacial acetic acid without decomposition.

Sol. in  $CCl_4, C_6H_6$ , (mol. wt. det.). (Oddo, Gazz. ch. it. 1899, 29. (2) 318; Chem. Soc. 1900, 78. (2) 75.)

**Trichromyl chloride,  $Cr_2O_3Cl_2$ .**

Deliquescent. Sol. in  $H_2O$  with gradual decomposition. Sol. in conc.  $HCl + Aq$ . (Thorpe, Chem. Soc. (2) 8. 31.)

Scarcely sol. in  $CS_2$ .

Sol. in alcohol and ether. (Rawson, C. N. 1889. 59. 185.)

**Chromyl chlorides.**

From  $Cr_2O_3$ .

See Chromium oxychlorides.

**Chromyl chloride nitrogen tetroxide,  $Cr_2Cl_2O_7, 2NO_2$ .**

Sol. in  $H_2O$  with decomp. (Thomas, C. R. 1899, 129. 823.)

**Chromyl fluoride,  $CrO_2F_2$ .**

Decomp. by  $H_2O$  with evolution of heat. (Oliveri, Gazz. ch. it. 16. 218.)

**Clay.**

See Silicate, aluminum,  $Al_2O_3, SiO_2 + 2H_2O$ .

**Cobalt, Co.**

Not attacked by  $H_2O$ .

Sol. in dil.  $HCl$ , or  $H_2SO_4$ , or  $HNO_3 + Aq$ . Conc. hot  $H_2SO_4$ , and  $HNO_3$  decomp. with evolution of  $SO_2$  or  $NO$  gas.

Exists also in passive state. See Iron. (Nickles, J. pr. 61. 186.)

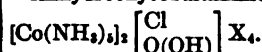
Sol. in conc.  $KOH + Aq$  when in finely divided state. (Winkler, J. pr. 91. 211.)

Sol. in  $NH_4OH + Aq$  in presence of air. (Hodgkinson and Bellairs, C. N. 1895, 71. 73.)

**Cobalt ammonia compounds.**

See—

Anhydrooxycobaltamine compounds,



Bromotetramine cobaltic compounds,  
 $BrCo(NH_3)_4X_3$ .

Bromopurplecobaltic compounds,  
 $BrCo(NH_3)_4X_3$ .

Carbonatotetramine cobaltic compounds,  
 $(CO_2)Co(NH_3)_4X$ .

Chlorotetramine cobaltic compounds,  
 $ClCo(NH_3)_4X_2$ .

Chloropurplecobaltic compounds,  
 $ClCo(NH_3)_4X_2$ .

Croceocobaltic compounds,  
 $Co(NH_3)_4(NO_2)_2X$ .

Decamine cobaltic sulphite,  
 $Co_2(NH_3)_{10}(SO_3)_2$ .

Diamine cobaltic nitrites,  
 $Co(NH_3)_2(NO_2)_4M$ .

Dichrocobaltic compounds,  $Co(NH_3)_2X_3$ .  
 Flavocobaltic compounds,

$(NO_2)_2Co(NH_3)_4X$ .

Fusocobaltic compounds,  
 $(OH)Co(NH_3)_4X_2$ .

Iodotetramine cobaltic compounds,  
 $ICo(NH_3)_4X_2$ .

Luteocobaltic compounds,  $Co(NH_3)_4X_3$ .  
 Melanocobaltic compounds,

$[Co(NH_3)_4Cl]_2, NH_4Cl$ .

Nitratotetramine cobaltic compounds,  
 $(NO_2)Co(NH_3)_4X_3$ .

Nitratopurplecobaltic compounds,  
 $(NO)_2Co(NH_3)_4X_3$ .

Nitritocobaltic compounds,  
 $(NO_2)Co(NH_3)_4X_3$ .

Octamine cobaltic compounds,  
 $Co_2(NH_3)_8X_6$ .

(= Tetramine cobaltic compounds,  
 $Co(NH_3)_4X_3$ ).

Oxycobaltamine compounds,  
 $Co_2(NH_3)_{10}(OOH)X_4$ .

Praseocobaltic compounds,  $Co(NH_3)_4X_3$ .  
 Purplecobaltic compounds,

$Co(NH_3)_4X_3$ .

Rosecobaltic compounds,  
 $Co(NH_3)_4(OH)_2X_3$ .

Sulphatotetramine cobaltic compounds,  
 $(SO_4)Co(NH_3)_4X$ .

Sulphatopurplecobaltic compounds,  
 $(SO_4)Co(NH_3)_4X$ .



"Tetramine cobaltic" compounds,

$\text{Co}(\text{NH}_3)_4\text{X}_3$ .

Xanthocobaltic compounds,

$(\text{NO}_2)\text{Co}(\text{NH}_3)_4\text{X}_2$ .

**Cobalt arsenide,  $\text{CoAs}_2$ .**

As  $\text{Co}_2\text{As}_2$ . (Ducelliez, C. R. 1908, 147. 425.)

$\text{CoAs}_2$ . As  $\text{Co}_2\text{As}_2$ . (Ducelliez, C. R. 1908, 147. 425.)

$\text{Co}_2\text{As}_2$ . As  $\text{Co}_2\text{As}_2$ . (Ducelliez, C. R. 1908, 147. 425.)

$\text{Co}_2\text{As}_2$ . Very sl. attacked by hot conc.  $\text{HCl}$ , less by  $\text{H}_2\text{SO}_4$ . Easily sol. in  $\text{HNO}_3$  and aqua regia. Sl. attacked by fused alkalis and alkali carbonates. (Ducelliez, C. R. 1908, 147. 425.)

$\text{CoAs}_2$ . Min. *Skutterudite*. Sol. in  $\text{HNO}_3$  + Aq, with separation of  $\text{As}_2\text{O}_3$ .

**Cobalt arsenide sulphide,  $\text{CoAs}_2\text{S}$ ,  $\text{CoS}_2$ .**

Min. *Cobaltite*. Sol. in  $\text{HNO}_3$  + Aq, with separation of S and  $\text{As}_2\text{O}_3$ .

*Glaucodote*. Completely sol. in  $\text{HNO}_3$  + Aq.

**Cobalt azoimide, basic,  $\text{Co}(\text{OH})\text{N}_2$ .**

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{HN}_3$  + Aq. (Curtius, J. pr. 1898, (2) 58. 300.)

**Cobalt potassium azoimide,  $\text{KN}_2$ ,  $\text{Co}(\text{N}_2)_2$ .**

Sol. in  $\text{H}_2\text{O}$ ; Aq. solution decomp. on boiling. (Curtius, J. pr. 1898, (2) 58. 301.)

**Cobalt boride,  $\text{Co}_2\text{B}$ .**

Attacked by  $\text{HNO}_3$ . (Jassonneix, C. R. 1907, 145. 240.)

$\text{CoB}$ . Decomp. by moist air and by alkali nitrates, chlorates, hydroxides and carbonates; decomp. by steam at red heat and by acids. (Moissan, C. R. 1896, 122. 425.)

Not attacked by  $\text{HCl}$ ; rapidly attacked by  $\text{HNO}_3$ . Not attacked by dil. but decomp. by conc.  $\text{H}_2\text{SO}_4$ . Rapidly attacked by aqua regia. (Moissan, A. ch. 1896, (7) 9. 272.)

$\text{CoB}_2$ . (Jassonneix, C. R. 1907, 145. 241.)

**Cobaltous bromide,  $\text{CoBr}_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.

Sat.  $\text{CoBr}_2$  + Aq contains at:

59° 75° 97°  
66.7 66.8 68.1%  $\text{CoBr}_2$ .

(Étard, A. ch. 1894, (7) 2. 542.)

Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{SO}_2\text{Cl}(\text{OH})$ . (Walden.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

1g.  $\text{CoBr}_2$  is sol. in 9.74g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 1.013. (Naumann, B. 1909, 42. 3792.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 24.)

+2, and 6 $\text{H}_2\text{O}$ . (Hartley, Chem. Soc. (2) 12. 214.)

**Cobaltous hydrazine bromide hydrazine,  $2\text{CoBr}_2 \cdot 4\text{N}_2\text{H}_4\text{HBr} \cdot \text{N}_2\text{H}_4(?)$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Ferradini, C. A. 1912. 1613.)

**Cobaltous mercuric bromide, basic,  $\text{CoBr}_2 \cdot \text{HgBr}_2 \cdot 6\text{CoO} + 20\text{H}_2\text{O}$ .**

(Mailhe, A. ch. 1902, (7) 27. 369.)

**Cobalt stannic bromide.**

See Bromostannate, cobalt.

**Cobaltous bromide ammonia,  $\text{CoBr}_2 \cdot 6\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with residue of cobalt hydroxide. (Rammelsberg, Pogg. 55. 245.)

**Cobaltous bromide hydrazine,  $\text{CoBr}_2 \cdot 2\text{N}_2\text{H}_4$ .**

Decomp. by boiling with  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1908, 60. 270.)

**Cobalt carbonyl,  $\text{Co}(\text{CO})_4$ .**

Insol. in  $\text{H}_2\text{O}$ . More or less sol. in  $\text{CS}_2$ , ether, alcohol and  $\text{Ni}(\text{CO})_4$ . Relatively stable with non-oxidizing acids. Quickly decomp. by oxidizing acids. (Mond, Hirts and Cowap, C. N. 1908, 96. 165.)

**Cobaltous chloride,  $\text{CoCl}_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat. 100 pts.  $\text{H}_2\text{O}$  dissolve 43.3 pts.  $\text{CoCl}_2$  at 0°. (Engel, A. ch. (6) 17. 355.)

100 pts. sat.  $\text{CoCl}_2$  + Aq at t° contain pts.  $\text{CoCl}_2$ .

t°	Pts. $\text{CoCl}_2$	t°	Pts. $\text{CoCl}_2$	t°	Pts. $\text{CoCl}_2$
-22	24.7	25	34.4	56	48.4
-4	28.0	34	37.5	78	48.8
+7	31.2	41	39.8	94	50.5
11	31.3	45	41.7	96	51.2
12	32.5	49	46.7	112	52.3

(Étard, C. R. 113. 699.)

Sp. gr. of  $\text{CoCl}_2$  + Aq containing—

5 10 12 20 25%  $\text{CoCl}_2$ .  
1.0496 1.0997 1.1579 1.2245 1.3002

Sat. solution, 1.3613.

(Franz, J. pr. (2) 5. 284.)

Sp. gr. of  $\text{CoCl}_2$  + Aq containing in 1000 g.  $\text{H}_2\text{O}$ , g.  $\text{CoCl}_2 + 6\text{H}_2\text{O}$ —

119 g. (=  $\frac{1}{2}$  mol.) 238 357 476 594  
1.055 1.101 1.141 1.177 1.209

833 952 1071 1190  
1.238 1.264 1.287 1.309

Containing g.  $\text{CoCl}_2$  (anhydrous)—  
 65 g. (=  $\frac{1}{2}$  mol.) 130 195 260 325 390  
 1.058 1.112 1.164 1.213 1.260 1.304

(Gerlach, Z. anal. 28. 466.)

Sp. gr. of  $\text{CoCl}_2$  + Aq at room temp. containing:

7.97 14.858 22.27%  $\text{CoCl}_2$ .  
 1.0807 1.1613 1.2845

(Wagner, W. Ann. 1883, 18. 267.)

Sp. gr. of  $\text{CoCl}_2$  + Aq at 20° containing M  
 g. mols. of salt per liter.

M 0.01 0.025 0.05 0.075  
 Sp. gr. 1.001159 1.003052 1.006065 1.009190

M 0.10 0.25 0.50 0.75  
 Sp. gr. 1.012386 1.03049 1.05492 1.09118

M 1.0 1.5 2.0  
 Sp. gr. 1.11847 1.17502 1.23637

(Jones and Pearce, Am. Ch. J. 1907, 38. 711.)

Sp. gr. of  $\text{CoCl}_2$  + Aq. at 25°.

Concentration of $\text{CoCl}_2$ + Aq.	Sp. gr.
1—normal	1.0571
$\frac{1}{2}$ —	1.0286
$\frac{1}{3}$ —	1.0144
$\frac{1}{4}$ —	1.0058

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Solubility in  $\text{HCl}$  + Aq at 0°.  $\frac{\text{CoCl}_2}{2} = \frac{1}{2}$  mols.

$\text{CoCl}_2$  in mgs. in 10 cm. of solution.  
 $\text{HCl}$  = mols.  $\text{HCl}$  in mgs. in ditto.  $\text{H}_2\text{O}$   
 = g.  $\text{H}_2\text{O}$ .

$\frac{\text{CoCl}_2}{2}$	$\text{HCl}$	$\text{CoCl}_2$ + $\text{HCl}$	Sp. gr.	$\text{H}_2\text{O}$
62.4	0	62.4	1.343	9.36
58.525	3.7	62.2	1.328	9.34
50.8	11.45	62.25	1.299	9.27
37.25	25.2	62.45	1.248	9.13
12.85	55.0	67.85	1.167	...
4.75	74.75	79.50	1.150	8.46
12.0	104.5	116.5	1.229	7.5
25.0	139.0	164.0	1.323	...

(Engel, A. ch. (6) 17. 355.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in alcohol.

Sat. solution in alcohol (0.792 sp. gr.) contains 23.66 %  $\text{CoCl}_2$  and has sp. gr. = 1.0107. (Winkler, J. pr. 91. 209.)

Very sol. in ether.

100 pts. absolute ether dissolve only 0.021 g.  $\text{CoCl}_2$ . (Bedtker, Z. phys. Ch. 1897, 23. 511.)

100 g. formic acid (95%) dissolve 6.2 g.  $\text{CoCl}_2$  at 20.2°. (Aschan, Ch. Z. 1913, 37. 1117.)

1g.  $\text{CoCl}_2$  is sol. in 271g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 0.938. (Naumann, B. 1909, 42. 3791.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

100 pts. acetone dissolve 8.62 pts. anhydrous  $\text{CoCl}_2$ . (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

0.08 pts. sol. in 100 pts. ethyl acetate at 14°.

0.26 " " " 100 " " " 79°.

9.11 " " " 100 " acetone " 0°.

9.28 " " " 100 " " " 22.5°.

(Laszcynski, B. 1894, 27, 2286.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

1 g.  $\text{CoCl}_2$  is sol. in 36.4 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 0.825. (Naumann, B. 1904, 37. 4334.)

100 g. acetonitrile dissolve 4.08 g.  $\text{CoCl}_2$  at 18°. (Naumann and Schier, B. 1914, 97. 249.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Solubility in pyridine at t°.

t°	G. $\text{CoCl}_2$ sol. in 100 g. pyridine	Solid phase
-50.3	0.4200	$\text{CoCl}_2$ , $6\text{C}_2\text{H}_5\text{N}$
-45.0	0.4204	
-30.0	0.4224	
-19.6	0.4227	
-10.0	0.4329	
0	0.4326	
+23.0	0.572	$\text{CoCl}_2$ , $4\text{C}_2\text{H}_5\text{N}$
25.0	0.578	
34.6	0.755	
37.6	0.760	
44.6	0.959	
47.2	1.029	
51.0	1.122	$\text{CoCl}_2$ , $2\text{C}_2\text{H}_5\text{N}$
55.0	1.206	
60.0	1.342	
64.2	1.483	
68.0	1.597	
74.8	2.079	
78.2	2.330	$\text{CoCl}_2$
79.8	2.488	
88.0	3.397	
96.5	7.817	
98.8	8.862	
106.0	14.340	
110.0	16.500	

(Pearce and Moore, Am. Ch. J. 1913, 50. 226.)

Mol. weight determined in piperidine, and pyridine. (Werner Z. anorg. 1897, 15. 18 and 23.)

Sol. in urethane. (Castoro, Z. anorg. 1899, 20. 61.)  
 +  $\text{H}_2\text{O}$ .

+2H<sub>2</sub>O. Very deliquescent. (Bersch, J. B. 1867. 291.)  
17.16 pts. sol. in 100 pts. acetone at 0°.  
17.06 " " 100 " " 25°.

(Lassczynski, B. 1894, 27. 2287.)

+4H<sub>2</sub>O. Deliquescent. (Bersch.)

+6H<sub>2</sub>O. Not deliquescent. Easily sol. in H<sub>2</sub>O.

Solubility of CoCl<sub>2</sub>+6H<sub>2</sub>O in ethyl alcohol +Aq at 11.5° under addition of increasing amounts of CoCl<sub>2</sub>.

P = Percent of alcohol by volume.

G = Grams of CoCl<sub>2</sub> added.

C<sub>c</sub> = Grams of CoCl<sub>2</sub> in 5 cc. of the solution.

C<sub>w</sub> = Grams of water in 5 cc. of the solution, calculated from

(1) the water content of the alcohol.

(2) the water of crystallization which had gone into solution.

(3) the water held mechanically in CoCl<sub>2</sub>+6H<sub>2</sub>O.

P	G	C <sub>w</sub>	C <sub>c</sub>
91.3	0.0	1.325	1.168
98.3	0.0	1.134	1.214
98.3	0.0	1.068	1.181
99.3	0.0	1.045	1.199
"	0.194	0.899	1.204
"	0.40C	0.829	1.325
"	0.612	0.764	1.459
"	0.813	0.688	1.568
"	1.022	0.634	1.713
"	1.240	0.553	1.831
"	1.446	0.483	1.943
"	0.650	0.500	2.186

(Bödtker, Z. phys. Ch. 1897, 22. 508.)

Easily soluble in absolute ethyl alcohol. 100 pts. absolute alcohol dissolve at room temperature 56.20 pts. CoCl<sub>2</sub>. Water precipitates CoCl<sub>2</sub>+6H<sub>2</sub>O from a solution of CoCl<sub>2</sub> in absolute alcohol. (Bödtker.)

100 pts. absolute ether dissolve 0.291g. CoCl<sub>2</sub>+6H<sub>2</sub>O. (Bödtker, Z. phys. Ch. 1897, 22. 511.)

Anhydrous ethylene glycol dissolves 10.6% CoCl<sub>2</sub>+6H<sub>2</sub>O at 16.4°. (de Coninck, Chem. Soc. 1904, 86, (2) 741.)

**Cobaltous hydrazine chloride,**

CoCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.HCl+2½H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Ferrattini, C. A. 1912. 1613.)

**Cobaltous iodine chloride,** CoCl<sub>2</sub>, 2ICl<sub>3</sub>+8H<sub>2</sub>O.

Hygroscopic. Decomp. by H<sub>2</sub>O. CCl<sub>4</sub> separates ICl<sub>3</sub>. (Weinland and Schlegelmilch, Z. anorg. 1902, 30. 137.)

**Cobalt lithium chloride,** CoCl<sub>2</sub>, LiCl+3H<sub>2</sub>O.

Very deliquescent. Sol. in H<sub>2</sub>O with decomp. Sol. in LiCl+Aq without decomp. Sol. in alcohol without decomp. (Chassevant, A. ch. (6) 30. 27.)

**Cobaltous mercuric chloride basic,** CoCl<sub>2</sub>, HgCl<sub>2</sub>, 6CoO+20H<sub>2</sub>O.

(Mailhe, A. ch. 1902, (7) 27. 369.)

**Cobaltous mercuric chloride,** CoCl<sub>2</sub>, HgCl<sub>2</sub>.

Very deliquescent. (v. Bonsdorff.)

**Cobaltous thallic chloride,** 2TlCl<sub>3</sub>, CoCl<sub>2</sub>+8H<sub>2</sub>O.

Hygroscopic; can be cryst. from H<sub>2</sub>O. (Gewecke, A. 1909, 366. 222.)

**Cobaltous tin (stannic) chloride,** CoCl<sub>2</sub>, SnCl<sub>4</sub>+6H<sub>2</sub>O.

See Chlorostannate, cobaltous.

**Cobaltous chloride ammonia,** CoCl<sub>2</sub>, 2NH<sub>3</sub>.

Decomp. by H<sub>2</sub>O. (F. Rose.)

CoCl<sub>2</sub>, 4NH<sub>3</sub>. Decomp. by H<sub>2</sub>O. (H. Rose.)

CoCl<sub>2</sub>, 6NH<sub>3</sub>. Decomp. by H<sub>2</sub>O. Sol. in dil. NH<sub>4</sub>OH+Aq with ease, but difficultly in conc. NH<sub>4</sub>OH+Aq. Insol. in absolute alcohol. (Freym.)

**Cobaltous chloride hydrazine,** CoCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.

Insol. in cold H<sub>2</sub>O.

Slowly decomp. by cold, rapidly by hot H<sub>2</sub>O.

Easily sol. in dil. acids and NH<sub>4</sub>OH+Aq. (Fransen, Z. anorg. 1908, 60. 270.)

**Cobaltous chloride hydroxylamine,** CoCl<sub>2</sub>, 2NH<sub>2</sub>OH.

Decomp. in the air; sol. in H<sub>2</sub>O. (Feldt, B. 1894, 27. 403.)

**Cobaltic chloride hydroxylamine,** CoCl<sub>3</sub>, 6NH<sub>2</sub>OH.

Insol. in alcohol.

Sol. in acidified H<sub>2</sub>O without decomp.; sol. in conc. H<sub>2</sub>SO<sub>4</sub> without decomp. (Feldt, B. 1894, 27. 404.)

**Cobaltous fluoride,** CoF<sub>2</sub>.

Sl. sol. in H<sub>2</sub>O; insol. in alcohol and ether; slowly attacked by cold HCl, H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub>+Aq. (Poulenc, C. R. 114. 1429.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 29. 827.)

+2H<sub>2</sub>O. Sol. in a little H<sub>2</sub>O without decomp. Decomp. into oxyfluoride by boiling with much H<sub>2</sub>O. Sol. in HF+Aq. (Berselius.)

+4H<sub>2</sub>O. Two modifications.

Solubility of a mod. at 7° = 2.2328 %

" " " " " " = 2.3203 %.

(Costachescu, Ann. Sci. Univ. Jassy, 1912, 7, 1, 10.)

**Cobaltic fluoride,** CoF<sub>3</sub>.

Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Barbieri, Chem. Soc. 1905, 88, (2) 393.)

**Cobaltous hydrogen fluoride**,  $\text{CoF}_2 \cdot 5\text{HF} + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. acids.

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. (Böhm, Z. anorg. 1905, 43. 330.)

**Cobalt columbium fluoride**.

See Fluocolumbate, cobalt.

**Cobaltous iron (ferric) fluoride**,

$\text{CoF}_2 \cdot \text{FeF}_3 + 7\text{H}_2\text{O}$ .

Sol. in dil.  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 23. 269.)

**Cobaltous manganic fluoride**,  $2\text{CoF}_2 \cdot \text{Mn}_2\text{F}_7 + 8\text{H}_2\text{O}$ .

(Christensen, J. pr. (2) 34. 41.)

**Cobalt molybdenyl fluoride**.

See Fluoxymolybdate, cobalt.

**Cobaltous potassium fluoride**,  $\text{CoF}_2 \cdot \text{KF}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; less in ethyl or methyl alcohol; insol. in amyl alcohol or benzene. Decomp. by hot  $\text{H}_2\text{SO}_4$ . (Poulenc, C. R. 114. 747.)

$+ \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896.)

$\text{CoF}_2 \cdot 2\text{KF}$ .

**Cobaltous sodium fluoride**,  $\text{CoF}_2 \cdot \text{NaF} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wagner, B. 19. 896.)

**Cobaltous stannic fluoride**.

See Fluostannate, cobaltous.

**Cobalt vanadium fluoride**.

See Fluovanadate, cobalt.

**Cobaltous hydroxide**,  $\text{CoO}_2\text{H}_2$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Insol. in  $\text{KOH} + \text{Aq}$ . Sol. in ammonium sulphate, chloride, nitrate, or succinate +  $\text{Aq}$ . (Brett.)

Sol. in warm acetic acid; insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and cold  $\text{NH}_4\text{Cl} + \text{Aq}$ , but sol. in warm  $\text{NH}_4\text{Cl} + \text{Aq}$ . (de Schulten, C. R. 109. 266.)

Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{KOH} + \text{Aq}$ ; somewhat sol. in conc.  $\text{KOH} + \text{Aq}$ ; easily sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Fresenius.)

Easily sol. in  $\text{KCN} + \text{Aq}$ . (Rodgers, 1834.)

Sol. in conc.  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Gmelin.)

Not pptd. by  $\text{KOH} + \text{Aq}$  in presence of  $\text{H}_2\text{C}_2\text{H}_3\text{O}_4$  or  $\text{NH}_4$  citrate. (Spiller.)

Sol. in large amt. in boiling  $\text{NH}_4\text{SCN} + \text{Aq}$ . (Grossmann, Z. anorg. 1908, 58. 269.)

Insol. in methyl, or amyl amine +  $\text{Aq}$ . (Wurtz.)

Many non-volatile organic substances prevent its pptn.

**Cobaltic hydroxide**,  $3\text{Co}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ .

(Mills, Phil. Mag. (4) 35. 257.)

$\text{Co}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . Decomp. by  $\text{HCl} + \text{Aq}$ ;

gives brown solutions with cold  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , which soon decomp. (Wernicke, Pogg. 141. 120.)

$\text{Co}_2\text{O}_3\text{H}_2 = \text{Co}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sol. in warm  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$  with decomp. (Proust.)

Sol. in cold  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , but decomp. on standing or warming. (Winkelblech.)

Sol. in racemic, tartaric, oxalic, or citric acid as cobaltous salt.

Sol. in conc. acetic acid without immediate decomp. (Remele). Solution is not decomp. by boiling. Sol. in warm sat.  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  with decomp.

Not attacked by cold or hot  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Sol. when freshly pptd. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Geuther, A. 128. 157.)

**Cobaltocobaltic hydroxide**,  $\text{Co}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in oxalic acid; solution decomp. by heat. Sol. in  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ . (Gibbs and Genth, Sill. Am. J. (2) 23. 257.)

$\text{Co}_2\text{O}_3 \cdot 7\text{H}_2\text{O}$ . Sol. in weak acids, especially  $\text{HC}_2\text{H}_3\text{O}_2$ , without decomp. (Fremy.)

$\text{Co}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ . Min. *Heterogenite*. Sol. in dil.  $\text{HCl} + \text{Aq}$  with evolution of  $\text{Cl}$ .

**Cobaltous iodide**,  $\text{CoI}_2$ .

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .

100 pts. sat.  $\text{CoI}_2 + \text{Aq}$  at  $t^\circ$  contain pts.  $\text{CoI}_2$ .

$t^\circ$	Pts. $\text{CoI}_2$	$t^\circ$	Pts. $\text{CoI}_2$	$t^\circ$	Pts. $\text{CoI}_2$
-22	52.4	14	61.6	60	79.2
-8	56.7	25	66.4	82	80.7
-2	58.7	34	73.0	111	80.9
+9	61.4	46	79.0	156	83.1

(Étard, C. R. 113. 699.)

Sol. in  $\text{SO}_2(\text{OCH}_3)_2$ . (Walden, Z. anorg. 1902, 29. 388.)

Sol. in  $\text{SOCl}_2$ . (Walden, Z. anorg. 1900, 25. 216.)

Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{AsCl}_3$ . (Walden, Z. anorg. 1900, 25. 214.)

Easily sol. in alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.) (Naumann, B. 1904, 37. 4328.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

$+ 2\text{H}_2\text{O}$ .

$+ 4\text{H}_2\text{O}$ . Very deliquescent. (Étard.)

+6H<sub>2</sub>O. (Hartley, Chem. Soc. (2) 12. 214.)

+9H<sub>2</sub>O. Very hygroscopic. (Bolschakoff, C. C. 1898, II. 660.)

**Cobaltous lead iodide**, 2 CoI<sub>2</sub>, PbI<sub>2</sub>+3H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O. (Mosnier, A. ch. 1897, (7) 12. 412.)

**Cobaltous mercuric iodide**, CoI<sub>2</sub>, HgI<sub>2</sub>+6H<sub>2</sub>O.

Partially decomp. by H<sub>2</sub>O.

Sol. in alcohol and acetone. (Dobroserdoff, C. C. 1901, II. 332.)

CoI<sub>2</sub>, 2HgI<sub>2</sub>+6H<sub>2</sub>O. Decomp. by H<sub>2</sub>O; sol. in alcohol and acetone. (Dobroserdoff, C. C. 1901, II. 332.)

**Cobaltous iodide ammonia**, CoI<sub>2</sub>, 4NH<sub>3</sub>.

Decomp. by H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+aq. (Rammelsberg, Pogg. 48. 155.)

CoI<sub>2</sub>, 6NH<sub>3</sub>. Insol. in NH<sub>4</sub>OH+aq. (Rammelsberg.)

**Cobaltous iodide hydrazine**, CoI<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.

Sl. sol. in H<sub>2</sub>O. Easily sol. in acids. (Franzen, Z. anorg. 1911, 70. 147.)

**Cobaltic octamine compounds.**

See Octamine cobaltic compounds.

**Cobaltous oxide**, CoO.

Insol. in H<sub>2</sub>O. Easily sol. in dil. or conc. HCl or HNO<sub>3</sub>+aq. Slowly sol. in cold, but easily in hot dil. H<sub>2</sub>SO<sub>4</sub>+aq, acetic, or tartaric acid+aq. Insol. in NH<sub>4</sub>OH+aq. Sol. in hot NH<sub>4</sub>Cl+aq, KOH, or NaOH+aq. (Rose.)

Insol. in NH<sub>4</sub>Cl or NH<sub>4</sub>NO<sub>3</sub>+aq. (Brett, 1834.)

Insol. in K<sub>2</sub>CO<sub>3</sub>+aq. Sol. in boiling Ce and Ni nitrates+aq, with pptn. of the oxides. (Persoz.)

Easily sol. in dil. acids, even tartaric, acetic, and oxalic acids. Not attacked by NH<sub>4</sub>OH+aq. Sol. in 13% NH<sub>4</sub>Cl+aq with evolution of NH<sub>3</sub>; also in NH<sub>4</sub>SCN+aq. Sol. in warm conc. NaOH, and KOH+aq. (Zimmerman, A. 232. 324.)

Solubility in (calcium sacrate+sugar)+aq. 1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 1.56 g. CoO; 1 l. solution containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.29 g. CoO. (Bodenbender, J. B. 1865. 600.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

See also Cobaltous hydroxide.

**Cobaltic oxide**, Co<sub>2</sub>O<sub>3</sub>.

Decomp. by most acids, even in the cold, with formation of cobaltous salts. Sol. in acetic acid without immediate decomp.

See also Cobaltic hydroxide.

**Cobaltocobaltic oxide**, Co<sub>3</sub>O<sub>4</sub>=CoO, Co<sub>2</sub>O<sub>3</sub>.

Insol. in boiling conc. HCl, HNO<sub>3</sub>, or aqua regia. Sol. by long standing with H<sub>2</sub>SO<sub>4</sub>. (Gibbs and Genth, Sill. Am. J. (2) 23. 257.)

See also Cobaltocobaltic hydroxide.

Co<sub>3</sub>O<sub>4</sub>=2CoO, Co<sub>2</sub>O<sub>3</sub>.

Co<sub>3</sub>O<sub>4</sub>=4CoO, Co<sub>2</sub>O<sub>3</sub>. Not attacked by boiling dil. HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>+aq. (Beetz.)

Co<sub>3</sub>O<sub>4</sub>=6CoO, Co<sub>2</sub>O<sub>3</sub>+20H<sub>2</sub>O. Sol. in dil. acids, with residue of Co<sub>2</sub>O<sub>3</sub>, which dissolves on warming. (Gentele, J. pr. 69. 131.)

+8H<sub>2</sub>O. As above. (Gentele.)

**Cobaltous oxychloride**, CoCl<sub>2</sub>, 3CoO+3½H<sub>2</sub>O.

Ppt. Very sl. sol. in H<sub>2</sub>O. (Habermann, M. 5. 432.)

**Cobaltous oxychloride hydroxylamine**, CoOCl, 2NH<sub>2</sub>OH.

Insol. in H<sub>2</sub>O; unstable; insol. in alcohol. (Feldt, B. 1894, 27. 404.)

**Cobaltous oxyfluoride**, CoO, CoF<sub>2</sub>+H<sub>2</sub>O.

Ppt. (Berzelius, Pogg. 1. 26.)

**Cobaltous oxyiodide**, CoO, CoI<sub>2</sub>.

Insol. in H<sub>2</sub>O. (Rammelsberg.)

**Cobaltous oxysulphide**, CoO, CoS.

Cold HCl+aq dissolves out CoO; hot HCl+aq decomp. with evolution of H<sub>2</sub>S. (Arfvedson, Pogg. 1. 64.)

**Cobalt phosphide**, Co<sub>3</sub>P.

Sol. in conc. HNO<sub>3</sub>. Slowly attacked by HCl and H<sub>2</sub>SO<sub>4</sub>. (Maronneau, C. R. 1900, 130. 658.)

Sol. in HNO<sub>3</sub>, aqua regia, and in fused alkalis. (Granger, Bull. Soc. 1896, (3) 15. 1089.)

Co<sub>3</sub>P<sub>2</sub>. Insol. in HNO<sub>3</sub> and aqua regia; stable in the air even when heated. (Granger, Bull. Soc. 1896, (3) 15. 1087.)

Co<sub>3</sub>P<sub>2</sub>. Insol. in conc. HCl+aq. Sol. in HNO<sub>3</sub>+aq. (Rose, Pogg. 24. 332.)

**Cobalt subselenide**, Co<sub>2</sub>Se.

Sol. in bromine water.

Only sl. attacked by boiling fuming HCl. (Fonze-Diacon, C. R. 1900, 131. 704.)

**Cobalt monoselenide**, CoSe.

(Little, A. 112. 211.)

**Cobalt diselenide** CoSe<sub>2</sub>.

Sol. in Br<sub>2</sub>+aq.

Only sl. attacked by boiling fuming HCl. (Fonze-Diacon, C. R. 1900, 131. 705.)

**Cobalt sesquiselenide,  $\text{Co}_2\text{Se}_3$ .**

Sol. in  $\text{Br}_2 + \text{Aq}$ .  
Only sl. attacked by boiling fuming  $\text{HCl}$ .  
(Fonsec-Diacon, C. R. 1900, 131. 704.)

**Cobalt selenide,  $\text{Co}_2\text{Se}_4$ .**

Sol. in  $\text{Br}_2 + \text{Aq}$ .  
Only sl. attacked by boiling fuming  $\text{HCl}$ .  
(Fonsec-Diacon, C. R. 190, 131. 704.)

**Cobalt silicide,  $\text{Co}_2\text{Si}$ .**

Sol. in  $\text{HF}$  and aqua regia. Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by steam at red heat. Sol. in fused alkali carbonates. (Vigouroux, C. R. 1895, 121. 687.)

$\text{CoSi}$ . Insol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . Sol. in aqua regia and  $\text{HCl}$ , and in fused  $\text{KOH}$ . (Lebeau, C. R. 1901, 132. 557.)

Not attacked by dil. or conc.  $\text{HNO}_3$ , or conc.  $\text{H}_2\text{SO}_4$ . Sol. in aqua regia and in conc.  $\text{HCl}$ .

Not attacked by dil. alkali hydroxides +  $\text{Aq}$ ; attacked by fused alkali. (Lebau, Bull. Soc. 1901, (3), 25. 540.)

$\text{CoSi}_2$ . Sl. sol. in hot conc.  $\text{HCl}$  and hot conc. alkali +  $\text{Aq}$ . Sol. in  $\text{HF}$ ; insol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Lebeau, C. R. 1902, 135. 476.)

**Cobaltous sulphide,  $\text{CoS}$ .**

*Anhydrous*. Easily sol. in acids, even  $\text{HCl}$ , but only slowly in the latter case. (Hjortdahl, C. R. 65. 75.)

Not attacked by cold dil.  $\text{HCl} + \text{Aq}$ . (Ebelmen, A. ch. (3) 25. 94.)

Min. *Seypoorite*.  
+  $\text{zH}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolve  $41.62 + 10^{-6}$  moles  $\text{CoS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Sol. in conc. mineral acids; very sl. sol. in cold dil. acids; scarcely sol. in acetic acid. (Wackenroder.)

Sol. when still moist in  $\text{SO}_2 + \text{Aq}$ . (Berthier.)

Easily sol. in  $\text{HNO}_3$ , but only very sl. sol. in  $\text{HCl} + \text{Aq}$ . Not pptd. from very dil. acid solutions by  $\text{H}_2\text{S}$ .

Insol. in  $\text{H}_2\text{O}$ , alkalies, and alkali carbonates, or sulphides +  $\text{Aq}$ . (Fresenius.)

Insol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

When pptd. by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , shows a brown colour in presence of 200,000 pts.  $\text{H}_2\text{O}$ . (Pfaff.)

Tartaric acid, etc. does not hinder the pptn. by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Rose.)

Sol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26. 15.)

Sol. in  $\text{Na}_2\text{S}_2$  or  $\text{K}_2\text{S}_2 + \text{Aq}$ . (de Koninck, Zeit. angew. Ch. 1891. 202.)

**Cobaltic sulphide,  $\text{Co}_2\text{S}_3$ .**

Partially decomp. by  $\text{HCl} + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$  with decomposition.

Sl. attacked by  $\text{HCl} + \text{Aq}$ ; and slowly even by aqua regia. (Schneider, J. pr. (2) 9. 209.)

**Min. Cobalt pyrite.**

+  $\text{zH}_2\text{O}$ . Insol. in  $\text{KCN} + \text{Aq}$ . (Fleck, J. pr. 97. 303.) More sol. in  $\text{HCl} + \text{Aq}$  than  $\text{CoS}$ . (Dingler, Berz, J. B. 10. 139.)

**Cobaltocobaltic sulphide,  $\text{Co}_3\text{S}_4$ .**

Min. *Linnanite*. Sol. in warm  $\text{HNO}_3 + \text{Aq}$ , with residue of S.

**Cobalt disulphide,  $\text{CoS}_2$ .**

Not attacked by alkalies or acids except  $\text{HNO}_3$  and aqua regia. (Setterberg, Pogg. 7. 40.)

**Cobalt sulphide,  $\text{Co}_3\text{S}_3$ .**

Easily sol. in hot  $\text{HCl}$  with evolution of  $\text{H}_2\text{S}$  (and  $\text{H}_2$ ?). (Proust.)

**Cobalt potassium sulphide,  $\text{K}_2\text{Co}_{11}\text{S}_{16}$ .**

Slowly sol. in cold  $\text{HCl}$  and aqua regia. Quickly sol. in warm aqua regia.

Sol. in  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  only on warming. Insol. in  $(\text{NH}_4)_2\text{S}$ , organic acids, alkalies, 12%  $\text{HCl} + \text{Aq}$  and  $\text{KCN} + \text{Aq}$ . (Milbauer, Z. anorg. 1904, 42. 447.)

**Cobalt telluride,  $\text{CoTe}$ .**

(Fabre, C. R. 105. 673.)

**Cobalt decamine sulphurous acid.**

See Decamine cobaltisulphurous acid.

**Cobaltic acid.****Potassium cobaltate,  $\text{K}_2\text{Co}_2\text{O}_{10} + 2\text{H}_2\text{O}$ , or  $3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  (Pebal, A. 100. 262), but decomp. by long boiling. Sol. in conc. acids.  $\text{K}_2\text{O}$ ,  $\text{zCoO}$ . Sol. in  $\text{H}_2\text{O}$ . (Winkler, J. pr. 91. 351.)

Does not exist. (Donath, W. A. B. 102, 2b. 71.)

**Cobalticyanhydric acid,  $\text{H}_3\text{Co}(\text{CN})_6 + \frac{1}{2}\text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and only sl. decomp. on boiling.

Sol. in  $\text{HCl} + \text{Aq}$  without decomp. even on boiling. Sl. sol. in conc., more sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . Not decomp. by boiling conc.  $\text{HNO}_3 + \text{Aq}$  or aqua regia. Insol. in conc., sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in alcohol. Insol. in ether. (Zwenger, A. 162. 157.)

**Ammonium cobalticyanide,  $(\text{NH}_4)_3\text{Co}(\text{CN})_6 + \frac{1}{2}\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol.

**Ammonium barium cobalticyanide,**

$\text{NH}_4\text{BaCo}(\text{CN})_6 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weselsky.)

**Ammonium calcium cobalticyanide,**

$\text{NH}_4\text{CaCo}(\text{CN})_6 + 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Ammonium lead cobalticyanide,**  
 $\text{NH}_4\text{PbCo}(\text{CN})_6 + 3\text{H}_2\text{O}.$ 

Sol. in 8.31 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and sl. sol. in 93% alcohol. (Schuler.)

**Ammonium mercuric cobalticyanide,**  
 $(\text{NH}_4)_6\text{Co}_2\text{Hg}(\text{CN})_{14} + \text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$  with decomp.  
Insol. in alcohol. (Soenderop, Dissert. 1899.)

**Ammonium sodium cobalticyanide,**  
 $\text{NH}_4\text{Na}_3\text{Co}(\text{CN})_6.$ 

Only sl. sol. in  $\text{H}_2\text{O}$ . (Weselsky, B. 2. 598.)

**Ammonium strontium cobalticyanide,**  
 $\text{NH}_4\text{SrCo}(\text{CN})_6 + 9\text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (W.)

**Barium cobalticyanide, basic,**  $\text{Ba}_2[\text{Co}(\text{CN})_6]_2 \cdot \text{BaO}_2\text{H}_2.$ 

Not very stable. Cannot be recryst. without partial decomp. (W.)

**Barium cobalticyanide,**  $\text{Ba}_2[\text{Co}(\text{CN})_6]_2 + 10\text{H}_2\text{O}.$ 

Sl. efflorescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

**Barium cobalticyanide chloride,**  
 $\text{Ba}_2[\text{Co}(\text{CN})_6]_2 \cdot \text{BaCl}_2 + 16\text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$  without decomp. (W.)

**Barium lithium cobalticyanide,**  $\text{BaLiCo}(\text{CN})_6 + 15\text{H}_2\text{O}.$ 

The most. sol. of the double cobalticyanides. (Weselsky.)

**Barium potassium cobalticyanide,**  
 $\text{BaKCo}(\text{CN})_6 + 11\text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (W.)

**Bismuth cobalticyanide**  $\text{BiCo}(\text{CN})_6.$ 

Ppt. (Mathews, J. Am. Chem. Soc. 1900, 22. 275.)

+  $5\text{H}_2\text{O}$ . Moderately stable with dil. min. acids; more stable with conc. acids than Cd or Zn comp.

Decomp. by  $\text{NH}_3$  and alkalis. (Fischer and Cuntze, Ch. Z. 1902, 26. 872.)

**Cadmium cobalticyanide,**  $\text{Cd}_2[\text{Co}(\text{CN})_6]_2 + 7\frac{1}{2}\text{H}_2\text{O}.$ 

Attacked by strong min. acids only when hot. Behaves as Zn salt, toward conc.  $\text{H}_2\text{SO}_4$  and dil. and conc.  $\text{HCl}$ .

Insol. in  $\text{K}_2\text{Co}(\text{CN})_6 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH}$  and  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Cadmium potassium cobalticyanide,**  
 $\text{KCdCo}(\text{CN})_6.$ 

Not attacked by  $\text{H}_2\text{O}$ . (Fischer and Cuntze, Ch. Z. 1902, 26, 873.)

**Cadmium sodium cobalticyanide,**  
 $\text{NaCdCo}(\text{CN})_6.$ 

(Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Cadmium cobalticyanide ammonia,**  
 $\text{Cd}_2[\text{Co}(\text{CN})_6]_2 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}.$ 

(Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

$\text{Cd}_2[\text{Co}(\text{CN})_6]_2 \cdot 5\text{NH}_3 + 3\text{H}_2\text{O}$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

$\text{Cd}_2[\text{Co}(\text{CN})_6]_2 \cdot 7\text{NH}_3$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

$\text{Cd}_2[\text{Co}(\text{CN})_6]_2 \cdot 9\text{NH}_3 + 2\text{H}_2\text{O}$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Calcium potassium cobalticyanide,**  
 $\text{CaKCo}(\text{CN})_6 + 9\text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (W.)

**Cobaltous cobalticyanide,**  $\text{Co}_2[\text{Co}(\text{CN})_6]_2 + 14\text{H}_2\text{O}.$ 

Insol. in  $\text{H}_2\text{O}$  and acids. Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$ .

**Cupric cobalticyanide,**  $\text{Cu}_2[\text{Co}(\text{CN})_6]_2 + 7\text{H}_2\text{O}.$ 

Insol. in  $\text{H}_2\text{O}$  and acids. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Cupric cobalticyanide ammonia,**  
 $\text{Cu}_2[\text{Co}(\text{CN})_6]_2 \cdot 4\text{NH}_3 + 7\text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (Zwenger.)

**Lead cobalticyanide, basic,**  $\text{Pb}_2[\text{Co}(\text{CN})_6]_2 \cdot 3\text{PbO}_2\text{H}_2 + 11\text{H}_2\text{O}.$ 

Insol. in  $\text{H}_2\text{O}$  or alcohol; somewhat sol. in hot  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Schuler.)

**Lead cobalticyanide,**  $\text{Pb}_2[\text{Co}(\text{CN})_6]_2 + 4\text{H}_2\text{O}.$ 

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

(Zwenger.) +  $7\text{H}_2\text{O}$ . Sol. in 1.77 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and 1.63 pts. at  $19^\circ$ . Insol. in absolute alcohol.

Sl. sol. in 93% alcohol. (Schuler, W. A. B. 79. 302.)

**Lead potassium cobalticyanide,**  $\text{PbKCo}(\text{CN})_6 + 3\text{H}_2\text{O}.$ 

Sol. in 6.74 pts.  $\text{H}_2\text{O}$  at  $18^\circ$  and much more easily in hot  $\text{H}_2\text{O}$ . Insol. in absolute, sl. sol. in 93% alcohol. (Schuler.)

**Lead cobalticyanide nitrate,**  $\text{Pb}_2[\text{Co}(\text{CN})_6]_2 \cdot \text{Pb}(\text{NO}_3)_2 + 12\text{H}_2\text{O}.$ 

Sol. in 16.91 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , 16.79 pts. at  $19^\circ$ , and much less hot  $\text{H}_2\text{O}$ .

Nearly insol. in 93% alcohol. (Schuler.)

**Mercurous cobalticyanide,**  $\text{Hg}_2\text{Co}(\text{CN})_6.$ 

Ppt. Decomp. by  $\text{HCl}$ . Not attacked by cold, but by hot conc.  $\text{H}_2\text{SO}_4$ . Not attacked by  $\text{HNO}_3$ , acetic or oxalic acid. Decomp. by alkalis +  $\text{Aq}$ . (Miller and Mathews, J. Am. Chem. Soc. 1900, 22. 64.)

**Mercuric cobalticyanide,  $Hg_2[Co(CN)_6]_2$ .**

Sl. sol. in  $H_2O$ , decomp. by boiling.  
Insol. in alcohol and ether. Not attacked by  $HCl$ . (Soenderop, Dissert, 1899.)

**Mercuric potassium cobalticyanide,  $K_2HgCo_2(CN)_{14}$ .**

Sol. in  $H_2O$  with decomp. Insol. in alcohol. Sl. sol. in ether. (Soenderop, Dissert, 1899.)

$K_2Hg_2Co_4(CN)_{24}$ . (Soenderop, Dissert. 1899.)

**Mercuric sodium cobalticyanide,  $Na_2Hg_2Co_4(CN)_{24}+4H_2O$ .**

Extremely deliquescent. (Soenderop, Dissert, 1899.)

**Nickel cobalticyanide,  $Ni_2[Co(CN)_6]_2+12H_2O$ .**

Insol. in  $H_2O$  and acids. Not attacked by boiling  $HCl+Ag$ . Sol. in  $NH_4OH+Ag$ . Decomp. by  $KOH+Ag$ .

**Nickel cobalticyanide ammonia,  $Ni_2[Co(CN)_6]_2, 4NH_3+7H_2O$ .**

Insol. in  $H_2O$ .

**Potassium cobalticyanide,  $K_3Co(CN)_6$ .**

Easily sol. in  $H_2O$ . Insol. in alcohol.

**Potassium strontium cobalticyanide,  $KSrCo(CN)_6+9H_2O$ .**

Sol. in  $H_2O$ . (Weselsky.)

**Potassium thallium cobalticyanide,  $K_2Tl_2[Co(CN)_6]_2$ .**

More sol. in  $H_2O$  than corresponding  $K$  salt. (Fischer and Benzian, Ch. Z. 1902, 26. 49.)

**Potassium zinc cobalticyanide,  $KZnCo(CN)_6+3H_2O$ .**

(Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Potassium cobalticyanide mercuric chloride,  $2K_2Co(CN)_6, 3HgCl_2$ .**

(Soenderop, Dissert. 1899.)

**Potassium cobalticyanide mercuric iodide,  $4K_2Co(CN)_6, HgI_2$ .**

Sol. in  $H_2O$  with subsequent decomp.  
Sol. in alcohol and ether with decomp. (Soenderop, Dissert, 1899.)

**Silver cobalticyanide,  $Ag_3Co(CN)_6$ .**

Insol. in  $H_2O$  and acids. Sol. in  $NH_4OH+Ag$ .

**Silver cobalticyanide ammonia,  $Ag_3Co(CN)_6, NH_3+\frac{1}{2}H_2O$ .**

Insol. in  $H_2O$ . (Zwenger.)

**Sodium cobalticyanide,  $Na_3Co(CN)_6+2H_2O$ .**

Easily sol. in  $H_2O$ ; insol. in alcohol.

**Sodium zinc cobalticyanide,  $NaZnCo(CN)_6+H_2O$ .**

(Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Strontium cobalticyanide,  $Sr_2[Co(CN)_6]_2+10H_2O$ .**

Very sol. in  $H_2O$ . (Weselsky.)

**Thallium cobalticyanide,  $Tl_2Co(CN)_6$ .**

100 pts.  $H_2O$  dissolve 3.6 pts. at  $0^\circ$ , 5.86 pts. at  $9.5^\circ$ , 10.04 pts. at  $19.5^\circ$ . (Fronmüller, B. 11. 91.)

**Yttrium cobalticyanide,  $YCo(CN)_6+2H_2O$ .**

Nearly insol. in  $H_2O$ . (Cleve.)

**Zinc cobalticyanide,  $Zn_2[Co(CN)_6]_2+12H_2O$ .**

Sol. in  $HCl+Ag$  and salt is pptd. by dilution with  $H_2O$ . Decomp. by  $H_2SO_4$ . Insol. in  $K_2Co(CN)_6+Ag$ . Sol. in  $NH_4OH$  and  $NH_4Cl+Ag$ . (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

**Zinc cobalticyanide ammonia,  $Zn_2[Co(CN)_6]_2, 5NH_3$ .**

Decomp. by  $H_2O$  and acids. (Fischer and Cuntze, Ch. Z. 1902, 26. 873.)

$Zn_2[Co(CN)_6]_2, 6NH_3$ . (Fischer and Cuntze.)

$+3H_2O$ . (Fischer and Cuntze.)

$Zn_2[Co(CN)_6]_2, 10NH_3+9H_2O$ . Decomp. by  $H_2O$ . (Fischer and Cuntze.)

**Cobaltimolybdic acid.**

**Ammonium barium cobaltous cobaltimolybdate,  $\frac{1}{2}(NH_4)_2O, 1\frac{1}{2}BaO, CoO, CoO_2, 10MoO_3+18\frac{1}{2}H_2O$ .**

Difficultly sol. in  $H_2O$ . (Friedheim and Keller, B. 1906, 39. 4306.)

**Ammonium cobaltous cobaltimolybdate,  $2(NH_4)_2O, CoO, CoO_2, 10MoO_3+12H_2O$ .**

Much more sol. in  $H_2O$  than  $3(NH_4)_2O, CoO, CoO_2, 12MoO_3+20H_2O$ . Sp. gr. of cold sat. solution = 1.096. (Friedheim and Keller.)

$3(NH_4)_2O, CoO, CoO_2, 12MoO_3+20H_2O$ . 100 cc. cold sat. aqueous solution contain 3 g. of the salt. Sp. gr. of the solution = 1.0234.

Sol. in conc.  $HCl$ .  
Decomp. by conc.  $H_2SO_4$ , by  $KOH+Ag$  and by  $NaOH+Ag$ . (Friedheim and Keller.)

**Barium cobaltous cobaltimolybdate,  $3BaO, CoO, CoO_2, 9MoO_3+25H_2O$ .**

Sl. sol. in  $H_2O$ . (Friedheim and Keller.)



**Cobaltous potassium cobaltimolybdate,**  
 $\text{CoO}, 3\text{K}_2\text{O}, \text{CoO}_2, 10\text{MoO}_3 + 10\text{H}_2\text{O}$ .  
 (Kurnakoff, Ch. Z. 1890, 14. 113.)

+11H<sub>2</sub>O. Sol. in conc. HCl. Decomp. by KOH+*Aq* and by NaOH+*Aq*. (Friedheim and Keller.)

$3\text{K}_2\text{O}, \text{CoO}, \text{CoO}_2, 12\text{MoO}_3 + 15\text{H}_2\text{O}$ . Sl. sol. in H<sub>2</sub>O. Sol. in conc. HCl. Decomp. by KOH+*Aq* and by NaOH+*Aq*. (Friedheim and Keller.)  
 +20H<sub>2</sub>O. (Kurnakoff, Ch. Z. 1890, 14. 113.)

**Potassium cobaltimolybdate,**  
 $3\text{K}_2\text{O}, \text{CoO}_2, 9\text{MoO}_3 + 6\frac{1}{2}\text{H}_2\text{O}$ .

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 703.)

**Cobaltinitrocyanhydric acid.**

**Potassium cobaltinitrocyanide,**  
 $\text{K}_4\text{Co}_2(\text{CN})_8\text{NO}_2 + 3\text{H}_2\text{O}$ .

Very sol. in H<sub>2</sub>O but quickly decomp. Insol. in alcohol. (Rosenheim and Koppel, Z. anorg. 1898, 17. 68.)

**Silver cobaltinitrocyanide,**  
 $\text{Co}_2\text{Ag}_2\text{NO}_2(\text{CN})_{10} + 6\text{H}_2\text{O}$ , and +21H<sub>2</sub>O.  
 (Rosenheim and Koppel.)

**Sodium cobaltinitrocyanide,**  
 $\text{Na}_4\text{Co}_2(\text{NO}_2)(\text{CN})_{10} + 11\text{H}_2\text{O}$ .

Very deliquescent. Sol. in H<sub>2</sub>O. (Rosenheim and Koppel.)

**Cobaltisulphurous acid,  $\text{H}_4\text{Co}_2(\text{SO}_3)_4$ .**

Not obtained in a solid state. (Berglund, Acta Lund. 1872.)

**Cobaltisulphites.**

The cobaltisulphites are insol. or at least very sl. sol. in H<sub>2</sub>O. (Berglund, Acta Lund. 1872. 23.)

**Ammonium cobaltous cobaltisulphite,**  
 $(\text{NH}_4)_2\text{SO}_3, 2\text{CoSO}_3, \text{Co}_2(\text{SO}_3)_3 + 14\text{H}_2\text{O} =$   
 $(\text{NH}_4)_2\text{Co}_2\text{Co}_2(\text{SO}_3)_6 + 14\text{H}_2\text{O}$ .

Scarcely sol. in H<sub>2</sub>O, but decomp. thereby. Easily sol. in acids, when finely divided; also in H<sub>2</sub>SO<sub>3</sub>+*Aq*. (Berglund.)

$2(\text{NH}_4)_2\text{SO}_3, \text{CoSO}_3, \text{Co}_2(\text{SO}_3)_3 + 8\text{H}_2\text{O} =$   
 $(\text{NH}_4)_4\text{CoCo}_2(\text{SO}_3)_6 + 8\text{H}_2\text{O}$ . As above. (Berglund.)

**Barium cobaltisulphite.  $3\text{BaSO}_3, \text{Co}_2(\text{SO}_3)_3 +$**   
 $12\text{H}_2\text{O} = \text{Ba}_3\text{Co}_2(\text{SO}_3)_6 + 12\text{H}_2\text{O}$ .

Ppt. Insol. in H<sub>2</sub>O. Not attacked by cold acids even H<sub>2</sub>SO<sub>4</sub>, but is decomp. by boiling therewith. (Berglund, Acta Lund. 1872.)

**Bismuth cobaltisulphite,  $\text{Bi}_2\text{Co}_2(\text{SO}_3)_4$ .**

Insol. in H<sub>2</sub>O, dil. HNO<sub>3</sub>, or HCl+*Aq*. (Berglund, Acta Lund. 1872. 31.)

**Calcium cobaltisulphite,  $\text{Ca}_2\text{Co}_2(\text{SO}_3)_4$ .**

Ppt. Insol. in H<sub>2</sub>O or HCl+*Aq*. (Berglund, Acta Lund. 1872. 30.)

**Cobaltous cobaltisulphite,  $\text{Co}_2\text{Co}_2(\text{SO}_3)_4 =$**   
 $3\text{CoSO}_3, \text{Co}_2(\text{SO}_3)_3$ .

Ppt. (Berglund, B. 7. 470.)

**Cobaltous potassium cobaltisulphite,**  
 $\text{CoK}_4\text{Co}_2(\text{SO}_3)_4$ .

Insol. in H<sub>2</sub>O. (Berglund.)

**Silver cobaltisulphite,  $\text{Co}_2(\text{SO}_3)_3, 3\text{Ag}_2\text{SO}_3$ .**

Properties as the following comp. (Berglund.)

**Silver cobaltous cobaltisulphite,  $\text{CoSO}_3,$**   
 $\text{Co}_2(\text{SO}_3)_3, 2\text{Ag}_2\text{SO}_3 + 9\text{H}_2\text{O}$ .

Insol. in H<sub>2</sub>O. Insol. in HNO<sub>3</sub>+*Aq*. Decomp. by HCl or H<sub>2</sub>S+*Aq*. (Berglund.)

**Sodium cobaltous cobaltisulphite.**

Decomp. by H<sub>2</sub>O, so that it has not been obtained pure. (Berglund, Acta Lund. 1872, 29.)

**Cobaltoctamine sulphurous acid.**

See Octamine cobaltisulphurous acid.

**Cobaltocobalticyanhydric acid,**  
 $\text{H}_2\text{Co}_2(\text{CN})_{11}$ .

Unstable. (Jackson and Comey, Am. Ch. J. 1897. 19, 277.)

**Barium cobaltocobalticyanide,**

$\text{BaHC}_2(\text{CN})_{11} + 1\frac{1}{2}\text{H}_2\text{O}$ .

Somewhat sol. in H<sub>2</sub>O when pure.

The crude salt is insol. even in hot H<sub>2</sub>O. (Jackson and Comey.)

**Cupric cobaltocobalticyanide,  $\text{Cu}_2\text{Co}_2(\text{CN})_{22}$**   
 $+ 4\text{H}_2\text{O}$ .

Ppt. (Jackson and Comey.)

**Potassium hydrogen cobaltocobalticyanide,**  
 $\text{K}_2\text{HC}_2(\text{CN})_{11} + 2\text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O.

Insol. in alcohol. (Jackson and Comey.)

$\text{KH}_2\text{Co}_2(\text{CN})_{11} + \text{H}_2\text{O}$ . Insol. in cold or hot H<sub>2</sub>O when impure.

The pure salt is slowly sol. in cold H<sub>2</sub>O. More sol. in warm H<sub>2</sub>O. (Jackson and Comey.)

**Silver cobaltocobalticyanide,  $\text{Ag}_2\text{Co}_2(\text{CN})_{11}$**   
 $+ \text{H}_2\text{O}$ .

Ppt. (Jackson and Comey, B. 1896, 29. 1021.)

**Zinc cobaltocobalticyanide,  $\text{ZnHC}_2(\text{CN})_{11}$**   
 $+ 3\text{H}_2\text{O}$ .

Ppt. (Jackson and Comey.)

**Cobaltocyanhydric acid,  $H_2Co(CN)_6$ .**

Very unstable. Sol. in  $H_2O$ . Insol. in alcohol.

**Cuprous potassium cobaltocyanide,  $K_2CuCo(CN)_6$ .**

(Straus, Z. anorg. 1895, 9. 17.)

**Potassium cobaltocyanide,  $K_3Co(CN)_6$ .**

Decomp. on air. Very deliquescent, and sol. in  $H_2O$ . Insol. in alcohol and ether. (Descamps, Zeit. Ch. 1868. 952.)

**Cobaltous acid.****Barium cobaltite,  $BaCoO_3$ .**

Insol. in  $H_2O$  or dil.  $HCl$ . Sol. in  $HCl + Aq.$  (Rousseau, C. R. 109. 64.)  
 $BaCo_3O_8$ . As above. (Rousseau.)

**Cobaltous potassium cobaltite,  $3CoO_2, CoO, K_2O$ .**

Rapidly hydrolysed by  $H_2O$ .  
Sol. in conc.  $HCl$ . (Bellucci, Chem. Soc. 1907, 92, (2) 354.)

**Magnesium cobaltite,  $MgCoO_3$ .**

Insol. in  $H_2O, NH_4OH$ , or  $(NH_4)_2CO_3 + Aq.$   
Easily sol. in  $NH_4Cl + Aq.$  from which it is pptd. by  $KOH + Aq.$  (Berzelius, Pogg. 33. 126.)

Sol. in  $HF, HCl, HNO_3 + H_2SO_4$ ; decomp. and partially dissolved by  $NH_4OH + Aq.$ ; quite stable when heated. (Dufau, C. R. 1896, 123. 240.)

**Potassium cobaltite.**

According to Bellucci and Dominici the compounds formerly described are more or less decomp. by hydrolysis. (C. C. 1907. I, 1530.)

**Sodium cobaltite.**

Sol. in  $NaOH + Aq.$  but pptd. by diluting the solution.

**Columbic acid (Niobic acid),  $3Cb_2O_5, 4H_2O$ , or  $3Cb_2O_5, 7H_2O$ .**

Easily sol. in  $HF$ ; very sl. sol. in  $HCl + Aq.$  but is sol. in  $H_2O$  after being treated with  $HCl + Aq.$  Sol. in conc.  $H_2SO_4$ . Sol. in  $KOH + Aq.$  Insol. in  $NaOH + Aq.$  but becomes sol. in  $H_2O$  by being treated with  $NaOH + Aq.$  Sol. in boiling  $Na_2CO_3 + Aq.$  (Rose, Pogg. 113. 109.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

$Cb_2O_5, 4H_2O$ .

$Cb_2O_5, 7H_2O$ . (Santesson, Bull. Soc. (2) 24. 52.)

**Aluminum columbate,  $Al_2O_3, 3Cb_2O_5 + 12H_2O$ .**

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1652.)

**Barium columbate,  $7BaO, 6Cb_2O_5 + 18H_2O$ .**

Ppt. (Bedford, J. Am. Chem. Soc. 1905, 27. 1218.)

**Cadmium columbate,  $CdO, Cb_2O_5$ .**

Sol. in boiling conc.  $H_2SO_4$ ; insol. in most acids; decomp. by  $HKSO_4$  at red heat. (Larsson, Z. anorg. 1896, 12. 199.)  
 $+ 3\frac{1}{2}H_2O$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1652.)

**Cesium columbate,  $4Cs_2O, 3Cb_2O_5 + 14H_2O$ .**

Very sol. in  $H_2O$ . (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1654.)  
 $7Cs_2O, 6Cb_2O_5 + 30H_2O$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1655.)

**Calcium columbate,  $2CaO, Cb_2O_5$ .**

Insol. in  $H_2O$ . (Joly, C. R. 81. 266.)  
 $CaO, Cb_2O_5$ . Sol. in boiling conc.  $H_2SO_4$ ; insol. in most acids; decomp. by  $HKSO_4$  at red heat. (Larsson, Z. anorg. 1896, 12. 198.)

**Cobalt columbate,  $CoO, Cb_2O_5$ .**

Sol. in conc. boiling  $H_2SO_4$ ; insol. in most acids; decomp. by  $HKSO_4$  at red heat. (Larsson.)

**Copper columbate,  $CuO, Cb_2O_5$ .**

Sol. in boiling conc.  $H_2SO_4$ ; insol. in most acids; decomp. by  $HKSO_4$  at red heat. (Larsson.)  
 $+ 3\frac{1}{2}H_2O$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1652.)

**Iron (ferrous) columbate,  $Fe(CbO_3)_2$ .**

Min. *Columbite*. Insol. in acids.

**Iron (ferrous) columbate tantalate,  $zFe(TaO_3)_3, yFe(CbO_3)_2$ .**

Min. *Tantalite*. Not attacked by acids.  
 $Fe(CbO_3)_2, 4Fe(TaO_3)_2$ . Min. *Tapiolite*.

**Lithium columbate,  $7Li_2O, 6Cb_2O_5 + 26H_2O$ .**

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1655.)

**Magnesium columbate,  $MgO, Cb_2O_5$ .**

Sol. in boiling conc.  $H_2SO_4$ ; insol. in most acids; decomp. by  $KHSO_4$  at red heat. (Larsson, Z. anorg. 1896, 12. 196.)

$+ 4H_2O$ . Precipitate. (Rammelsberg.)

$+ 7H_2O$ . Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1651.)

$4MgO, Cb_2O_5$ . Insol. in  $H_2O$ . (Joly, C. R. 81. 266.)

$3MgO, Cb_2O_5$ . As above.

**Manganous columbate.**

Insol. in  $H_2O$ . (Joly, C. R. 81. 266.)

$3MnO, 5Cb_2O_5$ . Sol. in boiling conc.  $H_2SO_4$ ; insol. in most acids; decomp. by  $HKSO_4$  at red heat. (Larsson, Z. anorg. 1896, 12. 201.)

**Potassium columbate,  $\text{KCbO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Joly, in *Fremy's Encyc. Ch.*)  
 $\text{K}_2\text{Cb}_2\text{O}_7 + 5\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Santesson.)

$\text{K}_2\text{Cb}_2\text{O}_{10} + 5\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ .  
 $\text{K}_2\text{Cb}_2\text{O}_7 + 11\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Santesson, *Bull. Soc.* (2) 24. 53.)

$\text{K}_2\text{Cb}_2\text{O}_{22} + 11\text{H}_2\text{O}$ . (Santesson.)  
 $\text{K}_2\text{Cb}_2\text{O}_{13} + 13\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .  
 $\text{K}_2\text{Cb}_2\text{O}_{10} + 16\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac, *A. ch.* (4) 8. 20.)

Very sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, *J. Am. Chem. Soc.* 1908, 30. 1652.)

$\text{K}_{11}\text{Cb}_{11}\text{O}_{37} + 27\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (E. F. Smith.)

$\text{K}_{10}\text{Cb}_{10}\text{O}_{48} + 32\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

**Potassium sodium columbate,  $3\text{K}_2\text{O}, \text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 9\text{H}_2\text{O}$ .**

Very slightly sol. in  $\text{H}_2\text{O}$ . Insol. in alkalis. (Marignac.)

**Rubidium columbate,  $3\text{Rb}_2\text{O}, 4\text{Cb}_2\text{O}_5 + 9\frac{1}{2}\text{H}_2\text{O}$ .**

(E. F. Smith, *J. Am. Chem. Soc.* 1908, 30. 1655.)

$4\text{Rb}_2\text{O} \cdot 3\text{Cb}_2\text{O}_5 + 14\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Silver columbate,  $\text{Ag}_2\text{O}, \text{Cb}_2\text{O}_5 + 2\text{H}_2\text{O}$ .**

Ppt. (E. F. Smith.)

$7\text{Ag}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Bedford, *J. Am. Chem. Soc.* 1905, 27. 1218.)

**Sodium columbate,  $\text{NaCbO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .**

Completely sol. in  $\text{H}_2\text{O}$ . (Rose.)

Ppt. (E. F. Smith, *J. Am. Chem. Soc.* 1908, 30. 1651.)

$+ 2\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . Insol. in  $\text{NaOH} + \text{Aq.}$  (Santesson.)

$2\text{Na}_2\text{O}, 3\text{Cb}_2\text{O}_5 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or  $\text{NaOH} + \text{Aq.}$  (Santesson.)

$8\text{Na}_2\text{O}, 7\text{Cb}_2\text{O}_5$ . 1 pt. is sol. in 195–200 pts.  $\text{H}_2\text{O}$  at 14–20°; in ether 75–80 pts. or in 103 pts. boiling water. (Rose.)

$7\text{Na}_2\text{O}, 6\text{Cb}_2\text{O}_5 + 32\text{H}_2\text{O}$ . Very stable. Sol. in  $\text{H}_2\text{O}$ . (Bedford, *J. Am. Chem. Soc.* 1905, 27. 1217.)

**Thorium columbate,  $5\text{Th}_2\text{O}_3, 16\text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larson, *Z. anorg.* 1896, 12. 202.)

**Yttrium columbate,  $\text{Y}_2\text{O}_3, \text{Cb}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ . (Joly, *C. R.* 81. 1261.)

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larson.)

**Zinc columbate,  $\text{ZnO}, \text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larson.)

$7\text{ZnO}, 6\text{Cb}_2\text{O}_5 + 25\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Bedford, *J. Am. Chem. Soc.* 1905, 27. 1218.)

**Zirconium columbate,  $\text{ZrO}_2, 5\text{Cb}_2\text{O}_5$ .**

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ ; insol. in most acids; decomp. by  $\text{HKSO}_4$  at red heat. (Larson.)

**Percolumbic acid.**

See Percolumbic acid.

**Columbium (Niobium),  $\text{Cb}$ .**

Scarcely attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia. Conc.  $\text{H}_2\text{SO}_4$  dissolves easily on warming.

Sol. in fused oxidizing agents; sol. in hot conc.  $\text{H}_2\text{SO}_4$  and in  $\text{HF}$ ; also in  $\text{HF} + \text{HNO}_3$ ; insol. in other acids. (Moissan, *C. R.* 1901, 133. 24.)

**Columbium pentabromide,  $\text{CbBr}_5$ .**

(Rose, *Pogg.* 104. 422.)

**Columbium carbide nitride,  $3\text{CbC}, 2\text{CbN}$ .**

(Joly, *Bull. Soc.* (2) 25. 506.)

**Columbium trichloride,  $\text{CbCl}_3$ .**

Not deliquescent; not attacked by  $\text{H}_2\text{O}$ , but easily oxidised by  $\text{HNO}_3 + \text{Aq.}$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Rosece, *C. N.* 37. 25.)

**Columbium pentachloride,  $\text{CbCl}_5$ .**

Decomp. by  $\text{H}_2\text{O}$  with separation of a hydrate of  $\text{Cb}_2\text{O}_5$ . Sol. in cold  $\text{HCl} + \text{Aq.}$  forming a solution which soon gelatinises, and separates out  $\text{Cb}_2\text{O}_5$  by heat or dilution; with hot  $\text{HCl} + \text{Aq.}$  forms a cloudy solution which does not gelatinise. Sol. in  $\text{H}_2\text{SO}_4$  to form a clear liquid which gelatinises on heating. Sol. in  $\text{KOH} + \text{Aq.}$  Sol. in alcohol with slight residue. (Rose, *Pogg.* 104. 432.)

**Columbium pentafluoride,  $\text{CbF}_5$ .**

Very hygroscopic; sol. in  $\text{H}_2\text{O}$  without separation of columbic acid. (Ruff, *B.* 1909, 42. 492.)

**Columbium fluoride with  $\text{MF}$ .**

See Fluocolumbate,  $\text{M}$ .

**Columbium hydride,  $\text{CbH}(\text{?})$ .**

Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  even on boiling. Sol. in boiling conc.  $\text{H}_2\text{SO}_4$  and in fused  $\text{KHSO}_4$ . Sol. in cold  $\text{HF} + \text{Aq.}$  if not too dilute. Also attacked by  $\text{KOH} + \text{Aq.}$  (Marignac, *N. Arch. Phys. Nat.* 31. 89.) Not attacked by boiling  $\text{H}_2\text{O}$ , or boiling  $\text{HCl}$ .

Oxidized by hot  $\text{H}_2\text{SO}_4$ . Insol. in boiling  $\text{HNO}_3$ . (Muthmann, *A.* 1907, 355. 90.)

**Columbium hydroxide  $\text{Cb}_2\text{O}_5, x\text{H}_2\text{O}$ .**

See Columbic acid.

**Columbium nitride.**

Not attacked by boiling nitric acid or aqua regia, but sol. in a cold mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Rose, Pogg. 111. 426.)

$\text{Cb}_2\text{N}_3$ . Not attacked by boiling  $\text{H}_2\text{O}$  or  $\text{HCl}$ . Insol. in conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ .

Decomp. by fused  $\text{KOH}$ . Not attacked by boiling with  $\text{KOH} + \text{Aq.}$  (Muthmann, A. 1907, 355. 94.)

**Columbium dioxide,  $\text{Cb}_2\text{O}_3$ .**

Sol. when still moist in boiling dil.  $\text{HCl} + \text{Aq.}$  Insol. in hot  $\text{HNO}_3$ ; less sol. in aqua regia than in  $\text{HCl} + \text{Aq.}$  Sol. in conc.  $\text{H}_2\text{SO}_4$  after long heating. (Rose.)

Insol. in  $\text{H}_2\text{O}$ ,  $\text{KOH}$ , or conc. acids, even when boiling. (Delafontaine.)

**Columbium trioxide,  $\text{Cb}_2\text{O}_3$ .**

Insol. in acids except  $\text{HF}$ . (Smith, Z. anorg. 1894, 7. 28.)

**Columbium tetroxide,  $\text{Cb}_2\text{O}_4$ .**

Not attacked by cold or hot  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or aqua regia. Slightly attacked by boiling  $\text{KOH} + \text{Aq.}$  (Delafontaine.)

**Columbium pentoxide,  $\text{Cb}_2\text{O}_5$ .**

When ignited insol. in hot conc.  $\text{H}_2\text{SO}_4$ . When it has not been ignited it forms a clear solution with  $\text{H}_2\text{SO}_4$ , which can be diluted without forming any precipitate. (Rose, Pogg. 112. 549.)

Sol. in fused  $\text{KHSO}_4$ , which can be diluted with  $\text{H}_2\text{O}$  without causing pptn. Insol. in  $\text{HF}$ .

**Columbium oxybromide,  $\text{CbOBr}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{Cb}_2\text{O}_3$  and  $\text{HBr}$ . Sol. in hot  $\text{H}_2\text{SO}_4$  and conc.  $\text{HCl} + \text{Aq.}$  (Rose, Pogg. 104. 442.)

$3\text{H}_2\text{O}$ ,  $\text{Cb}_2\text{O}_4$ ,  $\text{HBr}(\text{?})$ . Easily sublimed. (Smith, Z. anorg. 1894, 7. 97.)

**Columbium oxybromide rubidium bromide,  $\text{CbOBr}_3$ ,  $2\text{RbBr}$ .**

Unstable in moist air. Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1903, 39. 3059.)

**Columbium oxychloride,  $\text{CbOCl}_3$ .**

Attracts  $\text{H}_2\text{O}$  from air without deliquescing and decomposed. Decomp. with  $\text{H}_2\text{O}$  with evolution of heat. Insol. in hot or cold  $\text{HCl} + \text{Aq.}$  Sol. by long contact with  $\text{H}_2\text{SO}_4$  to a cloudy liquid, which clears up on warming, but soon separates out  $\text{Cb}_2\text{O}_3$ . Sol. in cold  $\text{KOH} + \text{Aq.}$  and hot  $\text{K}_2\text{CO}_3 + \text{Aq.}$  (Rose.)

Sol. in alcohol, from which it is precipitated by ether. (Blomstrand.)

$3\text{H}_2\text{O}$ ,  $\text{Cb}_2\text{O}_4$ ,  $\text{HCl}$ . Sublimate. (Smith, Z. anorg. 1894, 7. 97.)

**Columbium oxychloride rubidium chloride,  $\text{CbOCl}_3$ ,  $2\text{RbCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1906, 39. 3057.)

**Columbium oxyfluoride,  $\text{CbOF}_3$ .**

(Joly, C. R. 81. 1266.)

**Columbium oxyfluoride with MF.**

See Fluoxycolumbate, and Fluoxyhypocolumbate, M.

**Columbium oxysulphide,  $\text{Cb}_2\text{OS}_3$ .**

Insol. in boiling  $\text{HCl} + \text{Aq.}$  Slowly decomp. into  $\text{Cb}_2\text{O}_3$  by boiling with  $\text{HNO}_3$  or aqua regia. Insol. in boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Converted into columbic sulphate, sol. in  $\text{H}_2\text{O}$ , by boiling conc.  $\text{H}_2\text{SO}_4$ . Sl. sol. in hot  $\text{HF}$ . Insol. in boiling  $\text{K}_2\text{S} + \text{Aq.}$  (Rose, Pogg. 111. 193.)

**Copper, Cu.**

Copper is not attacked by distilled  $\text{H}_2\text{O}$ , or by  $\text{NH}_4\text{NO}_3$ ,  $\text{KNO}_3$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  or by a mixture of those salts in solution. (Muir, cited by Carnelly, Chem. Soc. 30. 1.)

Distilled  $\text{H}_2\text{O}$  has slight action on Cu. 100 ccm.  $\text{H}_2\text{O}$  dissolved from 2 sq. dem. Cu from 0.035 mg. Cu in one hour up to 0.280 mg. in 72 hours. 100 ccm.  $\text{H}_2\text{O}$  dissolved 0.44 mg. from 6 sq. dem. in 48 hours. Presence of solder diminishes solubility about one-half. At 90–100° the amount dissolved is about one-half that at ord. temp. (Carnelly, Chem. Soc. 30. 1.)

100 ccm. distilled  $\text{H}_2\text{O}$  dissolved only 1 mg. Cu from 11.8 sq. cm. during a week, while air free from  $\text{CO}_2$  was conducted through the solution. When the air contained  $\text{CO}_2$ , 3 mg. were dissolved. (Wagner, Dingl. 221. 259.)

100 l. sea water dissolved 12.96 g. Cu from 1 sq. m. (Calvert and Johnson, C. N. 11. 171.)

**Solubility in  $\text{H}_2\text{SO}_4$ .**

Not attacked by dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Vogel, Schw. J. 32. 301.)

Action of  $\text{H}_2\text{SO}_4$  at ordinary temp. is very slight even after a long time. (Barruel, J. Pharm. 20. 13 [1834].)

$\text{H}_2\text{SO}_4$  has no action below 130°. (Calvert and Johnson, Chem. Soc. 19. 438.)

$\text{H}_2\text{SO}_4$  acts slightly even at 20°. 16.3 g.  $\text{H}_2\text{SO}_4$  (1.843 sp. gr.) dissolved the following amts. from 3 g. Cu, having a surface of 65 sq. cm. at the given temp.

Temp.	Time	% Cu dissolved
19°	14 days	About 6
60	120 min.	2.5
80	30 "	1.5
100	30 "	3.1
124	30 "	22.7
130	30 "	32.6
137	30 "	35.0
150	30 "	69.2
170	10 "	51.92
195	2 "	53.5
220	½ "	70.57
270	few seconds	nearly 100

With dilute acid the action was much less violent, as is seen in the following table—

Tem.	Time	Acid	Sp. gr.	% Cu dissolved
100°	30 min.	H <sub>2</sub> SO <sub>4</sub>	1.843	2.380
100	30 "	2H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.8295	0.585
100	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.780	0
100	30 "	H <sub>2</sub> SCl <sub>4</sub> , 2H <sub>2</sub> O	1.620	0
130	30 "	H <sub>2</sub> SO <sub>4</sub>	1.843	32.6
130	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.780	1.18
130	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1.620	0
165	15 "	H <sub>2</sub> SO <sub>4</sub>	1.843	70
165	30 "	H <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O	1.780	16.5
165	30 "	H <sub>2</sub> SO <sub>4</sub> , 2H <sub>2</sub> O	1.620	2.7

(Pickering, Chem. Soc. 33. 112.)

Cu is very sl. attacked by cold HCl+Aq of 1.12 sp. gr., but somewhat more on warming. Even less sol. in dil. HCl+Aq. (Löwe, Z. anal. 4. 361.)

Sol. in warm conc. HI+Aq. (Rose.)

Slowly attacked by H<sub>2</sub>SO<sub>4</sub>+Aq. (Causse, Bull. Soc. (2) 45. 3.)

More or less sol. in all dil. mineral acids and also in organic acids, as acetic, tartaric, etc., when supply of air is afforded; but absolutely insol. in the latter acids when air is wholly excluded. The importance of this fact in the use of Cu cooking utensils is manifest.

Easily attacked by ord. HNO<sub>3</sub>+Aq.

With very conc. HNO<sub>3</sub>+Aq (sp. gr. 1.52) it becomes passive, as in the case of Fe.

Pure dil. HNO<sub>3</sub>+Aq of 1.07 sp. gr. or less does not attack Cu at 20°, but if NO<sub>2</sub> or KNO<sub>3</sub> is added the action begins at once. If HNO<sub>3</sub>+Aq is more conc. the Cu is attacked. HNO<sub>3</sub>+Aq of 1.108 sp. gr. begins to act at -2°, and of 1.217 sp. gr. at -10°.

HNO<sub>3</sub>+Aq of 1.512 sp. gr. attacks Cu violently at 20°, but action soon ceases on account of formation of a crust of Cu(NO<sub>3</sub>)<sub>2</sub>, insol. in pure HNO<sub>3</sub>. (Millon, A. ch. (3) 6. 95.)

Easily sol. in 2N-HClO<sub>4</sub>+Aq at 50°. (Hendrixson, J. Am. Chem. Soc. 1904, 26. 756.)

Not appreciably sol. in anhydrous HF. (Poulenc, A. ch. 1894, (7) 2. 12.)

When in contact with the air, Cu is soon oxidised by acids, alkalies (especially NH<sub>4</sub>OH +Aq), and many fatty bodies.

Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. (Traube, B. 18. 1887.)

Slowly sol. in NH<sub>4</sub>OH+Aq. (Schönbein, B. A. B. 1856. 580.)

Sol. in KI+Aq when warm and conc. (Rose.)

When finely divided, Cu is easily sol. in hot FeCl<sub>3</sub>+Aq.

Action of dilute solutions of salts on solubility of Cu in H<sub>2</sub>O.

100 ccm. solution of the following salts dissolve the amts. of Cu given below, from a surface of 1 sq. decm. in 48 hours.

Salts	G. salt dissolved in 100 ccm. H <sub>2</sub> O	Mg. Cu dissolved
H <sub>2</sub> O	....	0.11
KNO <sub>3</sub> {	0.01 0.05 5.00	0.07 0.13 0.16
NaNO <sub>3</sub> {	0.05 5.00	0.18 0.19
CaSO <sub>4</sub>	0.05	0.11
K <sub>2</sub> SO <sub>4</sub> {	0.05 5.00	0.12 0.28
MgSO <sub>4</sub> {	0.05 5.00	0.16 0.34
Na <sub>2</sub> CO <sub>3</sub> {	0.01 0.05 5.00	0.05 0.11 2.80
K <sub>2</sub> CO <sub>3</sub> {	0.05 5.00	0.14 2.35
NaCl {	0.01 0.05 5.00	0.05 0.18 7.50
KCl	5.00	8.17
(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> {	0.05 5.00	0.66 28.50
NH <sub>4</sub> NO <sub>3</sub> {	0.01 0.05 5.00	0.17 0.66 60.00
NH <sub>4</sub> Cl {	0.05 5.00	0.92 158.75

At 100° the action of KNO<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub>, and NH<sub>4</sub>NO<sub>3</sub> is diminished, while that of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>, and NaCl is increased.

Tables are also given for mixtures of the above salts. (Carnelley, Chem. Soc. 30. 1.)

Solubility of Cu in dilute salt solutions.

11.8 sq. cm. Cu were used, and the action continued one week, while air with or without CO<sub>2</sub> was passed through the solution continually.

100 ccm. solution of the following salts dissolved the given amts. Cu.

Salt	G. salt dissolved in 100 ccm. H <sub>2</sub> O	Mg. Cu dissolved without CO <sub>2</sub>	Mg. Cu dissolved with CO <sub>2</sub>
NaCl	0.50	4	115
KCl	0.50	4	115
MgCl <sub>2</sub>	0.83	5	112
NH <sub>4</sub> Cl	1.00	904	138
K <sub>2</sub> SO <sub>4</sub>	1.00	0	4
KNO <sub>3</sub>	1.00	0	3
Na <sub>2</sub> CO <sub>3</sub>	1.00	0	...
NaOH	0.923	0	...
CaO, H <sub>2</sub>	sat.	0	...

(Wagner, Dingl. 221. 260.)

Distilled H<sub>2</sub>O dissolved no Cu from 420 sq. mm. in 150 hours at ord. temp.

NH<sub>4</sub>NO<sub>3</sub>+Aq with less than 0.4 g. per litre showed the same result.

KNO<sub>3</sub>+Aq or (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq containing 0.1 to 0.2 g. per litre dissolved no Cu.

H<sub>2</sub>O containing carbonates+nitrates, carbonates+sulphates, or chlorides+nitrates also dissolved no Cu.

NH<sub>4</sub>NO<sub>3</sub>+Aq containing 0.4 g. per litre dissolved 3 mg. per litre after 150 hours contact.

From a surface of 2100 sq. m. of Cu, H<sub>2</sub>O charged with CO<sub>2</sub> at ord. pressure, and containing the following salts in solution, dissolved the given amts. Cu. in 120 hours.

Salt	G. salt dissolved in 1 l. H <sub>2</sub> O	Mg. Cu dissolved
H <sub>2</sub> O	....	1.0
K <sub>2</sub> CO <sub>3</sub>	0.2	0.2
CaCl <sub>2</sub>	0.2	1.80
NH <sub>4</sub> NO <sub>3</sub>	0.02	1.40
NH <sub>4</sub> NO <sub>3</sub>	0.04	1.40
K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub>	0.1	1.00
NH <sub>4</sub> NO <sub>3</sub>	0.02	
K <sub>2</sub> CO <sub>3</sub> + NH <sub>4</sub> NO <sub>3</sub>	0.2	
NH <sub>4</sub> NO <sub>3</sub>	0.04	0.1
NH <sub>4</sub> NO <sub>3</sub> + CaCl <sub>2</sub>	0.2	
	0.2	3.6

From a surface of 2100 sq. m., H<sub>2</sub>O charged with CO<sub>2</sub> at pressure of 6 atmos. dissolved 0.6 mg. in 48 hours.

H<sub>2</sub>O when charged with CO<sub>2</sub> at 6 atmos. and containing:

16 mg. NH<sub>4</sub>NO<sub>3</sub> per litre, dissolved 0.8 mg. in 48 hours.

80 mg. NH<sub>4</sub>NO<sub>3</sub> per litre, dissolved 1.4 mg. in 48 hours.

40 mg. K<sub>2</sub>CO<sub>3</sub> per litre, dissolved 1.2 mg in 48 hours. (Muir, Proc. Soc. Manchester, 15. 31.)

Sol. in KCN+Aq. (Goyder, C. N. 1894, 69. 262.)

A solution of (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub> containing 0.829 g.

in 110 cc. dissolves 0.2050-0.2279 g. Cu. (Turrentine, J. phys. Chem. 1907, 11. 625.)

Sl. attacked by liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

Amts. Cu dissolved by action of various oils on 8 sq. in. Cu by 10 days' exposure and subsequent 67 days—

	Amt. Cu dissolved in 10 days	Amt. Cu dissolved in subsequent 67 days
Linseed oil	0.3000 grain	0.2435 grain
Olive oil	0.2200 "	0.0200 "
Colza oil	0.0170 "	0.1230 "
Almond oil	0.1030 "	0.1170 "
Seal oil	0.0485 "	0.0315 "
Sperm oil	0.0030 "	0.0575 "
Castor oil	0.0065 "	0.0035 "
Neatsfoot oil	0.1100 "	....
Sesame oil	0.1700 "	0.0015 "
Paraffine oil	0.0015 "	....

(Watson, C. N. 36. 200.)

Qualitative results of the action of various oils on Cu are also given by Thompson. (C. N. 34. 176, 200, 219.)

½ ccm. oleic acid dissolves 0.0157 g. Cu in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

Sol. in an alkaline solution of gelatine (3.54 %) copper gauze dissolved in 48 hours. (Lidoff, C. C. 1899, II. 471.)

#### Cuprous acetylde, Cu<sub>2</sub>C<sub>2</sub>.

Decomp. by heating with H<sub>2</sub>O or KCN+Aq. Decomp. by HNO<sub>3</sub>. (Keiser, Am. Ch. J. 1892, 14. 289.)

Not decomp. by H<sub>2</sub>SO<sub>4</sub>, NH<sub>4</sub>OH, KOH + Aq or acetic acid, even on warming. The dry salt is sol. in very dil. HCl+Aq without evolution of gas. Sol. in conc. KCN+Aq. (Böttger, A. 1859, 109. 356.)

#### Cupric acetylde, CuC<sub>2</sub>.

Easily sol. in HCl. Turns brown in the air, and becomes insol. in acids. (Phillips, Z. anorg. 1894, 6. 241.)

3Cu<sub>2</sub>C<sub>2</sub>O+2H<sub>2</sub>O. Solubility as that of Cu<sub>2</sub>C<sub>17</sub>H<sub>4</sub>O<sub>8</sub>. (Söderbaum, B. 1897, 30. 764.)

Cu<sub>2</sub>C<sub>17</sub>H<sub>4</sub>O<sub>8</sub>. Insol. in H<sub>2</sub>O. When dry is violently decomp. by conc. H<sub>2</sub>SO<sub>4</sub> or not too dil. HNO<sub>3</sub>. Rapidly decomp. by warming with dil. acids, especially HCl.

Insol. in NH<sub>4</sub>OH+Aq in absence of air, partially sol. in presence of air.

Insol. in organic solvents. (Söderbaum, B. 1897, 30. 762.)

#### Cuprous acetylde iodide, Cu<sub>2</sub>C<sub>2</sub>I, CuI.

Ppt. (Berthelot and Delépine, A. ch. 1900, (7) 19. 54.)

**Cupric arsenide,  $\text{Cu}_3\text{As}_2$ .**(Reinsch, J. pr. **24**. 244.) $\text{Cu}_3\text{As}_2$ . (Gehlen.) $\text{Cu}_3\text{As}_2$ . Ppt. Decomp. by acids. (Kane, Pogg. **44**. 471.) $\text{Cu}_3\text{As}_2$ . Min. *Domeykite*. Insol. in  $\text{HCl}$  + Aq; sol. in  $\text{HNO}_3$ . $\text{Cu}_3\text{As}_2$ . Min. *Algodonite*. $\text{Cu}_3\text{As}_2$ . Min. *Darwinite*.**Cuprous azoimide,  $\text{CuN}_3$ .**Insol. in  $\text{H}_2\text{O}$ . (Curtius.)Sensitive to sunlight. (Wöhler, B. 1913, **46**. 2053.)**Cupric azoimide, basic,  $\text{CuO}$ ,  $\text{CuN}_3$ .**Insol. in  $\text{H}_2\text{O}$ . (Wöhler, B. 1913, **46**. 2055.)**Cupric azoimide,  $\text{CuN}_3$ .**

Very explosive.

Very sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2) **58**. 296.)**Copper azoimide ammonia,  $\text{CuN}_3$ ,  $2\text{NH}_3$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Dennis, J. Am. Chem. Soc. **1907**. 29, 19.)**Copper boride,  $\text{Cu}_2\text{B}_3$ .**(Marsden, J. B., **1880**. 330.)**Cuprous bromide,  $\text{Cu}_2\text{Br}_2$ .**1 l.  $\text{H}_2\text{O}$  dissolves at  $18^\circ\text{--}20^\circ$ :

0.4320 millimols bromine.

0.3157 " cupric copper.

0.1061 " cuprous copper.

(Bodländer, Z. anorg. 1902, **31**. 460.)Sol. in  $\text{HBr}$ ,  $\text{HCl}$  without decomp., or  $\text{HNO}_3$  + Aq with decomp., also in  $\text{NH}_4\text{OH}$  + Aq. Insol. in boiling conc.  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. (Berthelot, A. ch. **44**. 385.)Sol. in  $\text{H}_2\text{SO}_4$  + Aq. (Lean and Whatmough, Chem. Soc. 1898, **73**. 151.)Sol. in  $\text{NaCl}$  and  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq. (Renault, C. R. **59**. 319.)Solubility of  $\text{Cu}_2\text{Br}_2$  in  $\text{KBr}$  + Aq.  
All values recorded in millimols per litre.

KBr	Total copper	Cupric copper	Cuprous copper
25	0.119	0.012	0.107
40	0.200	0.013	0.187
60	0.310	0.025	0.285
80	0.423	0.012	0.411
100	0.5836	...	0.5836
120	0.6934	...	0.6934
500	8.719	...	8.719

(Bodländer and Storbeck, Z. anorg. 1902, **31**. 462.)Difficultly sol. in methyl acetate. (Naumann, B. 1909, **42**. 3790.)Sol. in ethyl acetate. (Naumann, B. 1910, **43**. 314.)Insol. in acetone. (Naumann, B. 1904, **37**. 4329; Eidmann, C. C. **1897**, II. 1014.)100 g. acetonitrile dissolve 3.86 g.  $\text{Cu}_2\text{Br}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, **47**. 249.)Sol. in pyridine. (Naumann, B. 1904, **37**. 4609.)Mol. weight determined in pyridine, methyl and ethyl sulphides. (Werner, Z. anorg. 1897, **15**. 19, 26, and 28.)**Cupric bromide,  $\text{CuBr}_2$ .**Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in benzene. (Franchimont, B. **16**. 387.)Very sl. attacked by cold or even hot  $\text{H}_2\text{SO}_4$ . (Viard, C. R. 1902, **135**. 169.)Moderately sol. in liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. **1908**, **39**. 219.)100 g. 95% formic acid dissolve 0.16 g. at  $21^\circ$ . (Aschan, Ch. Z. 1913, **37**. 1117.)100 g. acetonitrile dissolve 24.43 g.  $\text{CuBr}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, **47**. 249.)Sol. in benzonitrile. (Naumann, B. 1914, **47**. 1369.)Sol. in methyl acetate. (Naumann, B. 1909, **42**. 3790.)Sol. in acetone. (Naumann, B. 1904, **37**. 4328.)Sol. in acetone with a brown color. (Eidmann, C. C. **1899**, II. 1014.)+  $2\text{H}_2\text{O}$  (?). (Berthelot, A. ch. 1830, **44**. 385.)+  $4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Sabatier, Bull. Soc. 1894, (3) **11**. 677.)**Cupric hydrogen bromide,  $\text{CuBr}_2$ ,  $\text{HBr}$  +  $2\text{H}_2\text{O}$ .**Decomp. by  $\text{H}_2\text{O}$ . (Sabatier, Bull. Soc. 1894, (3) **11**. 681.)+  $10\text{H}_2\text{O}$ . (Weinland and Knöll, Z. anorg. 1905, **44**. 116.)**Cupric lithium bromide,  $\text{CuBr}_2$ ,  $2\text{LiBr}$  +  $6\text{H}_2\text{O}$ .**Very hygroscopic. (Sementschenko, Z. anorg. 1899, **19**. 336.)Very hygroscopic; decomp. by  $\text{H}_2\text{O}$ . (Kurnakoff, C. C. **1899**, I. 16.)**Cupric potassium bromide,  $\text{CuBr}_2$ ,  $\text{KBr}$ .**Decomp. by  $\text{H}_2\text{O}$ . (Sabatier, Bull. Soc. 1894, (3) **11**. 683.)**Cuprous bromide ammonia,  $\text{Cu}_2\text{Br}_2$ ,  $2\text{NH}_3$ .**

Stable when dry.

Easily sol. in  $\text{HNO}_3$  and  $\text{NH}_4\text{OH}$  + Aq. Other mineral acids and acetic acid separate  $\text{Cu}_2\text{Br}_2$ . (Richards, Z. anorg. 1898, **17**. 245.) $\text{Cu}_2\text{Br}_2$ ,  $6\text{NH}_3$ . (Lloyd.) $\text{Cu}_2\text{Br}_2$ ,  $3\text{NH}_3$ . (Lloyd, J. phys. Chem. 1908, **12**. 399.)

**Cupric bromide ammonia,  $\text{CuBr}_2 \cdot 2\text{NH}_3$ .**

Sol. in  $\text{NH}_4\text{Br} + \text{Aq}$  without decomp. (Richards, B. 23. 3790.)

$3\text{CuBr}_2 \cdot 10\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Richards, Am. Ch. J. 15. 651.)

$\text{CuBr}_2 \cdot 3\text{NH}_3$ . Completely sol. in a little  $\text{H}_2\text{O}$ , but is decomp. by dilution. Insol. in alcohol. (Rammelsberg, Pogg. 55. 246.)

$\text{CuBr}_2 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 69.03 pts.  $\text{CuBr}_2 \cdot 4\text{NH}_3$  at  $25^\circ$ . (Pudschies, Dissert.)

$\text{CuBr}_2 \cdot 5\text{NH}_3$ . As above. (Rammelsberg.)

$\text{CuBr}_2 \cdot 6\text{NH}_3$ . Sol. in small amts. of  $\text{H}_2\text{O}$ , but decomp. on dilution. (Richards.)

**Cupric bromide nitric oxide,  $\text{CuBr}_2 \cdot \text{NO}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Manchot, B. 1914, 47. 1607.)

**Cuprous chloride,  $\text{Cu}_2\text{Cl}_2$ .**

1.53 g.  $\text{Cu}_2\text{Cl}_2$  dissolve in 100 g.  $\text{H}_2\text{O}$  at  $21.5^\circ$ ; 1.55 g. at  $26.5^\circ$ . (Kremann and Noss, M. 1912, 33. 1206.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{H}_2\text{O}$  in an atmosphere of hydrogen.

Solubility is recorded in mg-atoms per l.

$t^\circ$	Total Cu	$\text{CuCl}_2$ by analysis	Cl	$\text{Cu}_2\text{Cl}_2$ calc.	$\text{Cu}_2\text{Cl}_2$ by analysis
...	2.752	2.124	5.672	0.628	...
20.2	2.919	2.254	5.525	0.665	0.420
19.6	2.971	2.294	5.464	0.677	0.474
19.3	2.861	2.245	5.464	0.616	0.499

(Bodländer, Z. anorg. 1902, 31. 12.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{H}_2\text{O}$  in an atmosphere of  $\text{CO}_2$ .

Solubility is recorded in mg-atoms per l.

$t^\circ$	Total Cu	$\text{CuCl}_2$ by analysis	Cl	$\text{Cu}_2\text{Cl}_2$ by analysis	$\text{Cu}_2\text{Cl}_2$ calc.
20.6	2.818	...	5.235	0.525	...
21.7	2.805	2.243	5.430	0.516	0.562
...	2.880	2.258	5.312	0.391	0.662
19.7	2.805	2.138	5.390	0.336	0.667

(Bodländer, l. c.)

Sol. in conc.  $\text{HCl} + \text{Aq}$ ; insol. in dil.  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , and only sl. on warming. (Rosenfeld, B. 12. 954.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in hot  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{FeCl}_3$ ,  $\text{ZnCl}_2$ ,  $\text{MnCl}_2$ , etc. +  $\text{Aq}$ . 1 mol.  $\text{Na}_2\text{S}_2\text{O}_3$  in aqueous solution dissolves 1 mol.  $\text{Cu}_2\text{Cl}_2$ . (Winkler, J. pr. 33. 428.) Sol. in  $\text{KI}$ ,  $\text{I}_2$ ,  $\text{KCN}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Renault, C. R. 59. 558.)

Solubility in  $\text{HCl} + \text{Aq}$  at  $17^\circ$ .  $\frac{\text{Cu}_2\text{Cl}_2}{2} =$   
 $\frac{1}{2}$  mols.  $\text{CuCl}_2$  in mgs. in 10 ccm. solution.  $\text{HCl} =$  mols.  $\text{HCl}$  in ditto.

$\frac{\text{Cu}_2\text{Cl}_2}{2}$	$\text{HCl}$	Sp. gr.
0.475	8.975	1.050
1.4	15.7	...
1.575	18.2	...
4.5	34.5	1.080
8.25	47.8	1.135
11.5	57.0	...

(Chatelier, calc. by Engel, A. ch. (6) 17. 377.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{HCl} + \text{Ac}$  at  $0^\circ$ .

$\frac{\text{Cu}_2\text{Cl}_2}{2}$	$\text{HCl}$	Sp. gr.
1.5	17.5	1.049
2.9	26.0	1.065
8.25	44.75	1.132
15.5	68.5	1.261
33.0	104.0	1.345

(Engel, l. c.)

Freshly pptd.  $\text{Cu}_2\text{Cl}_2$  is sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$ . (Lean and Whatmough, Chem. Soc. 1898, 73. 150.)

Sl. sol. in normal  $\text{NH}_4\text{OH} + \text{Aq}$  only by shaking several hours, a 0.02 normal solution of cuprous copper being obtained. (Gaus, Z. anorg. 1900, 25. 258.)

Insol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Siewert, Gm. K. 5. 1, 893.)

Sol. in alkyl triphosphites. (Arbusoff, C. C. 1906, II. 750.)

Solubility in  $\text{FeCl}_3$ ,  $4\text{H}_2\text{O} + \text{Aq}$  at  $21.5^\circ$ .

In 100 g. $\text{H}_2\text{O}$		Solid phase
g. $\text{FeCl}_3$	g. $\text{Cu}_2\text{Cl}_2$	
...	1.535	$\text{Cu}_2\text{Cl}_2$
6.015	1.33	"
11.62	1.81	"
16.30	3.11	"
26.305	7.125	"
29.35	8.06	"
33.125	9.565	"
43.75	12.44	"
54.00	17.04	"
66.40	21.60	"
73.20	23.20	$\text{Cu}_2\text{Cl}_2 + \text{FeCl}_3 \cdot 4\text{H}_2\text{O}$
71.895	21.655	$\text{FeCl}_3 \cdot 4\text{H}_2\text{O}$
69.34	11.895	"
65.10	...	"

(Kremann and Noss, M. 1912, 33. 1208.)



Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ . Determined in an atmosphere of  $\text{CO}_2$ .

$t^\circ$	g. mol. $\text{KCl}$ per l.	g. atoms $\text{Cu}$ per l.
18.3	0.05	0.002411
16	0.1	0.004702
16	0.2	0.009458
19.2	1.0	0.0970
16.4	2.0	0.3840

(Bodländer and Storbeck, Z. anorg. 1902, 31. 17.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ . Determined in an atmosphere of  $\text{CO}_2$ . All values recorded in millimols per litre.

$t^\circ$	$\text{KCl}$	Cupric copper	Total copper	Cuprous copper calc.	$\text{Cl}$
20°	0	2.222	2.851	0.629	5.436
19	1	1.901	2.385	0.484	5.287
19	2	1.571	2.150	0.589	5.614
19	2.5	1.421	1.955	0.534	6.015
19	3	1.523	1.983	0.460	6.247
16	5	1.008	1.522	0.514	7.525
18	10	0.475	1.236	0.761	11.735
20	15	0.322	1.344	1.022	16.437
19	20	0.324	1.446	1.122	21.356
19	30	0.1308	1.761	1.630	31.911
18	50	0.1088	2.411	2.302	...
16	100	0	4.702	4.702	...
16	200	0	9.485	9.485	...
19	1000	0	97.0	97.0	...
16	2000	0	384.0	384.0	...

(Bodländer and Storbeck, Z. anorg. 1902, 31. 24.)

Solutions of 0.05 = 0.4 normal  $\text{KCl}$  dissolve  $\text{Cu}_2\text{Cl}_2$  with the formation of  $\text{KCuCl}_2$ ; those of higher concentration with the formation of  $\text{K}_2\text{CuCl}_4$ . (Bodländer and Storbeck, Z. anorg. 1902, 31. 41.)

Solubility of  $\text{Cu}_2\text{Cl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $22^\circ$ .

G. in 1 g. of solution		Solid Phase
$\text{Cu}_2\text{Cl}_2$	$\text{KCl}$	
0.00115	0.0387	$\text{Cu}_2\text{Cl}_2$
0.00405	0.0656	"
0.00861	0.0824	"
0.0137	0.0984	"
0.0219	0.1133	"
0.0390	0.1406	"
0.0484	0.1530	"
0.0675	0.1639	"
0.0719	0.1747	"
0.0863	0.1839	"
0.1043	0.2027	"
0.1084	0.2018	"
0.1021	0.2031	"
0.1204	0.2095	"
0.1332	0.2164	"

Solubility of  $\text{Cu}_2\text{Cl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $22^\circ$ .—  
*Continued*

G. in 1 g. of solution		Solid Phase
$\text{Cu}_2\text{Cl}_2$	$\text{KCl}$	
0.1621	0.2330	$\text{Cu}_2\text{Cl}_2$
0.1723	0.2384	"
0.1907	0.2374	"
0.2148	0.2516	"
0.2145	0.2506	$\text{Cu}_2\text{Cl}_2 + \text{Cu}_2\text{Cl}_2, 4\text{KCl}$
0.2149	0.2549	$\text{Cu}_2\text{Cl}_2, 4\text{KCl}$
0.1548	0.2387	"
0.1473	0.2363	"
0.1399	0.2357	"
0.1439	0.2389	"
0.1451	0.2363	"
0.1165	0.2320	"
0.1139	0.2350	"
0.0953	0.2359	"
0.0735	0.2349	"
0.0555	0.2389	"
0.0463	0.2404	"
0.0366	0.2433	"
0.0314	0.2503	"
0.0285	0.2499	"
0.0265	0.2523	"
0.0220	0.2628	"
0.0193	0.2687	"
0.0176	0.2698	"
0.0193	0.2703	$\text{Cu}_2\text{Cl}_2, 4\text{KCl} + \text{KCl}$
0.0160	0.2706	$\text{KCl}$
0.0124	0.2668	"
0.0058	0.2632	"
0.0000	0.2568	"

(Brönsted, Z. phys. Ch. 1912, 80. 208.)

Solubility in  $\text{NaCl} + \text{Aq}$ .

Sat.  $\text{NaCl} + \text{Aq}$  dissolves 16.9 %  $\text{Cu}_2\text{Cl}_2$  at  $90^\circ$ ; 11.9 % at  $40^\circ$ ; and 8.9 % at  $11^\circ$ .

15 %  $\text{NaCl} + \text{Aq}$  dissolves 10.3 %  $\text{Cu}_2\text{Cl}_2$  at  $90^\circ$ ; 6.0 % at  $40^\circ$ ; and 3.6 % at  $14^\circ$ .

5%  $\text{NaCl} + \text{Aq}$  dissolves 2.6 %  $\text{Cu}_2\text{Cl}_2$  at  $90^\circ$ , and 1.1 % at  $40^\circ$ . (Hunt, Sill. Am. J. (2) 49. 154.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26.5^\circ$ .

In 100 g. $\text{H}_2\text{O}$		Solid phase
$\text{Cu}_2\text{Cl}_2$	$\text{NaCl}$	
1.55	...	$\text{Cu}_2\text{Cl}_2$
3.15	10.80	"
7.30	20.70	"
40.60	27.00	"
49.10	36.48	"
57.21	44.14	$\text{Cu}_2\text{Cl}_2 + \text{NaCl}$
41.40	55.95	$\text{NaCl}$
18.70	50.90	"

(Kremann and Noes, M. 1912, 33. 1210.)

Solubility of  $\text{Cu}_2\text{Cl}_2$  in  $\text{CuSO}_4 + \text{Aq}$  at  $t^\circ$ .  
Values recorded in millimols per l.

$t^\circ$	Conc. of $\text{CuSO}_4$	Cupric copper	Total copper	Cuprous copper calc.	Cl
19.7	...	2.258	2.880	0.622	5.312
16.3	0.49375	2.746	3.125	0.379	4.805
18.6	0.9875	3.145	3.602	0.457	4.908
17.5	1.4812	3.315	3.915	0.600	4.530
19.4	1.975	4.131	4.553	0.422	4.687
20.4	2.4687	4.349	4.786	0.437	4.287
20.5	2.9625	4.625	5.193	0.509	4.256
20.1	4.9375	6.546	7.276	0.730	4.329

(Bodländer and Storbeck, Z. anorg. 1902, 31, 22.)

Insol. in  $\text{SbCl}_3$ . (Klemensiewicz, Bull. Acad. Crac. 1908, 6, 485.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Insol. in alcohol.

Sl. sol. in ether. (Gehlen.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51, 236.)

Sol. in pyridine. (Schroeder, Dissert. 1901.)

Insol. in phosgene. (Eidmann, Dissert. 1899.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II, 1014.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Insol. in ethyl acetate. (Alexander, Dissert. 1899.) (Naumann, B. 1904, 37, 3601.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

100 g. acetonitrile dissolve 13.33 g.  $\text{Cu}_2\text{Cl}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, 47, 249.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol. in hot benzonitrile and other aromatic nitriles. (Werner, Z. anorg. 1897, 15, 7.)

Mol. weight determined in pyridine methyl and ethyl sulphides. (Werner, Z. anorg. 1897, 15, 19, 25 and 28.)

Min. Nantokite. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ .

Cupric chloride,  $\text{CuCl}_2$ .

Deliquescent. 100 pts.  $\text{H}_2\text{O}$  dissolve 70.6 pts.  $\text{CuCl}_2$  at  $0^\circ$ ; 100 pts.  $\text{CuCl}_2 + \text{Aq}$  contain 41.4 pts.  $\text{CuCl}_2$ . (Engel, A. ch. (6) 17, 350.)

100 pts.  $\text{H}_2\text{O}$  dissolve 76.2 pts.  $\text{CuCl}_2$  at  $16.1^\circ$ , or 100 pts.  $\text{CuCl}_2 + \text{Aq}$  sat. at  $16.1^\circ$  contain 43.25 pts.  $\text{CuCl}_2$ . (Rudorff, B. 6, 484.)

100 pts.  $\text{CuCl}_2 + \text{Aq}$  sat. at  $17^\circ$  contain 43.06 pts.  $\text{CuCl}_2$ ; at  $31.5^\circ$ , contain 44.7 pts.  $\text{CuCl}_2$ . Coefficient of solubility = 41.4 + 0.105t. (Reicher and Deventer, Z. phys. Ch. 5, 560.)

Sat.  $\text{CuCl}_2 + \text{Aq}$  contains at:

$-20^\circ$	$-5^\circ$	$+12^\circ$	$17^\circ$	$32^\circ$
37	38.8	39.3	41.7	43.2%
39	55	68	73	91%
44.0	46.5	47.9	43.6	51.0%

(Étard, A. ch. 1894, (7) 2, 536.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{CuCl}_2$	Sp. gr.	% $\text{CuCl}_2$	Sp. gr.
5	1.0455	25	1.2918
10	1.0920	30	1.3618
15	1.1565	35	1.4447
20	1.2223	40	1.5284

(Frans, J. pr. (2) 5, 274.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at  $22.9^\circ$ , containing in 1000 g.  $\text{H}_2\text{O}$ , g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .

85.5 ( $= \frac{1}{2}$  mol.) 171 255.5 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1.057 1.108 1.154

342 427.5 513 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1.197 1.238 1.275

598.5 684 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1.309 1.341

769.5 855 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1.371 1.399

940.5 1026 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ , 1.425 1.449

Containing  $\text{CuCl}_2$  (anhydrous).

67.5 ( $= \frac{1}{2}$  mol.) 135 202.5 270 g.  $\text{CuCl}_2$ , 1.059 1.114 1.165 1.213

337.5 405 472.5 g.  $\text{CuCl}_2$ , 1.257 1.299 1.30

540 607.5 675 g.  $\text{CuCl}_2$ , 1.379 1.416 1.453

(Gerlach, Z. anal. 28, 468.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at  $0^\circ$ . S = pts.  $\text{CuCl}_2$  in 100 pts. solution;  $S_1$  = mols.  $\text{CuCl}_2$  in 100 mols. of solution.

S	$S_1$	Sp. gr.
39.4170	8.00	1.4797
35.3839	6.82	1.4173
30.9255	5.65	1.3529
26.1129	4.51	1.2881
20.6697	3.36	1.2204
14.5820	2.23	1.1494
8.0732	1.16	1.0796

(Charpy, A. ch. (6) 29, 25.)

Tables for  $7^\circ$ ,  $30.5^\circ$ ,  $49.2^\circ$ , and  $65^\circ$  are also given by Charpy.

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at room temp., containing:

12.006 21.349 33.027%  $\text{CuCl}_2$ , 1.1037 1.2154 1.3312

(Wagner, W. Ann. 1883, 18, 273.)

Sp. gr. at 20° of  $\text{CuCl}_2 + \text{Aq}$  containing M. mols.  $\text{CuCl}_2$  per liter.

M.	0.01	0.05	0.075
Sp. gr.	1.001208	1.00637	1.009264
M.	0.10	0.20	0.50
Sp. gr.	1.012614	1.030991	1.051479
M.	0.75		1.0
Sp. gr.	1.090912		1.120249
M.	1.5		2.0
Sp. gr.	1.177618		1.234551

(Jones and Pearce, Am. Ch. J. 1907, 38. 717.)

Sp. gr. of  $\text{CuCl}_2 + \text{Aq}$  at 25°.

Concentration of $\text{CuCl}_2 + \text{Aq}$ .	Sp. gr.
1—normal	1.0624
$\frac{1}{2}$ —	1.0313
$\frac{1}{4}$ —	1.0158
$\frac{1}{8}$ —	1.0077

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Much less sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . 1 l.  $\text{HCl} + \text{Aq}$  containing 45 pts.  $\text{HCl}$  to 100 pts.  $\text{H}_2\text{O}$  dissolves only 290 g.  $\text{CuCl}_2$  at 12°, whereas 1 l.  $\text{H}_2\text{O}$  at 12° dissolves 630 g.  $\text{CuCl}_2$ . (Ditte, C. R. 1881, 92. 353.)

Solubility in  $\text{HCl} + \text{Aq}$  at 0°.  $\frac{\text{CuCl}_2}{2} =$

$\frac{1}{2}$  mols. in milligrammes in 10 ccm. solution.  $\text{HCl} =$  mols.  $\text{HCl}$  in ditto;  $\text{H}_2\text{O} =$  g.  $\text{H}_2\text{O}$ .

$\frac{\text{CuCl}_2}{2}$	$\text{HCl}$	Sum of equiv.	Sp. gr.	$\text{H}_2\text{O}$
91.75	0	91.75	1.490	8.73
86.8	4.5	91.3	1.475	8.74
83.2	7.8	91	1.458	....
79.35	10.5	89.85	1.435	8.64
68.4	20.25	88.65	1.389	8.56
50.0	37.5	87.5	1.319	8.47
22.8	70.25	93.05	1.231	8.21
23.5	102.5	126	1.288	7.56
26.7	128	154.7	1.323	6.77

(Engel, A. ch. (6) 17 351.)

Not decomp. by cold  $\text{H}_2\text{SO}_4$ .

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Very sol. in conc.  $\text{NaCl} + \text{Aq}$ . (Boussingault.)

Solubility of  $\text{CuCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at 30°.

% $\text{NH}_4\text{Cl}$	% $\text{CuCl}_2$	Solid phase
29.5	0	$\text{NH}_4\text{Cl}$
28.6	1.9	$\text{NH}_4\text{Cl} + \text{CuCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
12.1	15.6	$\text{CuCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
2.03	43.2	$\text{CuCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O} + \text{CuCl}_2, 2\text{H}_2\text{O}$
0	43.95	$\text{CuCl}_2, 2\text{H}_2\text{O}$

(Schreinemakers, Z. phys. Ch. 1909, 66. 688.)

See also  $\text{NH}_4\text{Cl} + \text{CuCl}_2$  under ammonium chloride.

Solubility of  $\text{CuCl}_2 + \text{HgCl}_2$  in  $\text{H}_2\text{O}$  at 35°.

% $\text{HgCl}_2$	% $\text{CuCl}_2$	Solid Phase
0	44.47	$\text{CuCl}_2, 2\text{H}_2\text{O}$
21.03	33.50	"
37.30	26.07	"
44.47	23.31	"
50.47	21.50	$\text{CuCl}_2 + \text{HgCl}_2$
52.44	19.40	$\text{HgCl}_2$
52.54	18.46	"
52.81	18.06	"
51.03	14.73	"
49.50	5.94	"
23.87	2.64	"
8.51	8.51	"

(Schreinemakers and Thonus, Proc. K. Akad. Wet. 1912, 15. 472.)

Solubility of  $\text{CuCl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at t°.

t°	Cl per g. of solution		Mols. per 100 mols. $\text{H}_2\text{O}$		
	As $\text{CuCl}_2$	As $\text{KCl}$	$\text{CuCl}_2$	$\text{KCl}$	
39.4	0.120	0.107	5.56	9.93	$\text{CuCl}_2, 2\text{KCl}, 2\text{H}_2\text{O} + \text{KCl}$
49.9	0.129	0.115	6.39	11.4	"
60.4	0.142	0.125	7.71	13.6	"
79.1	0.168	0.142	11.1	18.8	"
90.5	0.188	0.154	14.9	24.4	"
93.7	0.194	0.156	16.2	26.0	$\text{CuCl}_2, \text{KCl} + \text{KCl}$
98.8	0.197	0.162	17.5	28.7	"
0	0.214	0.021	9.84	1.94	$\text{CuCl}_2, 2\text{KCl}, 2\text{H}_2\text{O} + \text{CuCl}_2, 3\text{H}_2\text{O}$
39.6	0.232	0.049	12.9	5.44	"
50.1	0.233	0.059	13.7	6.90	"
52.9	0.241	0.062	14.8	7.63	"
60.2	0.246	0.066	15.8	8.49	$\text{CuCl}_2, \text{KCl} + \text{CuCl}_2, 2\text{H}_2\text{O}$
72.6	0.255	0.063	16.8	8.35	"
64.2	...	...	14.9	11.6	$\text{CuCl}_2, 2\text{KCl}, 2\text{H}_2\text{O} + \text{CuCl}_2, \text{KCl}$
72.5	...	...	14.8	1.50	$\text{CuCl}_2, \text{KCl}$

(Meyerhoffer, Z. phys. Ch. 1890, 5. 102.)

100 g.  $\text{H}_2\text{O}$  dissolve 72.6 g.  $\text{CuCl}_2 + 16.0$  g.  $\text{NaCl}$ . (Rudorff, B. 6. 684.)

Solubility of  $\text{CuCl}_2 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at 30°.

% $\text{NaCl}$	% $\text{CuCl}_2$	Solid Phase
0	43.95	$\text{CuCl}_2, 2\text{H}_2\text{O}$
3.10	41.14	"
4.28	41.06	"
6.41	39.40	"
10.25	36.86	$\text{CuCl}_2 + \text{NaCl}$
12.02	32.38	$\text{NaCl}$
12.25	32.40	"
13.54	28.64	"
15.40	23.72	"
18.44	16.98	"
20.61	11.03	"
26.47	0	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, 65. 586.)

Solubility of  $\text{CuCl}_2$  in  $\text{CuSO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase.
% by wt. $\text{CuCl}_2$	% by wt. $\text{CuSO}_4$	
0	20.32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
6.58	13.62	"
15.68	8.93	"
25.67	4.77	"
39.48	3.21	"
42.77	2.89	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
42.47	2.90	"
43.25	1.14	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.95	0	"

(Schreinemakers, Z. phys. Ch. 1909, 69, 561.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 827.)

Sl. sol. in liquid HF. (Franklin, Z. anorg. 1905, 46, 2.)

Sol. in alcohol and ether.

Sol. in 1 pt. strong alcohol.

100 pts. absolute methyl alcohol dissolve 68 pts.  $\text{CuCl}_2$  at  $15.5^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 53 pts.  $\text{CuCl}_2$  at  $15.5^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)See also under  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .Solubility of  $\text{CuCl}_2 + \text{KCl}$  in absolute alcohol at  $25^\circ$ .

% $\text{CuCl}_2$	% $\text{KCl}$	Solid Phase
1.27	0.28	$\text{KCl} + \text{KCl}, \text{CuCl}_2$
1.51	0.28	
2.15	....	
5.25	....	$\text{KCl}, \text{CuCl}_2$
30.16	....	"
34.17	0.21	$\text{KCl}, \text{CuCl}_2 + \text{CuCl}_2, \text{C}_2\text{H}_5\text{OH}$
34.45	0.21	
34.29	0.21	
33.97	0.00	$\text{CuCl}_2, \text{C}_2\text{H}_5\text{OH}$

(Foote and Walden, J. Am. Chem. Soc. 1911, 33, 1032.)

Solubility of  $\text{CuCl}_2 + \text{KCl}$  in acetone at  $25^\circ$ .

% $\text{CuCl}_2$	% $\text{KCl}$	Solid Phase
0.34	0.38	$\text{KCl} + \text{KCl}, \text{CuCl}_2$
0.48	....	
1.50	....	
2.06	....	"
2.49	0.27	$\text{KCl}, \text{CuCl}_2 + \text{CuCl}_2, \text{C}_2\text{H}_5\text{O}$
2.32	....	

(Foote and Walden, J. Am. Chem. Soc. 1911, 33, 1032.)

100 g. of sat. solution of  $\text{CuCl}_2$  in ethyl alcohol contains 33.97 g.  $\text{CrCl}_3$ . (Foote and Walden, J. Am. Chem. Soc. 1911, 33, 1032.)Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)  
Insol. in benzene.

## Solubility in organic solvents.

Solvent	$t^\circ$	Sat. solution contains % $\text{CuCl}_2$
Methyl alcohol	22	36.8
	40	37.5
	50	37.1
	60	37.5
Abs. ethyl alcohol	0	32.0
	19	35.7
	20	35.9
	38	38.5
	50	41.7
Propyl alcohol	-15	26.8
	19	30.9
	37	30.7
	57	30.3
	62	30.5
Allyl alcohol	-20	23.4
	-4	23.6
	27	22.9
	32	23.3
N-butyl alcohol	0	15.2
	23	15.8
	37	15.7
	55	16.1
	84	16.2
	92	16.7
Ethyl formate	-20	10.2
	+24	9.4
	37	7.4
	50	7.2
Ethyl acetate	+20	3.0
	40	2.5
	72	1.3
Acetone	-20	18.4
	+8	18.8
Isopropyl alcohol	32	11.0
	70	28.3
	84	28.7

(Étard, A. ch. 1894, (7) 2, 565.)

See also under  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .1 g.  $\text{CuCl}_2$  is sol. in 181 g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/4^\circ$  of the sat. solution = 0.939. (Naumann, B. 1909, 42, 3793.)1 g.  $\text{CuCl}_2$  is sol. in 249 g. ethyl acetate at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ$  = 0.9055. (Naumann, B. 1904, 37, 3603.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

1 pt. sol. in 249.3 pts. ethyl acetate at 10°.  
(Alexander, Dissert. 1899.)

Solubility in acetone.

34.7 g. acetone dissolve 1 g.  $\text{CuCl}_2$  at 18°.  
Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.8154$ . (Naumann, B. 1904, 37. 4329.)

1.40 pts. are sol. in 100 pts. acetone at 56°.  
(Lasscsynski, B. 1894, 27. 2287.)

Sol. in acetone and methylal. 1 gram. dissolves in 34.08 grams of acetone at 18°.  
(Eidmann, C. C. 1899, II, 1014.)

100 pts. absolute ether dissolve 0.043 g.  $\text{CuCl}_2$ . (Böttker, Z. phys. Ch. 1897, 22. 511.)

Mol. weight determined in pyridine and methyl sulphide. (Werner, Z. anorg. 1897, 15. 20 and 25.)

100 g. sat. solution in acetonitrile contains 1.57 g.  $\text{CuCl}_2$ . (Naumann and Schier, B. 1914, 47. 249.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in boiling dipropylamine. (Werner, Z. anorg. 1897, 15. 34.)

Sol. in urethane. (Ley, Z. phys. Ch. 1897, 22. 81); (Castoro Z. anorg. 1899, 20, 61.)

+  $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) 22. 551.)

Sol. in  $\text{H}_2\text{O}$  with slight decomp. (Sabatier, Bull. Soc. 1895, (3) 13. 601.)

+  $2\text{H}_2\text{O}$ . Deliquescent. 100 g.  $\text{H}_2\text{O}$  dissolve 121.4 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  at  $16.1^\circ$ . (Rüddorff.)

Aq. sol. at  $35^\circ$  contains 9.689 Mol. %  $\text{CuCl}_2$ .  
" 15° " 8.934 " % "

(Schreinemakers, C. C. 1911, II. 349.)

■  $\text{CuCl}_2 + 2\text{H}_2\text{O} + \text{Aq}$ . sat. at  $30^\circ$  contains 43.95%  $\text{CuCl}_2$ . (Meerburg, C. C. 1904, II. 1362.)

43.95 g. anhydrous  $\text{CuCl}_2$  are dissolved in 100 g.  $\text{CuCl}_2 + \text{Aq}$  at  $30^\circ$ . (Schreinemakers, Arch. near. Sc. 1910 [2], 15. 117.)

44.47% by weight anhydrous  $\text{CuCl}_2$  is dissolved in  $\text{H}_2\text{O}$  at  $35^\circ$ . (Schreinemakers and Thonus, Verh. k. Akad. Wet. Amst. 1912, 21. 333.)

Solubility of  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  in ethyl alcohol + Aq at  $11.5^\circ$ .

Percent of ethyl alcohol by volume	Grams $\text{CuCl}_2$ dissolved in 5 cc.
99.3	1.175
98.3	1.116
96.3	1.097
95.3	1.070
94.3	1.059

Anhydrous salt dissolves readily in absolute ethyl alcohol;  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  is precipitated by  $\text{H}_2\text{O}$ .

Solubility of  $\text{CuCl}_2 + 2\text{H}_2\text{O}$  in ethyl alcohol + Aq at  $11.5^\circ$  C. under addition of increasing amounts of  $\text{CuCl}_2$ .

P = Percent of ethyl alcohol by volume.

G = Grams of  $\text{CuCl}_2$  added.

$C_c$  = Grams of  $\text{CuCl}_2$  in 5 cc. of the solution.

$C_w$  = Grams of water in 5 cc. of the solution, calculated from

- (1) the water content of the alcohol.
- (2) the water of crystallization which had gone into solution.
- (3) the water held mechanically in  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ .

P	G	$C_w$	$C_c$
89.3	0.000	0.794	1.137
90.3	"	0.744	1.122
91.3	"	0.695	1.104
92.3	"	0.648	1.090
94.3	"	0.561	1.096
95.3	"	0.517	1.095
96.3	"	0.478	1.116
97.3	"	0.440	1.140
98.3	"	0.396	1.194
99.3	"	0.369	1.208
"	0.223	0.330	1.295
"	0.444	0.290	1.395
"	0.665	0.270	1.506
"	0.887	0.247	1.639
"	1.106	0.223	1.772
"	1.324	0.205	1.921
"	1.540	0.191	2.086
"	1.739	0.179	2.236
"	1.957	0.164	2.400

(Böttker, Z. phys. Ch. 1897, 22. 506-507.)

100 pts. absolute ether dissolve 0.061 g.  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ . (Böttker, Z. phys. Ch. 1897, 22. 511.)

0.11 pts. are sol. in 100 pts. ether at  $16^\circ$ .  
0.11 " " " " 100 " " "  $35^\circ$ .

8.86 " " " " 100 " acetone "  $0^\circ$ .

8.92 " " " " 100 " " "  $13.5^\circ$ .

(Lasscsynski, B. 1894, 27. 2286 and 2287.)

Solubility in organic solvents at  $t^\circ$ .

Solvent	$t^\circ$	Pts. of solvent required to dissolve 1 pt. $\text{CuCl}_2 + 2\text{H}_2\text{O}$ at $t^\circ$ .
Pure methyl alcohol	$20^\circ$	7.3
"	18.9	7.6
Ethyl alcohol (95°)	20.3	11.6
"	19.6	11.9
Pure acetone	22.1	43.6
"	20.0	44.2
99 pts. ethyl alcohol (98°) + 10 pts. $\text{H}_2\text{O}$	21.8	9.0
"	23.0	8.5

Solubility in organic solvents at t°.—*Cont.*

Solvent	t°	Pts. of solvent required to dissolve 1 pt. CuCl <sub>2</sub> +2H <sub>2</sub> O at t°
80 pts. abs. alcohol+20 pts. H <sub>2</sub> O	28.1	6.0
"	20.7	6.2
80 pts. acetone+20 pts. H <sub>2</sub> O	23.1	5.3
"	21.8	5.6
80 pts. acetone+20 pts. methyl alcohol	23.1	12.0
"	24.0	11.6
10 pts. methyl alcohol+90 pts. ethyl alcohol (98°)	24.2	5.4
"	25.0	5.1
20 pts. methyl alcohol+80 pts. ord. ether	24.1	15.1
"	22.4	15.7
80 pts. abs. alcohol+20 pts. ord. ether	24.1	8.8
"	25.0	8.5
Comm. methyl alcohol	23.9	5.4
"	23.0	5.6
85 pts. pyridine+15 pts. H <sub>2</sub> O	24.4	63.4
"	23.6	63.7
60 pts. pyridine+40 pts. H <sub>2</sub> O	27.3	26.7
"	28.0	26.2
75 pts. α picoline+25 pts. H <sub>2</sub> O	26.1	51.6
"	25.1	52.3
70 pts. α picoline+30 pts. H <sub>2</sub> O	26.1	47.3

(de Coninck, C. R. 1900, 131. 59.)

## Solubility in organic solvents.

Sol. in propyl alcohol, hot glycol, hot glycerine, hot paraldehyde, hot crys. acetic acid, pure acetone, 30% methylamine+Aq. pure pyridine, pure α-picoline, acetonitrile; al. sol. in isobutyl and amyl alcohols, crystallisable formic acid, ethyl acetate; insol. in cold glycol, cold glycerine, cold paraldehyde, benzaldehyde, cold crystallisable acetic acid, ord. ether, abs. ether, hot and cold CS<sub>2</sub>, cold aniline, cold orthotoluidine, methylene chloride, ethyl iodide, propyl iodide, ethylene bromide, benzene, toluene, xylene, ligroin, nitrobenzene, cold piperidine and essence of terebenthine. (de Coninck, C. R. 1900, 131. 59.)

+5H<sub>2</sub>O.Aq. sol. at 35° contains 2.921 Mol. % CuCl<sub>2</sub>.  
15° " 1.11

(Schreinemakers, C. C. 1911, II. 349.)

## Cuprous hydrogen chloride, CuCl.HCl.

Sol. in H<sub>2</sub>O. (Neumann, M. 1894, 15. 493.)Cupric hydrogen chloride, CuCl<sub>2</sub>.HCl+3H<sub>2</sub>ODecomp. by H<sub>2</sub>O. Sol. in HCl+Aq below 0° (Engel, C. R. 106. 273.)CuCl<sub>2</sub>. 2HCl. Deliquescent. Very sol. in H<sub>2</sub>O. (Alexander, Dissert. 1899.)+5H<sub>2</sub>O. Properties as above. (Sabatier, C. R. 106. 1724.)CuCl<sub>2</sub>. 3HCl. Sol. in H<sub>2</sub>O. (Neumann M. 1894, 15. 493.)Cupric gold (auric) chloride, CuCl<sub>2</sub>. 2AuCl<sub>3</sub>+6H<sub>2</sub>O.10% is sol. in H<sub>2</sub>O at 18°. (Mylius, Z. anorg. 1911, 70. 210.)Cupric lithium chloride, CuCl<sub>2</sub>. LiCl+2½H<sub>2</sub>O.Decomp. on air. Decomp. by dissolving in H<sub>2</sub>O. Sol. in conc. LiCl+Aq without decomp. Decomp. by alcohol. (Chassevant, A. ch. (6) 30. 33.)+2H<sub>2</sub>O. (Meyerhoffer, W. A. B. 100, 2b. 621.)

## Cupric mercuric chloride.

Easily sol. in H<sub>2</sub>O. (v. Bonsdorff.)Cupric mercuric potassium chloride, CuCl<sub>2</sub>. 3HgCl<sub>2</sub>. 6KCl+2H<sub>2</sub>O.Deliquescent in moist air. Sol. in boiling H<sub>2</sub>O without decomp., and recrystallises if cooled slowly. Insol. in absolute alcohol. (v. Bonsdorff, Pogg. 33. 81.)Cuprous nitrosyl chloride, Cu<sub>2</sub>Cl<sub>2</sub>. 2NOCl.Very deliquescent and sol. in H<sub>2</sub>O with immediate decomp. (Sudborough, Chem. Soc. 59. 658.)Cuprous potassium chloride, Cu<sub>2</sub>Cl<sub>2</sub>. 4KCl.Sol. in H<sub>2</sub>O. (Mitscherlich, A. ch. 73. 384.)  
For solubility data, see Cu<sub>2</sub>Cl<sub>2</sub>+KCl under cuprous chloride.

## Cupric potassium chloride.

CuCl<sub>2</sub>. KCl. (Meyerhoffer, Z. phys. Ch. 3. 336.)Sol. in H<sub>2</sub>O; only al. sol. in conc. HCl+Aq. (Gröger, Z. anorg. 1899, 19. 330.)CuCl<sub>2</sub>. 2KCl+2H<sub>2</sub>O. Sol. in H<sub>2</sub>O and alcohol. (Berzelius, Pogg. 13. 458.)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr. pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, 34. 322.)

For solubility data, see CuCl<sub>2</sub>+KCl under cupric chloride.Cupric rubidium chloride, CuCl<sub>2</sub>. 2RbCl.Easily sol. in H<sub>2</sub>O and HCl+Aq. (Godefroy, B. 8. 9.)+2H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Wyruboff, J. B. 1887. 538.)

## Cuprous sodium chloride.

Very sol. in H<sub>2</sub>O.

**Cupric sodium chloride.**

Easily sol. in conc. NaCl + Aq. Sol. in alcohol of 0.837 sp. gr.

No double salt exists. (Schreinemakers and de Baat, Z. phys. Ch. 1909, 65. 586.)

**Cupric thallic chloride,  $\text{CuCl}_2$ ,  $2\text{TiCl}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) 5. 55.)  
+  $6\text{H}_2\text{O}$ . Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A. 1909, 366. 225.)

**Cuprous chloride ammonia,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{NH}_3$ .**

(Lloyd, J. phys. Chem. 1908, 12. 399.)

$\text{Cu}_2\text{Cl}_2$ ,  $2\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$  or acids, not by alcohol. (Ritthausen, J. pr. 59. 369.)

$\text{Cu}_2\text{Cl}_2$ ,  $3\text{NH}_3$ . (Lloyd, J. phys. Chem. 1908, 12. 399.)

$\text{Cu}_2\text{Cl}_2$ ,  $6\text{NH}_3$ . (Lloyd, J. phys. Chem. 1908, 12. 399.)

**Cupric chloride ammonia,  $\text{CuCl}_2$ ,  $2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Kane, A. ch. 72. 273.)  
 $\text{CuCl}_2$ ,  $4\text{NH}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Bouszat, C. R. 1902, 135. 294.)

+  $\text{H}_2\text{O}$  (*Cuprammonium chloride*). Sol. in  $\text{H}_2\text{O}$  and hot  $\text{NH}_4\text{OH}$  + Aq.

+  $2\text{H}_2\text{O}$ . Sol. in small amt. of  $\text{H}_2\text{O}$ .  
 $\text{Cu}(\text{OH})_2$  is pptd. by dilution. (Bouszat, A. ch. 1903, (7) 29. 350.)

$\text{CuCl}_2$ ,  $5\text{NH}_3$ . (Bouszat, A. ch. 1903, (7) 29. 350.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . On dilution  $\text{Cu}(\text{OH})_2$  is pptd. Sol. in  $\text{NH}_4\text{OH}$  + Aq; solubility decreases as  $\text{NH}_3$  concentration increases. (Bouszat, A. ch. 1903, (7) 29. 350.)

$\text{CuCl}_2$ ,  $6\text{NH}_3$ . Completely sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 55.)

Sol. in  $\text{H}_2\text{O}$  but decomp. by great dilution with pptn. of  $\text{Cu}(\text{OH})_2$ .

Insol. in liquid  $\text{NH}_3$ . (Bouszat, A. ch. 1903, (7) 29. 350.)

**Cuprocupric chloride ammonia,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{CuCl}_2$ ,  $4\text{NH}_3$  +  $\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol. Abundantly sol. in  $\text{NH}_4\text{Cl}$  + Aq, but with partial decomposition. (Ritthausen.)

**Cupric chloride ammonia platinous chloride,  $\text{CuCl}_2$ ,  $4\text{NH}_3$ ,  $\text{PtCl}_2$ .**

See Platodiamine cupric chloride.

**Cuprous chloride carbon monoxide,**

$\text{Cu}_2\text{Cl}_2$ ,  $2\text{CO}$  +  $4\text{H}_2\text{O}$ .

Very sol. in HCl (sp. gr. 1.19) with evolution of CO. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Manchot and Friend, A. 1908, 359. 110.)

$2\text{Cu}_2\text{Cl}_2$ ,  $\text{CO}$  +  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Berthelot, A. ch. 1856, (3) 46. 488.)

$4\text{Cu}_2\text{Cl}_2$ ,  $3\text{CO}$  +  $7\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. therewith very quickly. Sol. in  $\text{Cu}_2\text{Cl}_2$  + HCl.

**Cupric chloride hydrazine,  $\text{CuCl}_2$ ,  $2\text{N}_2\text{H}_4$ .**

Easily decomp. (Hofmann and Marburg, A. 1899, 305. 222.)

**Cuprous chloride mercuric sulphide,  $\text{Cu}_2\text{Cl}_2$ ,  $2\text{HgS}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in conc. hot HCl + Aq; not decomp. by boiling dil.  $\text{H}_2\text{SO}_4$  + Aq, but decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Heumann, B. 7. 1390.)

**Cuprous fluoride,  $\text{Cu}_2\text{F}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or HF. Sol. in conc. HCl + Aq, from which it is precipitated by  $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius, Pogg. 1. 28.)

Decomp. by  $\text{H}_2\text{O}$  into sol.  $\text{CuF}_2$ . Sol. in boiling HCl + Aq and in  $\text{HNO}_3$  + Aq. Only sl. attacked by warm  $\text{H}_2\text{SO}_4$ . (Poulenc, C. R. 116. 1447.)

**Cupric fluoride,  $\text{CuF}_2$ .**

Easily takes up  $\text{H}_2\text{O}$  to form  $\text{CuF}_2 \cdot 2\text{H}_2\text{O}$ . Sol. in HCl,  $\text{HNO}_3$ , or HF + Aq. (Poulenc, C. R. 116. 1448.)

**Solubility at 25° in HF + Aq.**

Normality of HF + Aq.	g. atoms Cu in 1000 c. c. of solution
0.12	0.0307
0.28	0.1164
0.57	0.2484
1.08	0.388
2.28	0.463

Solubility is decreased by presence of KF. (Jaeger, Z. anorg. 1901, 27. 29.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

+  $2\text{H}_2\text{O}$ . Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Berzelius.)

**Cupric hydrogen fluoride,  $\text{CuF}_2$ ,  $5\text{HF}$  +  $5\text{H}_2\text{O}$ .**

Deliquescent.

Easily sol. in  $\text{H}_2\text{O}$  and dil. acids.

Sol. in  $\text{NH}_4\text{OH}$  + Aq with decomp. (Böhm, Z. anorg. 1905, 43. 329.)

**Cupric potassium fluoride,  $\text{CuF}_2$ ,  $2\text{KF}$ .**

Easily sol. in  $\text{H}_2\text{O}$ .

$\text{CuF}_2$ ,  $\text{KF}$ . Very sl. sol. in  $\text{H}_2\text{O}$ ; sl. sol. in dil. acids. (Helmholtz, Z. anorg. 3. 115.)

**Cupric rubidium fluoride,  $\text{CuF}_2$ ,  $\text{RbF}$ .**

As the K salt. (Helmholtz.)

**Cupric silicon fluoride.**

See Fluosilicate, cupric.

**Copper stannic fluoride.***See Fluostannate, copper.***Copper tantalum fluoride.***See Fluotantalate, copper.***Copper titanium fluoride.***See Fluotitanate, copper.***Copper tungstyl fluoride.***See Fluoxytungstate, copper.***Copper zirconium fluoride.***See Fluozirconate, copper.***Cupric fluoride ammonia,  $\text{CuF}_2 \cdot 4\text{NH}_3 + 5\text{H}_2\text{O}$ .**

Decomp. rapidly in the air.

Easily sol. in  $\text{H}_2\text{O}$ .Decomp. by boiling with  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ .

Easily sol. in dil. acids. (Böhm, Z. anorg. 1905, 43. 333.)

**Cuprous hydride,  $\text{CuH}$ .**Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Wurts, C. R. 18. 102.)Sol. in warm conc.  $\text{HCl}$  with decomp. (Bartlett, Am. Ch. J. 1895, 17. 187.)**Cupric hydride,  $\text{CuH}_2$ .**Sol. in  $\text{HCl}$  with decomp. (Bartlett, Am. Ch. J. 1895, 17. 187.)**Copper hydrosulphide,  $7\text{CuS}, \text{H}_2\text{S}$ .**

(Linder and Picton, Chem. Soc. 1892, 61. 120.)

 $9\text{CuS}, \text{H}_2\text{S}$ . (Linder and Picton.) $22\text{CuS}, \text{H}_2\text{S}$ . (Linder and Picton.)**Cuprous hydroxide,  $\text{Cu}_2\text{O}, x\text{H}_2\text{O}$ .**Sol. in acids as cupric salt. Insol. in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$ .Sol. in  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ ; sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ .**Cuprocupric hydroxide,  $\text{CuOH}, 3\text{Cu}(\text{OH})_2 + 3\text{H}_2\text{O}$ .**

Sol. in acids. (Francke, Dissert. 1907.)

**Cupric hydroxide,  $3\text{CuO}, \text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$  or dil. alkalies. Easily sol. in warm  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)Much more difficultly sol. than  $\text{CuO}_2\text{H}_2$  in  $\text{KOH} + \text{Aq}$ . (Chodnew, J. pr. 28. 220.)True composition is  $6\text{CuO}, \text{H}_2\text{O}$ .*See also Cupric oxide.* $\text{CuO}_2\text{H}_2$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. into  $6\text{CuO}, \text{H}_2\text{O}$  by being boiled therewith.

Extremely easily sol. in acids.

Sol. in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$ .**Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .**

$\text{NH}_3$ no. cm.	g. Cu per l.	equiv. $\text{CuO}_2\text{H}_2$ per l.
2.63	3.05	0.096
2.00	2.12	0.067
1.32	1.08	0.034
2.540	6.26	0.197
1.965	6.28	0.166
1.280	4.13	0.129
0.973	3.36	0.106
0.870	3.08	0.097
0.540	2.36	0.074
0.391	2.04	0.064
3.176	8.06	0.253
2.070	5.72	0.180
1.272	4.75	0.149
0.451	2.54	0.080
0.320	2.13	0.067

The non-agreement of the results is due to the presence of different modifications of  $\text{CuO}_2\text{H}_2$ .

(Bonsdorff, Z. anorg. 1904, 41. 182.)

**Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $18^\circ$ .**

$\text{NH}_3$ mols per l.	Cu g. atoms per l.
0.20	0.00054
0.50	0.0033
1.0	0.0109
1.5	0.0204
2.0	0.0314
2.5	0.0442
3.0	0.0548
4.0	0.0784
5.0	0.1041
6.0	0.1254
8.0	0.1599
9.96	0.1787

(Dawson, Z. phys. Ch. 1909, 69. 111.)

Sol. in cold  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$  (Proust); but  $\text{CuO}$  is pptd. on boiling (Berthollet); is not pptd. (Chodnew, J. pr. 28. 220.)

Insol. in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$  unless they contain organic matter (Berzelius). This is contradicted by Volcker (A. 59. 34).

Entirely sol. in conc.  $\text{KOH} + \text{Aq}$ , but solution is decomp. by heating. (Fremy, A. ch. (3) 12. 510.)

Sol. in  $\text{NaOH} + \text{Aq}$  (70%  $\text{NaOH}$ ). (Löw, Z. anal. 9. 463.)

The solubility in  $\text{NaOH}$  of  $\text{CuO}_2\text{H}_2$ , prepared either from  $\text{CuSO}_4$  or  $\text{Cu}(\text{NO}_3)_2$ , decreases with decrease in concentration of the base. The solubility of  $\text{CuO}_2\text{H}_2$  in  $\text{NaOH}$  is only very slightly affected by the addition of sodium or potassium carbonate. (Fischer, Z. anorg. 1904, 40. 41.)



Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal  $\text{Ba}(\text{OH})_2$  and  $\text{NaOH}$  solutions at  $18^\circ$ .

Solvent contains per litre	Cu concentration g. atoms per l.
1 mol. $\text{NH}_3$ + 0 mol. $\text{Ba}(\text{OH})_2$	0.01090
" + 0.0025 "	0.00907
" + 0.005 "	0.00801
" + 0.01 "	0.00633
" + 0.02 "	0.00526
2 mols. $\text{NH}_3$ + 0 mol. $\text{Ba}(\text{OH})_2$	0.0314
" + 0.01 "	0.0277
4 mols. $\text{NH}_3$ + 0 mol. $\text{Ba}(\text{OH})_2$	0.0784
" + 0.01 "	0.0747
1 mol. $\text{NH}_3$ + 0 mol. $\text{NaOH}$	0.0109
" + 0.01 "	0.00766
" + 0.02 "	0.00655
" + 0.03 "	0.00531
" + 0.05 "	0.00456
" + 0.10 "	0.00410

(Dawson, Chem. Soc. 1909, 95. 377.)

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal salt solutions at  $18^\circ$ .

Solvent contains per litre	Conc. of dissolved Cu. g. atoms per l.
1 mol. $\text{NH}_3$	0.0109
0.05 mol. $\text{NH}_3$ + 0.01 mol. $(\text{NH}_4)_2\text{SO}_4$	0.00129
" + 0.025 "	0.00511
0.1 mol. $\text{NH}_3$ + 0.01 mol. $(\text{NH}_4)_2\text{SO}_4$	0.00326
" + 0.025 "	0.0108
" + 0.05 "	0.0233
0.2 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.00054
" + 0.01 "	0.00649
" + 0.025 "	0.0175
" + 0.05 "	0.0384
" + 0.10 "	0.0690
0.5 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0033
" + 0.01 "	0.0127
" + 0.025 "	0.0284
" + 0.05 "	0.0536
" + 0.10 "	0.1013
" + 0.20 "	0.1844
1.0 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0109
" + 0.01 "	0.0210
" + 0.025 "	0.0386
" + 0.05 "	0.0660
" + 0.10 "	0.1185
" + 0.20 "	0.2275
" + 0.40 "	0.4135
2 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0314
" + 0.01 "	0.0462
" + 0.025 "	0.0605
" + 0.05 "	0.0886
" + 0.10 "	0.1468
" + 0.20 "	0.2591
" + 0.40 "	0.4718
3 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0548
" + 0.01 "	0.0672
" + 0.025 "	0.0847
" + 0.05 "	0.1156

Solubility of crystalline  $\text{CuO}_2\text{H}_2$  in ammoniacal salt solutions at  $18^\circ$ —Continued

Solvent contains per litre	Conc. of dissolved Cu. g. atoms per l.
3 mol. $\text{NH}_3$ + 0.10 mol. $(\text{NH}_4)_2\text{SO}_4$	0.1740
" + 0.20 "	0.2861
" + 0.40 "	0.5044
4 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.0784
" + 0.01 "	0.0922
" + 0.025 "	0.1101
" + 0.05 "	0.1397
" + 0.10 "	0.2002
" + 0.20 "	0.3188
" + 0.40 "	0.5451
5 mol. $\text{NH}_3$ + 0.00 mol. $(\text{NH}_4)_2\text{SO}_4$	0.1041
" + 0.01 "	0.1154
" + 0.025 "	0.1320
" + 0.05 "	0.1639
" + 0.10 "	0.2239
" + 0.20 "	0.3415
" + 0.40 "	0.5615
1 mol. $\text{NH}_3$ + 0.00 mol. $\text{Na}_2\text{SO}_4$	0.0109
" + 0.025 "	0.0134
" + 0.10 "	0.0162
" + 0.20 "	0.0192
" + 0.40 "	0.0784
4 mol. $\text{NH}_3$ + 0.10 mol. $\text{Na}_2\text{SO}_4$	0.0994
" + 0.20 "	0.1161

(Dawson, Chem. Soc. 1909, 95. 373.)

Sl. sol. in alkali carbonates + Aq, especially  $\text{KHCO}_3$  and  $\text{NaHCO}_3$ . (Berzelius.)

Sol. in cold  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq, but pptd. on warming. (Field, Chem. Soc. (2) 1. 28.)

Partially sol. when freshly pptd. in KCN + Aq. (Rodgers, 1834.)

Sol. in  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  + Aq. (Moreau, Apoth. Ztg. 1901, 16. 383.)

Sol. in  $\text{MSCN}$  + Aq.; more difficultly sol. in  $\text{NH}_4\text{SCN}$  + Aq than  $\text{ZnO}_2\text{H}_2$ . (Grossmann, Z. anorg. 1903, 58. 269.)

Very sol. in hydroxylamine. (Jannasch and Cohen, J. pr. 1905, (2), 72. 14.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Sol. in large amt. in  $\text{NaC}_2\text{H}_3\text{O}_2$  + Aq. (Mercer, 1844.)

Not pptd. in presence of Na citrate. (Spiller.)

Insol. in cane sugar + Aq, unless an alkali or alkaline earth is present. (Peschier.)

Recently pptd.  $\text{CuO}_2\text{H}_2$  is easily sol. in cane sugar with  $\text{NaOH}$ ,  $\text{KOH}$ , or  $\text{CaO}_2\text{H}_2$  + Aq; less sol. in presence of  $\text{SrO}_2\text{H}_2$  or  $\text{BaO}_2\text{H}_2$ . (Becquerel.)

Not pptd. by  $\text{KOH}$  + Aq in solutions containing tartaric acid, cane sugar, and many other non-volatile organic substances.

Sol. in Ca, Ba, Sr, K or Na sucrates + Aq, and ppts. of double sucrates form when solutions of the first three bases are heated, but no

ppt. forms in the last two cases even at 100°. (Hunton.)

Insol. in simple Ca, Ba, or K sucrates + Aq, but immediately sol. when an excess of cane sugar + Aq is present. (Peligot.)

Moderately sol. in amyl amine, easily sol. in methyl, less in ethyl amine. (Wurts.)

Sol. in sorbine + Aq. (Pelouse.)

Not pptd. in presence of aromatic oxyacids or phenols of the ortho series. Thus in presence of salicylic acid, pyrocatechin, gallic acid, pyrogallie acid, etc., NaOH + Aq does not ppt.  $\text{Cu}_2\text{O}_2\text{H}_2$  from Cu solutions, but pptn. is not prevented by benzoic acid, resorcin, hydroquinone, etc. (Weith, B. 9. 342.)

Sol. in solutions of alkali salts of "spaltungsprodukte" of albumen. (Kalle and Co, Pat. 1901.)

Sol. in starch emulsion which has become thin liquid in an alternating magnetic field. (Rosenthal, C. C. 1906, I. 593.)

$\text{CuO}$ ,  $2\text{H}_2\text{O}$ . (Rubénovitch, C. R. 1899, 129. 336.)

$\text{CuO}$ ,  $3\text{H}_2\text{O}$ . (Kosmann, Z. anorg. 1893, 3. 373.)

$2\text{CuO}$ ,  $3\text{H}_2\text{O}$ . (Cross, Gm.—K. 5. 1, 753.)

$4\text{CuO}$ ,  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Mailhe, A. ch. 1902, (7) 27. 393.)

**Cupric hydroxide ammonia**,  $\text{CuO}_2\text{H}_2$ ,  $4\text{NH}_3$ .

Present in ammoniacal solution of  $\text{CuO}_2\text{H}_2$ . (Dawson, Z. phys. Ch. 1909, 69. 110.)

**Cuprous imide**,  $\text{Cu}_2\text{NH}$ .

Decomp. at 160° forming  $\text{Cu}_2\text{N}$ .

Readily hydrolysed by  $\text{H}_2\text{O}$ .

Sol. in liquid  $\text{NH}_3$ , solutions of  $\text{NH}_4\text{NO}_3$ . (Franklin, J. Am. Chem. Soc. 1912, 34. 1502.)

**Cuprous iodide**,  $\text{Cu}_2\text{I}_2$ .

Insol. in  $\text{H}_2\text{O}$ , or dil. acids.

Calculated from electrical conductivity of  $\text{Cu}_2\text{I}_2$  + Aq, 1 l.  $\text{H}_2\text{O}$  dissolves about 8 mg.  $\text{Cu}_2\text{I}_2$  at 18°. (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Vitali, Gm.—K. 5. 1, 947.)

Sol. with difficulty in conc.  $\text{HCl}$  + Aq.

Decomp. by conc.  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{NaCl}$ ,  $\text{KNO}_3$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{KBr}$ , or  $\text{NH}_4\text{Cl}$  + Aq. Sol. in  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{KCN}$ , or  $\text{KI}$  + Aq. (Renault, C. R. 59. 558.)

Appreciably sol. in N/10  $\text{HCl}$ . Practically insol. in N/10  $\text{H}_2\text{SO}_4$ . (Moser, Z. anal. 1904, 43. 604.)

Results of experiments on solubility of  $\text{Cu}_2\text{I}_2$  in  $\text{I}_2$  + Aq in presence of acids and salts are given by Bray and MacKay.

$\text{Cu}_2\text{I}_2$  was found to be sl. sol. in  $\text{H}_2\text{O}$  but a considerable amt. dissolves in presence of  $\text{I}_2$ , owing to formation of  $\text{CuI}_2$  and  $\text{CuI}$ . (J. Am. Chem. Soc. 1910, 32. 1207.)

### Solubility of $\text{Cu}_2\text{I}_2$ in $\text{I}_2$ + Aq at 20°.

g. per l.		Solid Phase
Cu	I	
0.285	0.585	$\text{Cu}_2\text{I}_2$
0.482	1.305	"
0.583	1.922	"
0.678	2.557	"
0.756	3.204	"
0.844	3.954	"
0.898	4.436	"
0.964	5.085	"
1.032	5.685	"
1.090	6.232	"
1.112	6.530	"
1.232	7.653	$\text{Cu}_2\text{I}_2 + \text{I}_2$
1.040	6.449	$\text{I}_2$
0.898	5.594	"
0.748	4.711	"
0.606	3.856	"
0.448	2.949	"
0.300	2.069	"
0.159	1.230	"
0.925*	5.461	$\text{Cu}_2\text{I}_2 + \text{I}_2$
1.658**	11.366	"

\* at 0°. \*\* at 40°.

(Fedotieff, Z. anorg. 1911, 69. 26.)

### Solubility in $\text{NH}_4\text{Br}$ + Aq at 20°.

$\text{NH}_4\text{Br}$ + Aq.	g. $\text{Cu}_2\text{I}_2$ in 1 l. of the solution
2-N	1.9068
3-N	3.6540
4-N	6.0588

(Kohn and Klein, Z. anorg. 1912, 77. 254.)

Sol. in  $\text{FeCl}_3$  + Aq. (Fleischer, C. N. 1869, 19. 206.)

### Solubility in $\text{KBr}$ + Aq at t°.

t°	$\text{KBr}$ + Aq.	g. $\text{Cu}_2\text{I}_2$ in 1 l. of the solution
19.5	2-N	1.4666
24.0	2-N	1.5576
19.5	3-N	3.4094
23.0	3-N	3.5949
22.0	4-N	7.1263
22.0	4-N	6.9768

The solutions undergo change in the course of a few days, iodine being set free; the solubility of the cuprous iodide is not markedly affected thereby.

(Kohn, Z. anorg. 1909, 63. 337.)

1 l. of a 0.2N solution of  $\text{KI}$  dissolves 0.000157 g. mol.  $\text{Cu}_2\text{I}_2$ . (Bodländer, Z. anorg. 1902, 31. 475.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Practically insol. in methylene iodide. (Retgers, Z. anorg. 1893, 3. 347.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in acetone (Naumann, B. 1904, 37. 4329); (Eidmann, C. C. 1899, II. 1014.)

100 g. acetonitrile dissolve 3.52 g.  $\text{Cu}_2\text{I}_2$  at  $18^\circ$ . (Naumann and Schier, B. 1914, 47. 249.)

Min. *Marshite*. (Gm.—K. 5. 1, 945.)

**Cupric iodide,  $\text{CuI}_2$ .**

Exists only in very dil. aqueous solution. (Traube, B. 17. 1064.)

**Copper periodide,  $\text{CuI}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Walker and Dover, Chem. Soc. 1905, 87. 1588.)

**Copper ammonium iodide ammonia.**

See Cupriammonium iodide ammonia.

**Cuprous mercuric iodide,  $\text{Cu}_2\text{I}_2, \text{HgI}_2$ .**

$\text{KI} + \text{Aq}$  dissolves out  $\text{HgI}_2$ .

**Cuprous mercuric iodide ammonia,  $\text{CuI}_2, 2\text{HgI}_2, 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  or acids. Sol. in a mixture of acetic acid and alcohol.

$\text{CuI}_2, \text{HgI}_2, 4\text{NH}_3$ . As above. (Jørgensen, J. pr. (2) 2. 347.)

**Cupric nitrogen iodide,  $\text{CuI}_2, \text{N}_2\text{H}_4\text{I}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ ; or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Guyard, C. R. 97. 526.)

**Cupric thallic iodide ammonia,  $\text{CuI}_2, 2\text{TH}_3, 4\text{NH}_3$ .**

Decomp. slowly by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. Sol. in alcohol.

**Cuprous iodide ammonia,  $\text{Cu}_2\text{I}_2, \text{NH}_3$ .**

Ppt. (Anderline, Gazz. ch. it. 1912, 42. I, 321.)

$+ 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Silberrad, Chem. Soc. 1905, 87. 67.)

$\text{Cu}_2\text{I}_2, 3\text{NH}_3$ . (Lloyd, J. phys. Chem. 1908, 12. 399.)

$\text{Cu}_2\text{I}_2, 4\text{NH}_3$ . (Levol, J. Pharm. 4. 328.)

$+ \text{H}_2\text{O}$ . (Saglier, C. R. 104. 1440.)

$\text{Cu}_2\text{I}_2, 6\text{NH}_3$ . (Lloyd.)

**Cupric iodide ammonia,  $\text{CuI}_2, 4\text{NH}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. Not attacked by cold

alcohol or ether. (Berthelmont, J. Pharm. 15. 445.) (Pozzi-Escot, C. R. 1900, 130. 90.)

$\text{CuI}_2, 6\text{NH}_3$ . Sol. in liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 205.)

$3\text{CuI}_2, 10\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Richards, Am. Ch. J. 1895, 17. 302.)

Sol. in liq.  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 204.)

**Cupriammonium iodide ammonia,**

$3\text{Cu}(\text{NH}_3)_2\text{I}_2, 4\text{NH}_3$ .

Decomp. by air and by  $\text{H}_2\text{O}$ . (Richards, Am. Ch. J. 1895, 17. 302.)

**Copper periodide ammonia,  $2\text{CuI}, \text{I}_2, 5\text{NH}_3 + \text{H}_2\text{O}$ .**

Because of its insolubility it cannot be recryst. from any solvent. (Silberrad, Chem. Soc. 1905, 87. 66.)

**Copper tetraiodide, ammonia,  $\text{CuI}_4, 4\text{NH}_3$ .**

(Jørgensen, J. pr. (2) 2. 353.)

**Copper hexaiodide ammonia,  $\text{CuI}_6, 4\text{NH}_3$ .**

Not decomp. in  $\text{H}_2\text{O}$  in closed vessels. (Jørgensen.)

**Copper mercuric iodide ammonia,**

$\text{CuHgI}_2, 5\text{NH}_3$ .

$\text{CuHgI}_2, 2\text{NH}_3$ . Ppt. Decomp. by  $\text{H}_2\text{O}$  and by alcohol.

$\text{CuHgI}_2, 3\text{NH}_3$ . Ppt. Decomp. by long washing with  $\text{H}_2\text{O}$ .

$\text{CuHgI}_2, 4\text{NH}_3$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sl. attacked by abs. alcohol.

$\text{CuI}_2, \text{HgI}_2, 4\text{NH}_3$ . Ppt. (Anderline, Gazz. ch. it. 1912, 42, (1) 321; C. C. 1912, II. 95.)

**Copper nitride,  $\text{Cu}_3\text{N}_2$ .**

Decomp. by dil. or conc. acids.

Easily decomp. by  $\text{H}_2\text{O}$  when finely powdered. (Rossel, C. R. 1895, 121. 942.)

**Copper suboxide,  $\text{Cu}_2\text{O}$ .**

Not attacked by  $\text{H}_2\text{O}$ . Decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  into  $\text{Cu}$  and  $\text{CuSO}_4$ ; dil.  $\text{HCl} + \text{Aq}$  has similar action. Not attacked by  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Rose, Pogg. 120. 1.)

$\text{Cu}_2\text{O}$ . Not attacked by dil. or conc. min. acids, even aqua regia. Slowly sol. in  $\text{HF} + \text{Aq}$ . (Bailey and Hopkins, Chem. Soc. 1890, 57. 272.)

Is a solution of oxide in  $\text{Cu}$ . (Jordis, Zeit. angew. Ch. 1908, 21. 51.)

**Cuprous oxide,  $\text{Cu}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{H}_3\text{PO}_4 + \text{Aq}$ , or cold very dil.  $\text{HNO}_3 + \text{Aq}$  into a cupric salt and  $\text{Cu}$ . Converted by  $\text{HCl} + \text{Aq}$  into cuprous chloride.

Solubility of  $\text{Cu}_2\text{O}$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

Conc. of total Cu		Conc. of total $\text{NH}_3$	
G. in 1000 g. of solution	G. mol. in 1000 g. of solution	G. in 1000 g. of solution	G. mol. in 1000 g. of solution

## Preparation I

0.3593	0.00566	3.91	0.23
0.5024	0.00791	12.07	0.71
0.6869	0.01080	13.77	0.81
0.6964	0.01095	16.15	0.95
1.0144	0.01597	27.03	1.59
1.0462	0.01645	32.64	1.92
1.0557	0.01660	36.89	2.17
1.2243	0.01924	45.73	2.69
1.3229	0.02081	68.68	4.04
1.4882	0.02340	74.12	4.36
1.5105	0.02375	81.26	4.78
1.6313	0.02565	98.52	5.58
1.6981	0.02670	122.40	7.20

## Preparation II

0.4229	0.00665	7.82	0.46
0.6678	0.01050	8.16	0.48
0.9890	0.01555	22.61	1.33
1.0494	0.01650	28.39	1.67
1.3528	0.02127	54.15	3.19
1.5047	0.02366	72.08	4.24
1.5963	0.02510	78.20	4.60
1.6555	0.02603	102.05	6.00

(Donnan and Thomas, Chem. Soc. 1911, 99, 1791.)

Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

Sl. sol. in excess of  $\text{KOH} + \text{Aq}$ . (Chodnew.)

Sol. in conc.  $\text{MgCl}_2$ , and  $\text{FeCl}_3 + \text{Aq}$ . (Hunt, C. R. 69, 1357.)

Sl. attacked by liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20, 827.)

Min. *Cuprite*. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ .

Cupric oxide,  $\text{CuO}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but dissolves on addition of a few drops of acid or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in dil., but sol. in warm conc.  $\text{NaOH}$ , and  $\text{KOH} + \text{Aq}$ . (Low, Z. anal. 9, 463.)

$\text{CuO}$  prepared at a low temp. is easily sol. in dil. acids, but when ignited is slowly sol. in boiling conc. acids, but moderately rapidly in a cold mixture of  $\text{NH}_4\text{I} + \text{HCl}$ . (Joannis, C. R. 1886, 102, 1161.)

Solubility in  $\text{N-HNO}_3$ . 1 l. of the solution contains 0.4802 g. atoms Cu at  $25^\circ$ . (Jaeger, Z. anorg. 1901, 27, 33.)

Solubility of  $\text{CuO}$  in  $\text{HF} + \text{Aq}$  at  $25^\circ$ .

	Time	G. $\text{CuO}$ in 10 ccm. of the solution
0.25N-HF	1 $\frac{1}{4}$ hrs.	0.0431
	3 $\frac{3}{4}$ "	0.0619
	25 $\frac{1}{2}$ "	0.0812
	71 $\frac{1}{2}$ "	0.0823
	170 $\frac{1}{2}$ "	0.0907
N-HF (a)	5 $\frac{1}{2}$ "	0.3018
	21 $\frac{1}{2}$ "	0.2797
	52 "	0.2747
	201 $\frac{1}{2}$ "	0.2339
	226 $\frac{1}{2}$ "	0.2353
N-HF (b)	4 $\frac{1}{4}$ "	0.3220
	44 $\frac{1}{4}$ "	0.2930
	117 $\frac{3}{4}$ "	0.2431
	167 $\frac{3}{4}$ "	0.2219
2.02N-HF	1 $\frac{1}{2}$ "	0.3646
	5 "	0.4533
	71 $\frac{1}{2}$ "	0.3583
	156 $\frac{1}{2}$ "	0.3311

(Deussen, Z. anorg. 1905, 44, 421.)

Solubility of  $\text{CuO}$  in  $\text{HF}$  at  $25^\circ$ .

$\text{Cu} = \text{g-atoms Cu}$  in 1 l. of the solution.

HF normality	Cu
0.12	0.0307
0.28	0.1164
0.57	0.2494
1.08	0.388
2.28	0.463

(Jaeger, Z. anorg. 1901, 27, 29.)

Solubility of  $\text{CuO}$  in  $\text{HF} + \text{KF}$  at  $25^\circ$ .

$\text{Cu} = \text{g-atoms Cu}$  in 1 l. of the solution.

HF normality	Cu
0.12	0.0356
0.28	0.06437
0.57	0.1442
1.11(1.08)	0.2451
2.17(2.28)	0.2517

(Jaeger, l. c.)

Sl. sol. in large excess of  $\text{KOH} + \text{Aq}$ . (de Coninck, C. C. 1904, II, 65.)

Slowly sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ , and less easily in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Rose.)

Sol. in boiling  $\text{H}_2\text{O}$  solutions of  $\text{Al}_2$ ,  $\text{Gl}$ ,  $\text{U}$ ,  $\text{Cr}_2$ ,  $\text{Fe}_2$ , or  $\text{Bi}$  nitrates and chlorides,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{Hg}_2(\text{NO}_3)_2$ ,  $\text{SbCl}_3$ ,  $\text{SnCl}_4$ , and  $\text{SnCl}_2$ , with pptn. of oxides of the bases of those salts. Unacted upon by boiling  $\text{H}_2\text{O}$  solutions of  $\text{Mn}$ ,  $\text{Mg}$ ,  $\text{Ni}$ ,  $\text{Co}$ ,  $\text{Zn}$ ,  $\text{Ce}$ , or

Fe nitrates or chlorides,  $\text{AgNO}_3$ ,  $\text{Pb(NO}_3)_2$ ,  $\text{Cd(NO}_3)_2$ , and  $\text{HgCl}_2$ . (Persoz.)

Pure  $\text{CuO}$  is very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  but the solution is greatly increased by the addition of  $\text{NH}_4$  salts. (Muthmann, C. C. 1904. II, 410.)

Sol. in hot  $(\text{NH}_4)_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_3 + \text{Aq}$ . (Jumau, *Electrochem. Ind.* 1908, 6. 258.)

15% dissolves in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  in 24 hrs. (Schnabel, Z. B. H. Sal. 1860, 28. 282.)

Sl. attacked by liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Solubility in N-acetic acid. 1 l. of the solution contains 0.1677 g-atoms Cu at 25°. (Jaeger, Z. anorg. 1902, 27. 33.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Sl. sol. in benzamide. (Dessaignes, A. ch. 1852, (3), 34. 146.)

Insol. in piperidine. (Cahours, C. R. 1852, 34. 481.)

Sol. in acid amines as asparagin. (Piria, A. ch. 1848, (3), 22. 160.)

Sol. in amines alone or mixed with  $\text{NH}_3$ . (Lance, *Dissert.* 1908.)

Slowly sol. in Ca or any other alkali succrate + Aq, but not in cane sugar + Aq. (Hunton.)

Solubility in (calcium succrate + sugar) + Aq. 1 l. solution containing 118.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 10.26 g.  $\text{CuO}$ .

1 l. solution containing 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 5.68 g.  $\text{CuO}$ .

1 l. solution containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 3.47 g.  $\text{CuO}$ . (Bodenbender, J. B. 1865. 600.)

Polypeptides in aqueous solution dissolve  $\text{CuO}$  by short boiling. (Fischer, B. 1906, 39. 576.)

$+1/2\text{H}_2\text{O} = 6\text{CuO} + \text{H}_2\text{O}$ . Insol. in dil., but sol. in conc.  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ .

Sol. in volatile oils.

See also Cupric hydride.

Min. *Melacomite*. Sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ .

**Cuprocupric oxide**,  $\text{Cu}_2\text{O}_2 = 2\text{Cu}_2\text{O}$ ,  $\text{CuO}$ .

(Favre and Maumené.)

$\text{Cu}_2\text{O}_2 + \text{H}_2\text{O} = \text{Cu}_2\text{O}$ ,  $\text{CuO} + \text{H}_2\text{O}$ . When freshly pptd., sol. in  $\text{HCl} + \text{Aq}$ , but insol. after drying. (Siewert, J. B. 1866. 257.)

$\text{Cu}_2\text{O}_2 = \text{Cu}_2\text{O}$ ,  $2\text{CuO}$ . (Siewert.)

All oxides of Cu except  $\text{Cu}_2\text{O}$ ,  $\text{Cu}_2\text{O}$ ,  $\text{CuO}$ , and  $\text{CuO}_2$  are mixtures. (Osborne, *Sill. Am. J.* (3) 32. 33; Debray, C. R. 99. 583.)

**Copper dioxide**,  $\text{CuO}_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids with formation of cupric salt and  $\text{H}_2\text{O}_2$ . (Weltzien, A. 140. 207.)

**Cuprous oxide ammonia** (cuprosammonium oxide).

Known only in solution. (Wagner, C. C. 1863. 239.)

**Cupric oxide ammonia** (cuprammonium hydroxide),  $3\text{CuO}$ ,  $4\text{NH}_3 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Kane, A. ch. 72. 283.)

$\text{CuO}$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ . Very deliquescent. Decomp. in the air and by  $\text{H}_2\text{O}$ . (Malaguti and Sarzeau, A. ch. (3) 9. 438.)

**Cuprous oxybromide**,  $\text{Cu}_2\text{Br}_2$ ,  $\text{CuO} + \text{H}_2\text{O}$ .

(Spring and Lucion, *Bull. Ac. Belg.* (3) 24. 21.)

**Cupric oxybromide**,  $\text{CuBr}_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Brun, C. R. 109. 66.)

Insol. in  $\text{H}_2\text{O}$  but decomp. by continued boiling. Sol. in conc. acetic acid, sl. sol. in conc.  $\text{CuBr}_2 + \text{Aq}$ . Insol. in dil.  $\text{KBr} + \text{Aq}$ . (Richards, *Proc. Am. Acad.* 1890, 25. 215.)

**Cupric oxybromide ammonia**,  $2\text{CuO}$ ,  $\text{CuBr}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ .

(Kohlschütter and Pudschies, B. 1904, 37. 1159.)

**Cuprous oxychloride**,  $\text{Cu}_2\text{Cl}_2$ ,  $\text{CuO} + 3\text{H}_2\text{O}$ .

(Spring and Lucion, *Bull. Ac. Belg.* (3) 24. 21.)

**Cupric oxychloride**,  $\text{CuO}$ ,  $\text{CuCl}_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rousseau, C. R. 1890, 110. 1263.)

$2\text{CuO}$ ,  $\text{CuCl}_2$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ , from which it is reprecipitated by dilution with  $\text{H}_2\text{O}$ .

$+ \text{H}_2\text{O}$ . (Kane, A. ch. 72. 277.)

$+ 4\text{H}_2\text{O}$ . (Gladstone, *Chem. Soc.* 8. 211.)

$3\text{CuO}$ ,  $\text{CuCl}_2 + 2\text{H}_2\text{O}$ . (Miller and Kenrick, *Trans. Roy. Soc. Can.* 1901, (2) 8, III. 35.)

$+ 3\text{H}_2\text{O}$ . (Dupont and Jansen, *Bull. Soc.* 1893, (3), 9. 193.)

$+ 3\frac{1}{2}\text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ , sl. decomp. by boiling. (Reindel, J. pr. 106. 378.)

Insol. in boiling  $\text{H}_2\text{O}$ . (Habermann, W. A. B. 90. 2. 268.)

$+ 4\text{H}_2\text{O}$ . Sol. in alkaline solution of  $\text{KNa}$  tartrate. (Grüger, Z. anorg. 1902, 31. 327.) (*Brunswick green*). Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids.

Min. *Atacamite*. Sol. in acids, and  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol. in cold sat. citric acid + Aq. (Bolton, B. 1880, 13. 732.)

$4\text{CuO}$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$ . (Kane, Gm.—K. 5. 1, 919.)

$+ 8\text{H}_2\text{O}$ . Min. *Talkingite*. (Church, Gm.—K. 5. 1, 919.)

$5\text{Cu(OH)}_2$ ,  $\text{Cu}_2\text{Cl}_2\text{Cl(OH)}$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Kühling, B. 1901, 34. 2852.)

$7\text{CuO}$ ,  $2\text{CuCl}_2 + 9\text{H}_2\text{O}$ . (Reindel.)

$6\text{CuO}$ ,  $\text{CuCl}_2 + 9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acetic acid. (Neumann, *Repert.* 37. 304.)

$8\text{CuO}$ ,  $\text{CuCl}_2 + 12\text{H}_2\text{O}$ . Min. *Footite*. (König, *Zeit. Kryst.* 1891, 19. 601.)

**Cupric zinc oxychloride**,  $\text{ZnO}$ ,  $2\text{ZnCl}_2$ ,  $5\text{CuO}$  +  $6\text{H}_2\text{O}$ .

(André, C. R. 1888, 106. 855.)

**Cupric oxychloride ammonia**,  $2\text{CuO}$ ,  $\text{CuCl}_2$ ,  $2\text{NH}_3$  +  $3\text{H}_2\text{O}$ .

(Dehérain, Gm.—K. 5. 1, 932.)

**Cupric oxyfluoride**,  $\text{CuO}$ ,  $\text{CuF}_2$  +  $\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Berzelius.) (Balbiano, Gazz. ch. it. 14. 74.)

**Cupric oxyfluoride ammonia (cuprammonium oxyfluoride)**,  $\text{Cu}(\text{OH})\text{F}$ ,  $2\text{NH}_3$ .

(Balbiano, Gazz. ch. it. 14. 74.)

$3\text{CuO}$ ,  $\text{CuI}_2$  +  $x\text{H}_2\text{O}$ . (Tschirwinski, Gm.—K, 5. 1, 1584.)

**Cuprous oxyiodide**,  $\text{Cu}_2\text{I}_2$ ,  $\text{CuO}$  +  $\text{H}_2\text{O}$ .

(Spring and Lucion, Bull. Ac. Belg. (3) 24. 21.)

**Cupric oxyiodide**,  $2\text{CuI}_2$ ,  $\text{CuO}$  +  $4\text{H}_2\text{O}$ .

Easily decomp. by  $\text{H}_2\text{O}$ . (Carnegie, Watts' Dict. II, 257.)

**Copper oxysulphide**,  $2\text{Cu}_2\text{S}$ ,  $\text{CuO}$ .

Insol. in  $\text{H}_2\text{O}$ . (Maumené, A. ch. (3) 18. 311.)

$5\text{CuS}$ ,  $\text{CuO}$ . Ppt. (Pelouze.)

$2\text{CuS}$ ,  $\text{CuO}$ . Insol. in  $\text{H}_2\text{O}$ .

$\text{CuS}$ ,  $\text{CuO}$ . Insol. in  $\text{H}_2\text{O}$ .

Above comps. do not exist. (Pickering, Chem. Soc. 33. 136.)

**Copper phosphide**,  $\text{Cu}_3\text{P}_2$ .

Easily sol. in  $\text{HNO}_3$  or aqua regia; insol. in  $\text{HCl}$  + Aq. (Rose, Pogg. 6. 209.)

Sol. in  $\text{HNO}_3$  and  $\text{Br}_2$  + Aq. Decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Rubénovitch, C. R. 1899, 128. 1399.)

$\text{Cu}_3\text{P}_2$ . Sol. in  $\text{HNO}_3$  + Aq. (Granger, A. ch. 1898, (7), 14. 64.)

*Crystallized*. Completely sol. in hot  $\text{HNO}_3$ , aqua regia and  $\text{HF}$  +  $\text{HNO}_3$ . Slowly sol. in hot  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Not attacked by hot or cold  $\text{HF}$  or acetic acid. (Maronneau, C. R. 1899, 128. 939.)

$\text{Cu}_3\text{P}_2$ . Easily sol. in  $\text{HNO}_3$ . Sol. in hot conc.  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{HCl}$  + Aq before the phosphide has been heated. (Rose, Pogg. 4. 110.)

$\text{Cu}_3\text{P}_2$ . Easily sol. in  $\text{HNO}_3$  or  $\text{HCl}$  + Aq. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Granger, Bull. Soc. (3) 9. 661.)

$\text{CuP}_2$ . Decomp. by  $\text{HNO}_3$ ; not readily sol. in  $\text{HCl}$ . Easily attacked by  $\text{Cl}_2$  or  $\text{Br}_2$  + Aq. (Granger, C. R. 1895, 120. 924.)

$\text{CuP}_2$ . (Granger, C. N. 1898, 77. 229.)

Very sol. in  $\text{HNO}_3$  and  $\text{Br}_2$  + Aq. Decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Rubénovitch, C. R. 1899, 129. 338.)

**Cupric zinc phosphide**,  $10\text{Cu}_3\text{P}_2$ ,  $\text{Zn}_3\text{P}_2$  (?).

(Hvoalef, A. 100. 99.)

**Copper phosphoselenide**,  $\text{CuSe}$ ,  $\text{P}_2\text{Se}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$  + Aq; sol. in  $\text{HNO}_3$  + Aq. Insol. in cold alkalies, but decomp. slowly when heated therewith. (Hahn, J. pr. 93. 436.)

$2\text{CuSe}$ ,  $\text{P}_2\text{Se}$ . Attacked only by fuming  $\text{HNO}_3$ . (Hahn.)

$2\text{CuSe}$ ,  $\text{P}_2\text{Se}$ . Sol. only in  $\text{HNO}_3$  + Aq. (Hahn.)

**Copper phosphosulphide**,  $2\text{Cu}_3\text{S}$ ,  $\text{P}_2\text{S}$ .

$\text{Cu}_3\text{S}$ ,  $\text{P}_2\text{S}$ . (Berzelius.)

$2\text{Cu}_3\text{S}$ ,  $\text{P}_2\text{S}$ . (Berzelius.)

$\text{CuS}$ ,  $\text{P}_2\text{S}$ . Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{HCl}$  + Aq. Sol. in conc.  $\text{HCl}$  + Aq, from which it is precipitated by  $\text{H}_2\text{O}$ . (Berzelius, A. 46. 252.)

$8\text{CuS}$ ,  $\text{P}_2\text{S}$ . (Berzelius.)

$\text{Cu}_4\text{PS}_2$ . Sol. in conc.  $\text{HNO}_3$  and in aqua regia. Insol. in  $\text{HCl}$ . Not attacked by hot  $\text{H}_2\text{SO}_4$  or conc.  $\text{NaOH}$  + Aq. (Ferrand, A. ch. 1899, (7), 17. 407.)

**Cuprous selenide**,  $\text{Cu}_2\text{Se}$ .

Ppt. Sol. in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$ .

Decomp. by  $\text{HNO}_3$ . Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Fonzes-Diacon, C. R. 1900, 131. 1207.)

Sol. in  $\text{KCN}$  + Aq. (Heyn and Bauer, Metall. 1903, 3. 84.)

Min. *Berzelianite*.

**Cupric selenide**,  $\text{CuSe}$ .

(Little, A. 112. 211.)

Ppt. Sol. in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$ . Decomp. by  $\text{HNO}_3$ . (Fonzes-Diacon, C. R. 1900, 131. 1207.)

**Cuprocupric selenide**,  $\text{Cu}_2\text{Se}_2$ .

Min. *Umangite*. Sol. in  $\text{HNO}_3$ . (Klockmann, Zeit. Kryst. 1891. 19. 270.)

**Cuprous lead selenide**,  $3\text{Cu}_2\text{Se}$ ,  $\text{PbSe}$ .

Min. *Zorgite*. Sol. in cold conc.  $\text{HNO}_3$  + Aq with separation of Se.

**Cupric lead selenide**,  $\text{CuSe}$ ,  $\text{PbSe}$ .

Sol. in cold conc.  $\text{HNO}_3$  with separation of Se. (Karsten.)

$\text{CuSe}$ ,  $2\text{PbSe}$ . As above.

$\text{CuSe}$ ,  $4\text{PbSe}$ . As above.

**Cuprous silver selenide**,  $\text{Cu}_2\text{Se}$ ,  $\text{Ag}_2\text{Se}$ .

Min. *Eucainite*. Sol. in hot  $\text{HNO}_3$  with decomp. (Berzelius.)

**Cuprous silicide**,  $\text{Cu}_3\text{Si}$ .

Sol. in warm dil. or conc.  $\text{HNO}_3$ . Only sl. sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HF}$ . Sol. in a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . Not attacked by solutions of alkalies. (Vigouroux, C. R. 1906, 142. 88.)

$\text{Cu}_2\text{Si}_2$ . Sol. in aqua regia and fused sodium potassium carbonate. (de Chalmot, Am. Ch. J. 1896, 18, 95.)

$\text{Cu}_2\text{Si}$ . Decomp. by water and moist air, and by acids and fused alkali. (Vigouroux, C. R. 1896, 122, 319.)

#### Cuprous sulphide, $\text{Cu}_2\text{S}$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{Ag}_2\text{S}$ , but much less than  $\text{PbS}$ . (Bodländer, Z. phys. Ch. 1898, 27, 64.)

1 l.  $\text{H}_2\text{O}$  dissolves  $3.1 \times 10^{-4}$  moles  $\text{Cu}_2\text{S}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58, 294.)

Very slowly decomp. by dil.  $\text{H}_2\text{SO}_4$  in presence of oxygen. (Thompson, Electrochem. Ind. 1904, 2, 225.)

Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Pickering, C. N. 1878, 37, 37.)

Cold  $\text{HNO}_3$  + Aq dissolves out Cu and leaves  $\text{CuS}$ ; hot  $\text{HNO}_3$  dissolves with separation of S. Sl. sol. in boiling conc.  $\text{HCl}$  + Aq. Insol. in  $(\text{NH}_4)_2\text{S}$  + Aq.

5N-HCl dissolves  $\text{Cu}_2\text{S}$  very slightly ( $0.0038$  g. Cu in  $7\frac{1}{2}$  hrs.) but it is more sol. in presence of Cl, when  $0.872$  g. are dissolved in  $7\frac{1}{2}$  hours. (Egli, Z. anorg. 1902, 30, 46.)

Sol. with exclusion of air in  $\text{NH}_4\text{OH}$  + Aq. (Malzac, Pat. 1904.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Min. *Chalcocite*. Completely sol. in warm  $\text{HNO}_3$  with separation of S.

#### Cupric sulphide, $\text{CuS}$ .

Almost absolutely insol. in  $\text{H}_2\text{O}$ ; sol. in 950,000 pts.  $\text{H}_2\text{O}$ . When exposed to the air, dissolves in  $\text{H}_2\text{O}$  as  $\text{CuSO}_4$ . Easily sol. in boiling  $\text{HNO}_3$  with separation of S. Difficultly sol. in hot conc.  $\text{HCl}$  + Aq. Insol. in dil.  $\text{H}_2\text{SO}_4$  + Aq. (1:6). (Hoffmann, A. 115, 286.)

Pptd. by  $\text{H}_2\text{S}$  or  $(\text{NH}_4)_2\text{S}$  + Aq in presence of 100,000 pts.  $\text{H}_2\text{O}$  (Pfaff), 200,000 pts.  $\text{H}_2\text{O}$  (Lassaigne), 15,000 pts.  $\text{H}_2\text{O}$  and 7500 pts.  $\text{HCl}$ , but with 40,000 pts.  $\text{H}_2\text{O}$  and 20,000 pts.  $\text{HCl}$  no colour is visible (Reinsch).

1 l.  $\text{H}_2\text{O}$  dissolves  $3.51 \times 10^{-4}$  moles  $\text{CuS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58, 294.)

Insol. in  $\text{H}_2\text{SO}_4$  + Aq. (Guerout, C. R. 1872, 75, 1276.)

Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Kliche, J. B. 1890, 593.)

Sol. in  $(\text{NH}_4)_2\text{CO}_3$  + Aq. (Berzelius.) Sol. in alkali bicarbonates + Aq.

Insol. in  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl}$  + Aq. (Brett.)

Insol. in acidified conc. alkali chlorides + Aq. (Cushman, Am. Ch. J. 1895, 17, 382.)

Sol. in  $\text{FeCl}_3$  + Aq with separation of S. (Cumenge and Wimmer, Dingl. 1883, 250, 123.)

Decomp. by boiling  $\text{CuCl}_2$  + Aq in presence of  $\text{HCl}$  or  $\text{NaCl}$ . (Raschig, Gm.—K. 5, I, 819.)

Sol. in  $\text{Fe}_2(\text{SO}_4)_3$  + Aq in presence of large excess of air. (Thompson, Electrochem. Ind. 1904, 2, 228.)

Insol. in  $\text{KOH}$ , or  $\text{K}_2\text{S}$  + Aq, especially if boiling; appreciably sol. in colourless and even more readily in hot yellow  $(\text{NH}_4)_2\text{S}$  + Aq.

Sl. sol. in  $\text{Na}_2\text{S}$  + Aq, more easily in  $\text{NaSH}$  + Aq. (Becker, Sill. Am. J. (3) 33, 199.)

100 cc. sat.  $\text{Na}_2\text{S}$  + Aq (sp. gr. = 1.225) dissolve  $0.0032$  g.  $\text{CuS}$ . (Holland, Ann. Chim. Anal. 1897, 2, 243.)

Sol. in K polysulphides (3-64%). (Prost, Bull. Soc. Belg. Chim. 1897, 103.)

Appreciably sol. in alkali polysulphides + Aq. (Rössing, Z. anal. 1902, 41, 1.)

Sol. in considerable quantity in alkali sulpharsenates, sulphantimonates, and sulphostannates + Aq. Therefore when a mixed ppt. of  $\text{CuS}$  and  $\text{As}_2\text{S}_3$ ,  $\text{Sb}_2\text{S}_3$ , or  $\text{SnS}$  is treated with  $\text{K}_2\text{S}$ , a portion of the  $\text{CuS}$  is dissolved. (Wöhler, A. 34, 236.)

Sol. in alkali sulphovandates, or sulphotungstates + Aq. (Storch, B. 16, 2015.)

Sol. in alkali sulphomolybdates + Aq. (Debray, C. R. 96, 1616.)

Insol. in K thiocarbonate + Aq. (Rosenblatt, Z. anal. 26, 15.)

Sol. in  $\text{KCN}$  + Aq.

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

Insol. in Na xanthogenate. (Ragg, Ch. Z. 1908, 32, 677.)

#### Solubility of $\text{CuS}$ in sugar + Aq at $t^\circ$ . g. $\text{CuS}$ per l. of solution.

$t^\circ$	10% sugar	30% sugar	50% sugar
17.5	0.5672	0.8632	0.9076
45	0.3659	0.7220	1.0589
75	1.1345	1.2033	1.2809

(Stolle, Z. Ver. Zuckerind. 1900, 50, 331.)

#### Min. *Covellite*.

Colloidal. Aqueous solution is stable when it contains 5 g.  $\text{CuS}$  in a litre; when it contains 4 or 5 times that amount it is decomposed in an hour.

Solutions of salts of the following concentration cause a precipitate in the above solution. Salts of univalent elements—

#### Salts of univalent elements—

$\text{K}_2\text{Fe}(\text{CN})_6$	1 : 62
$\text{K}_2\text{Fe}(\text{CN})_6$	1 : 127
$\text{Na}_2\text{S}_2\text{O}_3$	1 : 157
$\text{Na}_2\text{CO}_3$	1 : 200
$\text{Na}_2\text{HPO}_4$	1 : 252
$\text{Na}_2\text{SO}_4$	1 : 333
$\text{K}_2\text{Cr}_2\text{O}_7$	1 : 2083
$\text{KI}$	1 : 80
$\text{KBr}$	1 : 133
$\text{KClO}_3$	1 : 166

Salts of univalent elements—*Continued.*

$\text{NaC}_2\text{H}_3\text{O}_2$	1 : 221
$(\text{NH}_4)_2\text{C}_2\text{O}_4$	1 : 255
$\text{NaCl}$	1 : 400
$\text{NaHCO}_3$	1 : 2500
$\text{K}_2\text{SO}_4$	1 : 117
$\text{K}_2\text{CrO}_4$	1 : 133
$\text{NaC}_2\text{H}_3\text{O}_2$	1 : 166
$\text{K}_2\text{S}_2\text{O}_8$	1 : 222
$\text{KCl}$	1 : 333
$\text{KNO}_3$	1 : 500

## Salts of bivalent metals—

$\text{BaSO}_4$	1 : 2242
$\text{Cd}(\text{NO}_3)_2$	1 : 3483
$\text{MgSO}_4$	1 : 6830
$\text{Ba}(\text{NO}_3)_2$	1 : 2677
$\text{BaCl}_2$	1 : 3921
$\text{Pb}(\text{ClO}_3)_2$	1 : 6988
$\text{CdSO}_4$	1 : 3442
$\text{MnSO}_4$	1 : 5518

## Salts of trivalent metals—

Ammonia alum	1 : 31,896
Chrome alum	1 : 58,889
$\text{Al}_2(\text{SO}_4)_3$	1 : 90,909

## Acids—

Succinic	1 : 100
Oxalic	1 : 162
$\text{HCl}$	1 : 733
$\text{H}_2\text{SO}_4$	1 : 208
Citric	1 : 20
Acetic	Not at all
Tartaric	" "

(Spring and de Boeck, Bull. Soc. (2) 58. 165.)

Copper polysulphide,  $\text{Cu}_2\text{S}_x$ .*Amorphous.* Ppt. Decomp. by boiling alcohol. (Rössing, Z. anorg. 1900, 25. 413.) $\text{Cu}_2\text{S}_x$ . *Amorphous.* Ppt. can be boiled with  $\text{H}_2\text{O}$  without decomposition. (Rössing, Z. anorg. 1900, 25. 4, 11.) $\text{Cu}_2\text{S}_x$ . Ppt.; insol. in alkali sulphides; decomp. by conc.  $\text{HNO}_3$ . (Bodroux, C. R. 1900, 130. 1398.)

Could not be obtained. (Rössing, Z. anorg. 1900, 25. 414.)

 $\text{Cu}_2\text{S}_x$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in alkali and barium polysulphides + Aq. Decomp. by colorless alkali sulphides + Aq. (Rössing, Z. anorg. 1900, 25. 407.)Cuprous iron (ferric) sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{FeS}_2$ .Decomp. by conc.  $\text{HCl}$  + Aq. Sol. in boiling  $\text{HNO}_3$  + Aq. of 1.2 sp. gr. (Schneider, J. pr. (2) 38. 569.)Min. *Chalcopyrite*. Insol. in  $\text{HCl}$  + Aq. When heated in a sealed tube with  $\text{H}_2\text{S}$  + Aq, a portion of it dissolves with difficulty and subsequent deposition of S. (Senarmont, A. ch. (3) 32. 168.)Cuprocupric iron (ferric) sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{CuS}$ ,  $\text{FeS}$ .Min. *Bornite*. Sol. in  $\text{HCl}$  + Aq with a residue of S.Cupric iron (ferric) sulphide,  $\text{CuS}$ ,  $\text{FeS}_2$ .Min. *Cubanite*.Copper iron potassium sulphide,  $\text{K}_2\text{FeCu}_2\text{S}_4$ .Sl. attacked by cold dil.  $\text{HCl}$  + Aq. Decomp. by warming. (Schneider, Pogg. 138. 318.)Copper iron sodium sulphide,  $\text{Na}_2\text{FeCu}_2\text{S}_4$ .Sl. attacked by cold dil., easily decomp. by hot  $\text{HCl}$  + Aq. (Schneider, Pogg. 138. 318.)Cuprous lead sulphide,  $9\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ . $3\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ . $2\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ . Min. *Cuprophumbite*.

## Copper phosphorus sulphide.

See Copper phosphosulphide.

## Cupric platinum sulphide.

See Sulphoplatinate, cupric.

Cuprous potassium sulphide,  $4\text{Cu}_2\text{S}$ ,  $\text{K}_2\text{S}$ .

(Ditte, C. R. 98. 1429.)

Cuprocupric potassium sulphide,  $3\text{Cu}_2\text{S}$ ,  $2\text{CuS}$ ,  $\text{K}_2\text{S}$ .Not decomp. by very dil.  $\text{HCl}$  + Aq, but easily by conc.  $\text{HCl}$  + Aq on warming. (Schneider, Pogg. 138. 311.)Copper potassium polysulphide,  $\text{KCuS}_x$ .Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Decomp. by conc. and dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . Sl. sol. in alcohol. (Biltz and Herms, B. 1907, 40. 977.) $2\text{CuS}_x$ ,  $\text{K}_2\text{S}$ . Decomp. by  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4\text{SH}$  + Aq. (Priwoznik, B. 5. 1291.) $\text{K}_2\text{Cu}_2\text{S}_{10}$ . Easily sol. in  $\text{H}_2\text{O}$ . 1 g. is sol. in less than 5 ccm.  $\text{H}_2\text{O}$ . Rapidly decomp. by dil. acids, slowly by conc. acids. Sl. sol. in alcohol. (Biltz and Herms, B. 1907, 40. 983.)Cupric rubidium polysulphide,  $\text{RbCuS}_x$ .

As K salt. (Biltz and Herms, B. 1907, 40. 978.)

 $\text{Rb}_2\text{Cu}_2\text{S}_{10}$ . Easily sol. in  $\text{H}_2\text{O}$ . Decomp. by acids. Sl. sol. in alcohol. (Biltz and Herms, B. 1907, 40. 985.)Cuprous silver sulphide,  $\text{Cu}_2\text{S}$ ,  $\text{Ag}_2\text{S}$ .Min. *Stromeyerite*. Sol. in  $\text{HNO}_3$  + Aq with separation of S. $\text{Cu}_2\text{S}$ ,  $3\text{Ag}_2\text{S}$ . Min. *Jalpaite*. As above.Cuprous sodium sulphide,  $\text{Na}_2\text{S}$ ,  $\text{Cu}_2\text{S}$ .

(Bodländer, Z. Elektrochem. 1905, 11. 181.)

 $\text{Na}_2\text{S}$ ,  $2\text{Cu}_2\text{S}$ . (Bodländer, Z. Elektrochem. 1905, 11. 181.)



**Cuprocupric sodium sulphide**,  $\text{Cu}_2\text{S}$ ,  $\text{CuS}$ ,  $\text{Na}_2\text{S}$ .

Scarcely decomp. by cold dil.  $\text{HCl} + \text{Aq}$ ; conc.  $\text{HCl} + \text{Aq}$  decomp. easily on warming, without, however, dissolving all the  $\text{Cu}_2\text{S}$ . Completely decomp. by warm  $\text{HNO}_3 + \text{Aq}$ . (Schneider, Pogg. 138. 315.)

**Copper zinc sulphide**,  $\text{CuS}$ ,  $3\text{ZnS}$ .

**Copper sulphophosphide**.

See Copper phosphosulphide.

**Cupric telluride**,  $\text{CuTe}$ .

$\text{Cu}_2\text{Te}$ . Insol. in  $\text{H}_2\text{O}$ . (Parkmann, Sill. Am. J. (2) 3. 335.)

$\text{Cu}_2\text{Te}$ . (Brauner, M. 1889. 423.)

**Croceocobaltic bromide**,

$\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Br}$ .

Very sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 10. 1.)

— **chloraurate**,  $2\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ ,  $\text{AuCl}_3$ .

Difficultly sol. in  $\text{H}_2\text{O}$ .

— **chloride**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ .

Very sl. sol. in cold easily in hot  $\text{H}_2\text{O}$ , but more sol. than the sulphate. (Gibbs.)

— **chloroplatinate**,  $2\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{Cl}$ ,  $\text{PtCl}_4$ .

Can be recrystallised without decomp. with difficulty. (Gibbs and Genth, Sill. Am. J. (2) 24. 91.)

— **chromate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{CrO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— **dichromate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{Cr}_2\text{O}_7$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— **periodide**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{I}$ ,  $\text{I}_2$ .

Difficultly sol. in cold  $\text{H}_2\text{O}$  and alcohol. Decomp. by hot  $\text{H}_2\text{O}$ . (Gibbs.)

— **nitrate**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2\text{NO}_3$ .

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  or dil. acids. Much more sol. than the sulphate. (Gibbs.)

Sol. in about 400 pts. cold  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 163.)

— **nitrite cobaltic nitrite**,  $3\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$ ,  $\text{Co}(\text{NO}_2)_2$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 178.)

— **nitrite diamine cobaltic nitrite**,  $\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2$ ,  $(\text{NO}_2)_2(\text{NH}_3)_2\text{Co}(\text{NO}_2)_2$ .

Nearly insol. in cold, very sl. sol. in boiling  $\text{H}_2\text{O}$ . (Jørgensen.)

**Croceocobaltic phosphomolybdate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]_2\text{O}$ ,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 317.)

— **sulphate**,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{SO}_4$ .

Very sl. sol. in cold or hot  $\text{H}_2\text{O}$ ; more easily in hot dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Cuprammonium compounds**.

See Copper compounds, ammonia.

**Cuprotetrammonium tetraiodide**.

See Cupric tetraiodide ammonia.

**Cupric acid**.

Known only in solution. (Krüger, Pogg. 62. 445.)

**Calcium cuprate**.

Decomp. by  $\text{H}_2\text{O}$  with evolution of oxygen. (Krüger and Crum, A. 55. 213.)

**Cyanhydric acid**,  $\text{HCN}$ .

Miscible with  $\text{H}_2\text{O}$ , alcohol, and ether with absorption of heat.

Sp. gr. of  $\text{HCN} + \text{Aq}$ .

% HCN	Sp. gr.	% HCN	Sp. gr.
1.60	0.9979	4.0	0.9940
1.68	0.9978	4.6	0.9930
1.77	0.9975	5.0	0.9923
2.0	0.9974	5.3	0.9914
2.1	0.9973	5.8	0.9900
2.3	0.9970	6.4	0.9890
2.5	0.9967	7.3	0.9870
2.7	0.9964	8.0	0.9840
3.0	0.9958	9.1	0.9815
3.2	0.9952	10.6	0.9768
3.6	0.9945	16.0	0.9570

(Ure, Quar. J. Sci. 13. 321.)

$2\text{HCN}$  mixed with  $3\text{H}_2\text{O}$  causes a diminution of temp. of  $9.75^\circ$ . (Bussy and Buignet, A. ch. (4) 3. 231.)

Miscible with volatile oils and other organic compounds.

**Cyanhydric iodhydric acid**,  $\text{HI}$ ,  $\text{HCN}$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol, with rapid decomp. Sl. sol. in ether. (Gal, A. 138. 38.)

**Cyanides**.

The alkali cyanides are easily sol. in  $\text{H}_2\text{O}$ ; those of the alkali-carths are less sol., while all others are insol. with the exception of  $\text{Hg}(\text{CN})_2$ . All cyanides are sol. in  $\text{KCN} + \text{Aq}$ .

**Ammonium cyanide**,  $\text{NH}_4\text{CN}$ .

Unstable; easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Ammonium cobaltic mercuric cyanide.**

See Cobalticyanide, ammonium mercuric.

**Ammonium cuprous cyanide,  $\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$ .**

Ppt. Decomp. by acids.

+ $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , less sol. in alcohol. Decomp. by acids and alkalis. (Treadwell and Girsawald, Z. anorg. 1904, 39. 90.)

$2\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$ . Sl. sol. in  $\text{H}_2\text{O}$ , but decomp. by long boiling therewith. Sol. in  $\text{HCN} + \text{Aq}$ . (Dufau, A. 88. 278.)

**Ammonium cuprous cyanide ammonia,  $\text{NH}_4\text{CN}$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $\text{NH}_3$ .**

Easily decomp. (Treadwell and Girsawald, Z. anorg. 1904, 39. 90.)

+ $2\text{H}_2\text{O}$ . Insol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fleurent, C. R. 1893, 116. 191.)

$\text{NH}_4\text{CN}$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_3$ . Insol. in cold, sl. sol. in boiling  $\text{H}_2\text{O}$  without decomp. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fleurent, C. R. 1891, 113. 1048.)

$\text{NH}_4\text{CN}$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3 + 2\text{H}_2\text{O}$ . (Fleurent, B. 26. 498R.)

**Ammonium gold (aurous) cyanide  $\text{NH}_4\text{CN}$ ,  $\text{AuCN}$ .**

Easily sol. in cold or warm  $\text{H}_2\text{O}$  or in alcohol. Insol. in ether.

**Ammonium gold (auric) mercuric cyanide, basic,  $3\text{NH}_4\text{CN}$ ,  $2\text{Au}_2\text{O}$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgO}$ .**  
(Schmidt, Ch. Z. 1896, 20. 633.)**Ammonium mercuric silver cyanide, basic,  $\text{NH}_4\text{CN}$ ,  $2\text{Ag}_2\text{O}$ ,  $3\text{AgCN}$ ,  $4\text{Hg}(\text{OH})\text{CN} + \frac{1}{2}\text{H}_2\text{O}$ .**

(Schmidt, Z. anorg. 1895, 9. 431.)

**Ammonium nickel cyanide,  $2\text{NH}_4\text{CN}$ ,  $\text{Ni}(\text{CN})_2$ .**

Easily decomposed.

**Ammonium tungsten cyanide.**

See Tungstocyanide, ammonium.

**Ammonium zinc cyanide,  $2\text{NH}_4\text{CN}$ ,  $\text{Zn}(\text{CN})_2$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Ammonium cyanide mercuric nitrate silver cyanide basic,  $2\text{Hg}(\text{OH})\text{NO}_2$ ,  $3\text{NH}_4\text{CN}$ ,  $4\text{AgCN}$ .**

(Schmidt, Z. anorg. 1895, 9. 431.)

**Arsenic tricyanide,  $\text{As}(\text{CN})_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ . Decomp. on heating. (Guenée, C. R. 1892, 114. 1188.)

**Barium cyanide,  $\text{Ba}(\text{CN})_2$ .**

Rather sl. sol. in  $\text{H}_2\text{O}$ , more easily in  $\text{KCN} + \text{Aq}$ . (Schuls, J. pr. 68. 257.)

10 pts.  $\text{H}_2\text{O}$  dissolve 8 pts., and 10 pts. 70% alcohol dissolve 1.8 pts.  $\text{Ba}(\text{CN})_2$  at 14° (Joannia, A. ch. (5) 26. 439.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+ $2\text{H}_2\text{O}$ . Very deliquescent.

$\text{Ba}(\text{CN})_2$ ,  $\text{BaO}$ . (Drechsel, J. pr. (2) 21. 84.)

**Barium cadmium cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Cd}(\text{CN})_2 + \text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sl. sol. in alcohol. (Loebe, Dissert, 1902.)

$2\text{Ba}(\text{CN})_2$ ,  $3\text{Cd}(\text{CN})_2 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Weselsky, B. 2. 590.)

**Barium cobaltous cobaltic cyanide.**

See Cobaltocobalticyanide, barium.

**Barium cuprous cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ .**

Sol. in  $\text{H}_2\text{O}$  without decomp. (Traube, Z. anorg. 1894, 8. 21.)

+ $\text{H}_2\text{O}$ . (Weselsky, B. 2. 590.)

Could not be obtained. (Grossmann, Z. anorg. 1905, 43. 101.)

+ $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 101.)

$2\text{Ba}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2 + 6\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 105.)

**Barium gold (aurous) cyanide,  $\text{Ba}(\text{CN})_2$ ,  $2\text{AuCN} + 2\text{H}_2\text{O}$ .**

Sl. sol. in cold but easily sol. in hot  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Lindbom, Lund Univ. Arsk. 12. No. 6.)

**Barium iridium cyanide.**

See Iridicyanide, barium.

**Barium manganous cyanide,  $\text{Ba}(\text{CN})_2$ ,  $2\text{Mn}(\text{CN})_2$ .**

Ppt. (Descamps.)

See also Manganocyanide and Manganicyanide, barium.

**Barium mercuric cyanide,  $(\text{Ba}(\text{CN})_2)$ ,  $\text{Hg}(\text{CN})_2 + 3\text{H}_2\text{O}$ .**

Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 4142.)

**Barium mercuric cyanide iodide,  $\text{Ba}(\text{CN})_2$ ,  $\text{HgI}_2 + 6\text{H}_2\text{O}$ .**

(Varet, C. R. 1895, 121. 499.)

**Barium palladium cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Pd}(\text{CN})_2 + 4\text{H}_2\text{O}$ .**

See Palladocyanide, barium.

**Barium nickel cyanide,  $\text{Ba}(\text{CN})_2$ ,  $\text{Ni}(\text{CN})_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids with pptn. of  $\text{Ni}(\text{CN})_2$ . (Weselsky, B. 2. 590.)

**Barium silver cyanide**,  $\text{Ba(CN)}_2$ ,  $2\text{AgCN} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weselsky, B. 2. 589.)

**Barium zinc cyanide**,  $\text{Ba(CN)}_2$ ,  $\text{Zn(CN)}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Cadmium cyanide, basic**,  $\text{CdO}_2\text{H}_2$ ,  $2\text{Cd(CN)}_2 + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Loebe, Dissert, 1902.)

**Cadmium cyanide**,  $\text{Cd(CN)}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 1.7 pts.  $\text{Cd(CN)}_2$  at  $15^\circ$ . (Joannis.)

Easily sol. in acids; sol. in  $\text{KCN} + \text{Aq}$ . Sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Wittstein.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

**Cadmium calcium cyanide**,  $\text{Cd(CN)}_2$ ,  $4\text{Ca(CN)}_2 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert, 1902.)

**Cadmium chromic cyanide.**

See Chromicyanide, cadmium.

**Cadmium cobaltic cyanide.**

See Cobalticyanide, cadmium.

**Cadmium cuprous cyanide**,  $2\text{Cd(CN)}_2$ ,  $\text{Cu}_2(\text{CN})_2$ .

Permanent. Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in cold, easily in warm  $\text{HCl} + \text{Aq}$  without decomp., except by long boiling. Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts +  $\text{Aq}$ . (Schüler.)

**Cadmium cupric cyanide**,  $\text{Cd(CN)}_2$ ,  $\text{Cu(CN)}_2$ .

Very unstable.

**Cadmium gold (aurous) cyanide**,  $\text{Cd(CN)}_2$ ,  $2\text{AuCN}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . Sl. sol. in boiling  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lindbom.)

**Cadmium mercuric cyanide**,  $2\text{Cd(CN)}_2$ ,  $3\text{Hg(CN)}_2$ .

Permanent. Readily sol. in cold  $\text{H}_2\text{O}$ . (Schüler.)

**Cadmium mercuric cyanide mercuric iodide**,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 5. 8.)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1890, 111. 679.)

**Cadmium mercuric cyanide mercuric iodide**,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 5. 8.)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1890, 111. 679.)

**Cadmium mercuric cyanide mercuric iodide ammonia**,  $\text{Cd(CN)}_2$ ,  $\text{Hg(CN)}_2$ ,  $\text{HgI}_2$ ,  $4\text{NH}_3$ .

Very easily decomp. (Varet, Bull. Soc. (3) 6. 22.)

**Cadmium molybdenum cyanide.**

See Molybdocyanide, cadmium.

**Cadmium potassium cyanide**,  $\text{Cd(CN)}_2$ ,  $2\text{KCN}$ .

Sol. in 3 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . Insol. in absolute alcohol. (Rammelsberg.)

**Cadmium sodium cyanide**,  $\text{Na}_2\text{Cd}_2(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert, 1902.)

**Cadmium strontium cyanide**,  $\text{Cd(CN)}_2$ ,  $2\text{Sr(CN)}_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert, 1902.)

**Cadmium tungsten cyanide**,  $\text{Cd}_2\text{W(CN)}_8 + 8\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

Sl. sol. in dil.  $\text{HCl}$ . Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in organic solvents. (Olsson, Z. anorg. 1914, 88. 68.)

**Cadmium cyanide dihydrazine**,  $\text{Cd(CN)}_2$ ,  $(\text{N}_2\text{H}_4)_2$ .

Easily sol. in dil. acids. (Franzen, Z. anorg. 1911, 70. 152.)

**Cæsium cuprous cyanide**,  $\text{CsCN}$ ,  $\text{CuCN} + 1\frac{1}{2}\text{H}_2\text{O}$ .

$\text{H}_2\text{O}$  separates  $\text{CuCN}$ . (Grossmann, Z. anorg. 1905, 43. 98.)

$2\text{CsCN}$ ,  $\text{CuCN} + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 98.)

$2\text{CsCN}$ ,  $3\text{CuCN}$ . Insol. in, and not decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 98.)

**Cæsium tungsten cyanide.**

See Tungstocyanide, cæsium.

**Calcium cyanide**,  $\text{Ca(CN)}_2$ .

Sol. in  $\text{H}_2\text{O}$ , but the solution is very unstable. (Schulz.)

$\text{Ca(CN)}_2$ ,  $3\text{CaO} + 15\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Joannis, A. ch. (5) 26. 496.)

**Calcium cuprous cyanide**,  $\text{Ca(CN)}_2$ ,  $\text{CuCN} + 4\text{H}_2\text{O}$ .

Easily decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 106.)

$\text{Ca(CN)}_2$ ,  $3\text{CuCN} + 8\text{H}_2\text{O}$ . Immediately

decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 99.)

**Calcium gold (aurous) cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $2\text{AuCN} + 3\text{H}_2\text{O}$ .

Easily sol. in hot or cold  $\text{H}_2\text{O}$  or in alcohol. (Lindbom.)

**Calcium manganous cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $2\text{Mn}(\text{CN})_2$ .

Ppt. (Descamps.)

See also Manganocyanide, calcium.

**Calcium mercuric cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $2\text{Hg}(\text{CN})_2 + 8\text{H}_2\text{O}$ .

Very deliquescent. (Grossmann, B. 1904, 37. 4143.)

$2\text{Ca}(\text{CN})_2$ ,  $3\text{Hg}(\text{CN})_2 + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 4143.)

**Calcium mercuric cyanide iodide**,  $\text{Ca}(\text{CN})_2$ ,  $\text{HgI}_2$ ,  $\text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .

(Varet, C. R. 1895, 121. 499.)

**Calcium nickel cyanide**,  $\text{Ca}(\text{CN})_2$ ,  $\text{Ni}(\text{CN})_2 + x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Calcium tungsten cyanide.**

See Tungstocyanide, calcium.

**Calcium zinc cyanide**,  $(\text{Ca}(\text{CN})_2, \text{Zn}(\text{CN})_2 + 3\frac{1}{2}\text{H}_2\text{O})$ .

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Loebe, Dissert. 1902.)

**Cerous cyanide (?)**.

Ppt. Very easily decomp. (Behringer, A. 42. 139.)

**Chromic cyanide, with MCN.**

See Chromicyanide, M.

**Chromous potassium cyanide.**

See Chromocyanide, potassium.

**Cobaltous cyanide**,  $\text{Co}(\text{CN})_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , and  $\text{KCN} + \text{Aq}$ ; also in  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NH}_4$  succinate +  $\text{Aq}$ ; insol. in  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Wittstein.)

**Cobaltous cyanide with 4MCN.**

See Cobaltocyanide, M.

**Cobaltic cyanide with 3MCN.**

See Cobaltocyanide, M.

**Cobalt gold (aurous) cyanide**,  $\text{Co}(\text{CN})_2$ ,  $2\text{AuCN}$ .

Insol. in  $\text{H}_2\text{O}$  or cold  $\text{HCl} + \text{Aq}$ .

**Cobalt hydrazine cyanide**,  $(\text{N}_2\text{H}_4)_4\text{Co}(\text{CN})_6$ .  
Deliquescent. (Franzen, Z. anorg. 1911, 70. 155.)

**Cobaltous cyanide ammonia**,  $\text{Co}(\text{CN})_2$ ,  $2\text{NH}_3$ .

Unstable. (Peters, B. 1908, 41. 3178.)

**Cuprous cyanide**,  $\text{Cu}_2(\text{CN})_2$ .

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4$  succinate +  $\text{Aq}$ , and in hot  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

Easily sol. in conc.  $\text{NH}_4\text{SCN}$  or  $\text{KSCN} + \text{Aq}$ . Sl. sol. in  $\text{NaSCN} + \text{Aq}$ . (Grossmann, Z. anorg. 1903, 37. 408.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Very sl. sol. in pyridine. (Schroeder, Dissert. 1902.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 20.)

**Cupric cyanide**,  $\text{Cu}(\text{CN})_2$ .

Easily decomp. Insol. in  $\text{H}_2\text{O}$ .

Sol. in pyridine. (Schroeder, Dissert. 1901.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Cuprocupric cyanide**,  $\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. Sol. in cold conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ , and in hot  $\text{NH}_4$  salts +  $\text{Aq}$ . Easily sol. in  $\text{KCN} + \text{Aq}$ .

+  $\text{H}_2\text{O}$ . Ppt. (Dufau.)

+  $\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2 + \text{H}_2\text{O}$ . Ppt.

**Cuprous hydrazine cyanide**,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{N}_2\text{H}_4\text{CN}$ .

Insol. in alcohol and  $\text{H}_2\text{O}$ . (Ferratini, C. C. 1912, I. 1231.)

**Cupric iridium cyanide.**

See Iridicyanide, cupric.

**Cuprous lithium cyanide**,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{LiCN} + \text{H}_2\text{O}$ .

Gradually decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 97.)

**Cuprous magnesium cyanide**,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Mg}(\text{CN})_2 + 11\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 103.)

**Cuprous mercuric cyanide bromide**,  $\text{Cu}(\text{CN})_2$ ,  $2\text{Hg}(\text{CN})_2$ ,  $\text{HgBr}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Varet, C. R. 1890, 110. 148.)

**Cupric molybdenum cyanide ammonia.**

See Molybdocyanide ammonia, cupric.

**Cuprous potassium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{KCN}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ , with partial decomp. Decomp. by acids, but not by alkalis.

Decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Fleurent, C. R. 1893, 116. 191.)

Sol. without decomp. in conc.  $\text{KSCN}$ . (Grossmann, Z. anorg. 1903, 37. 407.)

Sol. without decomp. in  $\text{KCN} + \text{Aq.}$  (Treadwell and Girsawald, Z. anorg. 1904, 38. 94.)

$\text{Cu}_2(\text{CN})_2$ ,  $\text{KCN} + \text{H}_2\text{O}$ . Almost insol. in cold  $\text{H}_2\text{O}$ . 100 cc.  $\text{H}_2\text{O}$  dissolve 0.0594 g. at  $15^\circ$ . Decomp. by much hot  $\text{H}_2\text{O}$  with separation of  $\text{Cu}_2(\text{CN})_2$ . Sol. in  $\text{KCN} + \text{Aq.}$  or in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Treadwell and Girsawald, Z. anorg. 1904, 38. 93.)

$3\text{Cu}_2(\text{CN})_2$ ,  $4\text{KCN}$ . Sol. in  $\text{H}_2\text{O}$ .

$\text{Cu}_2(\text{CN})_2$ ,  $6\text{KCN}$ . Sol. in  $\text{H}_2\text{O}$ .

**Cuprous potassium cyanide ammonia,**

$\text{Cu}_2(\text{CN})_2$ ,  $\text{KCN}$ ,  $\text{NH}_3$ .

(Treadwell and Girsawald, Z. anorg. 1904, 39. 88.)

**Cuprous potassium cyanide potassium sulphocyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{KCN}$ ,  $2\text{KSCN}$ ,  $\text{H}_2\text{O}$ .**

Easily sol. in cold  $\text{H}_2\text{O}$ . (Itzig, B. 1902, 35. 108.)

**Cupric potassium cyanide,  $\text{Cu}(\text{CN})_2$ ,  $2\text{KCN}$ .**

Sol. in  $\frac{1}{2}$  pt.  $\text{H}_2\text{O}$  at  $15^\circ$  and  $\frac{1}{3}$  pt. at  $100^\circ$ . (Buignet, J. Pharm. 1859, (3), 35. 168.)

**Cuprocupric potassium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Cu}(\text{CN})_2$ ,  $2\text{KCN}$ .**

(Straus, Z. anorg. 1895, 9. 15.)

**Cuprous rubidium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{RbCN}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Pure  $\text{H}_2\text{O}$  separates  $\text{CuCN}$ . (Grossmann, Z. anorg. 1905, 43. 100.)

$3\text{Cu}_2(\text{CN})_2$ ,  $4\text{RbCN}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Pure  $\text{H}_2\text{O}$  separates  $\text{CuCN}$ . (Grossmann, Z. anorg. 1905, 43. 98.)

**Cuprous silver cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{AgCN}$ .**

Ppt.

$\text{Cu}_2(\text{CN})_2$ ,  $6\text{AgCN}$ . Sol. in excess of  $\text{Cu}_2(\text{CN})_2$ ,  $\text{KCN} + \text{Aq.}$  (Rammelsberg.)

**Cuprous sodium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{NaCN}$ .**

(Traube, Z. anorg. 1894, 8. 21.)

$+4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in excess of  $\text{NaCN} + \text{Aq.}$  (Grossmann, Z. anorg. 1905, 43. 96.)

$\text{Cu}_2(\text{CN})_2$ ,  $\text{NaCN} + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1905, 43. 96.)

$\text{Cu}_2(\text{CN})_2$ ,  $4\text{NaCN} + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  without decomp. (Grossmann, Z. anorg. 1905, 43. 96.)

$\text{Cu}_2(\text{CN})_2$ ,  $6\text{NaCN} + 6\text{H}_2\text{O}$ . Very sol. in

$\text{H}_2\text{O}$  without decomp. (Grossmann, Z. anorg. 1905, 43. 96.)

**Cuprous strontium cyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Sr}(\text{CN})_2 + 8\text{H}_2\text{O}$ .**

$\text{H}_2\text{O}$  separates  $\text{Cu}_2(\text{CN})_2$ . (Grossmann, Z. anorg. 1905, 43. 103.)

**Cuprous cyanide ammonia,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  in absence of oxygen. Insol. in alcohol and ether. Decomp. by hot  $\text{H}_2\text{O}$  and acids. (Treadwell and Girsawald, Z. anorg. 1904, 39. 87.)

**Cuprocupric cyanide ammonia,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{Cu}(\text{CN})_2$ ,  $2\text{NH}_3$ .**

(Malmberg, Arch. Pharm. 1898, 236. 256.)  $+ \text{H}_2\text{O}$ . Sl. sol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Dufau, A. 83. 278.)

$\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_3$ . (Mills, Z. Ch. 1867. 545.)

Sl. decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  and can be recryst. therefrom. Insol. in alcohol and ether. Decomp. by alkalis and acids. (Treadwell and Girsawald, Z. anorg. 1904, 39. 96.)

$\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3$ . Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Treadwell and Girsawald, Z. anorg. 1904, 39. 92.)

$2\text{Cu}_2(\text{CN})_2$ ,  $\text{Cu}(\text{CN})_2$ ,  $2\text{NH}_3$ . Insol. in  $\text{H}_2\text{O}$ , alcohol and ether. Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Decomp. by boiling acids and alkalis. (Treadwell and Girsawald, Z. anorg. 1904, 39. 92.)

$+ \text{H}_2\text{O}$ . (Monthier, J. Pharm. 11. 257.)

$\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3$ . (Hillenkamp, A. 97. 218.)

$\text{Cu}(\text{CN})_2$ ,  $2\text{Cu}_2(\text{CN})_2$ ,  $6\text{NH}_3$ . (Schiff and Becchi, A. 134. 33.)

$2\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ . (Fleurent, C. R. 114. 1060.)

$2\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$ . Correct formula for  $\text{Cu}(\text{CN})_2$ ,  $\text{Cu}_2(\text{CN})_2$ ,  $4\text{NH}_3$ . (Bouveault, Bull. Soc. (3) 4. 641.)

**Cuprous cyanide ammonium sulphocyanide,  $\text{Cu}_2(\text{CN})_2$ ,  $3\text{NH}_4\text{SCN}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37. 409.)

**Cupric cyanide hydrazine,  $\text{Cu}(\text{CN})_2(\text{N}_2\text{H}_4)$ .**

Insol. in  $\text{H}_2\text{O}$  and cold dil. acids.

Sol. in warm dil. acids. (Franzen, Z. anorg. 1911, 70. 154.)

**Cuprous cyanide mercuric iodide,  $\text{Cu}_2(\text{CN})_2$ ,  $\text{HgI}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 4. 484.)

**Cuprous cyanide potassium sulphocyanide,**  $\text{Cu}_2(\text{CN})_2, 3\text{KSCN}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37. 409.)

**Gold (aurous) cyanide,  $\text{AuCN}$ .**

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. Not attacked by dil. or conc. acids, even boiling aqua regia.

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in soluble cyanides +  $\text{Aq}$ .

Slowly decomp. by boiling  $\text{KOH} + \text{Aq}$ , also by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ .

Sol. in  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$ . (Bentel, Z. anorg. 1912, 78. 152.)

**Gold (auric) cyanide with  $\text{MCN}$ .**

See Auricyanide, M.

**Gold (auroauric) mercuric cyanide auric mercuric chloride,**  $4\text{AuCN}, \text{Au}(\text{CN})_3, 5\text{Hg}(\text{CN})_2, 7\text{AuCl}_3, 5\text{HgCl}_2$ .

(Schmidt, Ch. Z. 1896, 20. 633.)

**Gold (aurous) potassium cyanide,  $\text{AuCN}, \text{KCN}$ .**

Sol. in 7 pts. cold, and less than 0.5 pt. boiling  $\text{H}_2\text{O}$ . Sl. sol. in cold, and somewhat more sol. in boiling alcohol. Insol. in ether. (Himly, A. 42. 160.)

Decomp. by warm acids, even tartaric, and acetic acids.

**Gold (aurous) sodium cyanide,  $\text{AuCN}, \text{NaCN}$ .**

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Lindbom.)

**Gold (aurous) strontium cyanide,  $2\text{AuCN}, \text{Sr}(\text{CN})_2 + 3\text{H}_2\text{O}$ .**

As the Na salt.

**Gold (aurous) zinc cyanide,  $2\text{AuCN}, \text{Zn}(\text{CN})_2$ .**

Nearly insol. in hot or cold  $\text{H}_2\text{O}$ .

Insol. in cold  $\text{HCl} + \text{Aq}$ .

**Gold (auric) cyanide auric mercuric chloride,**  $\text{Au}(\text{CN})_3, \text{AuCl}_3, 2\text{HgCl}_2$ .

(Schmidt, Ch. Z. 1896, 20. 633.)

**Gold (auroauric) cyanide aurous mercuric chloride,  $12\text{AuCN}, 3\text{Au}(\text{CN})_3, 4\text{AuCl}_3, 2\text{HgCl}_2$ .**

(Schmidt, Ch. Z. 1896, 20. 633.)

**Gold (auroauric) cyanide mercuric chloride,  $15\text{AuCN}, 2\text{Au}(\text{CN})_3, 5\text{HgCl}_2$ .**

(Schmidt, Ch. Z. 1896, 20. 633.)

**Iridium cyanide,  $\text{Ir}(\text{CN})_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCN} + \text{Aq}$ .

**Iridium cyanide with  $\text{MCN}$ .**

See Iridicyanide, M

**Lanthanum cyanide,  $\text{La}(\text{CN})_3$ .**

Ppt. (Frerichs and Smith, B. 11. 910, 1151.)

**Lead cyanide,  $\text{Pb}(\text{CN})_2$ .**

Sl. sol. in cold, more in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ , and  $\text{KCN} + \text{Aq}$ . Partially sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , and  $\text{NH}_4$  salts +  $\text{Aq}$ . Not pptd. in presence of Na citrate.

Above compound is  $2\text{PbO}, \text{Pb}(\text{CN})_2 + \text{H}_2\text{O}$ . (Joannis, A. ch. (5) 26. 204.)

$2\text{PbO}, \text{Pb}(\text{CN})_2 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

**Lead tungsten cyanide.**

See Tungstocyanide, lead.

**Lead zinc cyanide,  $\text{Pb}(\text{CN})_2, 2\text{Zn}(\text{CN})_2$ .**

Ppt. (Rammelsberg.)

**Lead cyanide chloride,  $2\text{Pb}(\text{CN})_2, \text{PbCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Grissom and Thorp, Am. Ch. J. 10. 229.)

**Lithium mercuric cyanide mercuric iodide,  $2\text{Li}(\text{CN})_2, \text{Hg}(\text{CN})_2, \text{HgI}_2 + 7\text{H}_2\text{O}$ .**

Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Varet, C. R. 111. 526.)

**Magnesium cyanide,  $\text{Mg}(\text{CN})_2$ .**

Known only in aqueous solution which decomposes on evaporation. (Schulz.)

**Magnesium mercuric cyanide,  $2\text{Mg}(\text{CN})_2, 3\text{Hg}(\text{CN})_2 + 5\text{H}_2\text{O}$ .**

(Grossmann, B. 1904, 37. 4143.)

**Magnesium mercuric cyanide mercuric bromide,  $\text{Mg}(\text{CN})_2, \text{Hg}(\text{CN})_2, \text{HgBr}_2 + 8\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 7. 170.)

**Magnesium mercuric cyanide mercuric iodide,  $\text{Mg}(\text{CN})_2, \text{Hg}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 7. 170.)

**Magnesium platinum cyanide.**

See Platinocyanide, magnesium.

**Magnesium tungsten cyanide.**

See Tungstocyanide, magnesium.

**Manganous and manganic cyanides.**

See Manganocyanhydric, and Manganocyanhydric acids.

**Manganous strontium cyanide,  $2\text{Mn}(\text{CN})_2, \text{Sr}(\text{CN})_2$ .**

Ppt. (Descamps.)

See also Manganocyanide, strontium.

**Manganous tungsten cyanide.**

See Tungstocyanide, manganous.

**Manganic cyanide, with MCN.**

See Manganicyanide, M.

**Manganous cyanide with MCN.**

See Manganocyanide, M.

**Mercuric cyanide, basic,  $\text{Hg}(\text{CN})_2, \text{HgO}$ .**

Sl. sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ .  
Sol. with decomp. in  $\text{KOH}$ ,  $\text{KCN}$ , or  $\text{KCl} + \text{Aq}$ . (Johnston.)

Decomp. by  $\text{H}_2\text{O}$  over  $80^\circ$ . (Holdermann, Arch. Pharm. 1906, 244, 135.)

Cold  $\text{H}_2\text{O}$  dissolves about 1%, boiling  $\text{H}_2\text{O}$  about 5%. (Borelli, Gazz. ch. it. 1908, 38, (1), 361.)

1.1% dissolves in  $\text{H}_2\text{O}$  at ord. temp. (Richard, J. Chim. Phys. (6) 18, 555.)

At  $0^\circ$  1/100 mol. dissolve in 1 l.  $\text{H}_2\text{O}$ .  
At  $25^\circ$  1/32 " " " "  
At  $90^\circ$  1/10 " " " "

(Borelli, Gazz. ch. it. 1908, 38, (1), 361.)

1000 cc. cold  $\text{H}_2\text{O}$  dissolve 1.35g. (Holdermann, Arch. Pharm. 1906, 244, 135.)

Less sol. in cold  $\text{H}_2\text{O}$  than  $\text{Hg}(\text{CN})_2$ . (Pieverling, J. B. 1899, 783.)

Somewhat sol. in dil. alcohol.

Practically insol. in alcohol, ether,  $\text{C}_2\text{H}_5$ , and all organic solvents. (Borelli, Gazz. ch. it. 1908, 38, (1), 361.)

Sol. in 110 pt. alcohol of  $90^\circ$  Bé. (Richard, J. Chim. Phys. (6), 18, 555.)

$3\text{Hg}(\text{CN})_2, \text{HgO}$ . (Joannis, A. ch. (5) 26, 469.)

Moderately sol. in  $\text{H}_2\text{O}$ . (Barthe, J. Pharm. 1896, (6), 3, 186.)

Very sol. in hot, less sol. in cold  $\text{H}_2\text{O}$ . (Holdermann, Arch. Pharm. 1904, 242, 32.)

Easily sol. in  $\text{HCl}$ . (Joannis, A. ch. 1882, (5) 26, 511.)

$\text{Hg}(\text{CN})_2, 3\text{HgO}$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{Hg}(\text{CN})_2, \text{HgO}$ .

**Mercuric cyanide,  $\text{Hg}(\text{CN})_2$ .**

Moderately sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{Hg}(\text{CN})_2 + \text{Aq}$  sat. at  $101.1^\circ$  contain 35 pts.  $\text{Hg}(\text{CN})_2$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 53.85 pts.  $\text{Hg}(\text{CN})_2$  at  $101.1^\circ$ . (Griffiths.)

Sol. in 8 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Abl.)

Sol. in 11 pts. cold, and 2.5 pts. boiling  $\text{H}_2\text{O}$ . (Wittstein.)

8 g. are sol. in 100 g.  $\text{H}_2\text{O}$  at  $-0.45^\circ$ . (Guthrie, Phil. Mag. 1878, (5) 6, 40.)

100 g.  $\text{H}_2\text{O}$  dissolve 9.3 g. at  $13.5^\circ$ . (Timofeiev, Dissert. 1894.)

100 cc. sat. solution contain 9.3 g. at  $20^\circ$ . (Konowalow, J. russ. Soc. 1898, (4) 30, 367.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 0.44$  mol. l. (Sherrill, Z. phys. Ch. 1903, 43, 735.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.3956 mol. (Hofmann and Wagner, Z. Elektrochem. 1909, 15, 444.)  
100 g.  $\text{H}_2\text{O}$  dissolve 12.5 g. at  $15^\circ$ . (Marsh and Struthers, Chem. Soc. 1905, 87, 1879.)

100 g.  $\text{H}_2\text{O}$  dissolve 11.27 g. at  $25^\circ$ . Sp. gr. of solution = 1.0813. (Herz and Anders, Z. anorg. 1907, 52, 164.)

$\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 7.23%  $\text{Hg}(\text{CN})_2$  has sp. gr.  $20^\circ/20^\circ = 1.0572$ .

$\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 9.07%  $\text{Hg}(\text{CN})_2$  has sp. gr.  $20^\circ/20^\circ = 1.0743$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19, 282.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{Hg}(\text{CN})_2 + \text{Aq}$  containing 7.8921%  $\text{Hg}(\text{CN})_2 = 1.06376$ ; containing 5.4037% = 1.04246; containing 7.5009% = 1.06049. (Schönrock, Z. phys. Ch. 1893, 11, 770.)

Not decomp. by acids except hot conc.  $\text{H}_2\text{SO}_4$ .

Sol. without decomp. in  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)

1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (5.2%  $\text{NH}_3$ ) dissolves 204.3 g. at about  $25^\circ$ . (Konowalow.)

Solubility in bases.

1 l.  $\text{H}_2\text{O}$  containing 0.3286 mols.  $\text{KOH}$  dissolves 0.5179 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.2350 mols.  $\text{NaOH}$  dissolves 0.4840 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.4775 mols.  $\text{NaOH}$  dissolves 0.5977 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.9475 mols.  $\text{NaOH}$  dissolves 0.79603 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.970 mols.  $\text{LiOH}$  dissolves 0.6543 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.480 mols.  $\text{LiOH}$  dissolves 0.5560 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.243 mols.  $\text{LiOH}$  dissolves 0.4840 mols.  $\text{Hg}(\text{CN})_2$ .

(Hofmann and Wagner, Z. Elektrochem. 1909, 15, 444.)

**Solubility in  $\text{KCN} + \text{Aq}$  at  $25^\circ$ .**

Concentration of $\text{KCN}$ Mols. per litre	Solubility of $\text{Hg}(\text{CN})_2$ Mols. per litre
0.0493	0.4855
0.0985	0.5350
0.1970	0.627.

(Sherrill, Z. phys. Ch. 1903, 43, 719.)

**Solubility in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ .**

1 l.  $\text{H}_2\text{O}$  containing 0.4923 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.4956 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.2443 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.4464 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.1250 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.4147 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.0000 mols.  $\text{Na}_2\text{CO}_3$  dissolves 0.3952 mols.  $\text{Hg}(\text{CN})_2$ .

(Hofmann and Wagner, Z. Elektrochem. 1909, 15, 444.)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ .

1 l.  $\text{H}_2\text{O}$  containing 0.9574 mols.  $\text{KNO}_3$  dissolves 0.5383 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.4614 mols.  $\text{KNO}_3$  dissolves 0.4619 mols.  $\text{Hg}(\text{CN})_2$ .

1 l.  $\text{H}_2\text{O}$  containing 0.0000 mols.  $\text{KNO}_3$  dissolves 0.3956 mols.  $\text{Hg}(\text{CN})_2$ .

(Hofmann and Wagner, Z. Elektrochem. 1909, 15. 444.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl alcohol at  $t^\circ$ .

$t^\circ$	% $\text{HgCl}_2$
0	8.3
10	8.8
20	9.25
30	9.8
40	10.3

(Timofeiev, Dissert. 1894.)

Solubility of  $\text{Hg}(\text{CN})_2$  in methyl alcohol at  $t^\circ$ .  
 $\text{Hg}(\text{CN})_2 = \text{g. Hg}(\text{CN})_2$  in 100 g. of the solution.

$t^\circ$	$\text{Hg}(\text{CN})_2$
0.0	26.10
14.7	29.17
23.4	32.01
27.4	31.77
31.7	32.53
38.1	33.29
44.5	34.05

(Dukelski, Z. anorg. 1907, 53. 337.)

100 pts. methyl alcohol dissolve 44.2 pts.  $\text{Hg}(\text{CN})_2$  at  $19.5^\circ$ ; 100 pts. ethyl alcohol dissolve 2.09 pts. at  $19.5^\circ$ . (de Bruyn, Z. phys. Ch. 1892, 10. 784.)

Sol. in 2.5 pts. methyl alcohol at  $14^\circ$ ; in 20 pts. ethyl alcohol at  $15^\circ$ . (Marsh, Chem. Soc. 1905, 87. 1878.)

Solubility of  $\text{Hg}(\text{CN})_2$  in methyl alcohol + Aq at  $25^\circ$ .

$P = \text{g. alcohol in 100 g. alcohol} + \text{Aq.}$   
 $\text{Hg}(\text{CN})_2 = \text{millimols. Hg}(\text{CN})_2$  in 10 cc. of the solution.

P	$\text{Hg}(\text{CN})_2$	Sp. gr.
0	4.34	1.0813
10.60	4.37	1.0642
30.77	4.94	1.0484
37.21	5.40	1.0430
47.06	6.49	1.0426
64.00	8.13	1.0441
78.05	9.75	1.0484
100	13.60	1.0762

(Herz and Anders, Z. anorg. 1907, 52. 165.)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl alcohol + Aq at  $25^\circ$ .

$P = \text{g. alcohol in 100 g. alcohol} + \text{Aq.}$   
 $\text{Hg}(\text{CN})_2 = \text{millimols Hg}(\text{CN})_2$  in 10 cc. of the solution.

P	$\text{Hg}(\text{CN})_2$	Sp. gr.
0	4.34	1.0813
20.18	3.47	1.0339
40.69	3.58	1.0006
70.01	3.80	0.9419
100	3.25	0.8552

(Herz and Anders, l. c.)

Solubility of  $\text{Hg}(\text{CN})_2$  in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

$P = \%$  methyl alcohol in the solvent.  
 $\text{Hg}(\text{CN})_2 = \text{g. Hg}(\text{CN})_2$  in 10 ccm. of the solution.

$S \ 25^\circ/4^\circ = \text{Sp. gr. of the sat. solution.}$

P	$\text{Hg}(\text{CN})_2$	$S \ 25^\circ/4^\circ$
0	0.819	0.8552
4.37	0.902	0.8618
10.4	1.01	0.8707
41.02	1.67	0.9267
80.69	2.82	1.024
84.77	2.96	1.034
91.25	3.09	1.052
100	3.43	1.076

(Herz and Kuhn, Z. anorg. 1908, 58. 166.)

100 g. propyl alcohol dissolve 3.79 g.  $\text{Hg}(\text{CN})_2$  at  $13.5^\circ$ . (Timofeiev, Dissert. 1894.)

Solubility in mixtures of propyl and methyl alcohol at  $25^\circ$ .

$P = \%$  propyl alcohol in the solvent.  
 $G = \text{g. Hg}(\text{CN})_2$  in 10 ccm. of the solution.  
 $S = \text{Sp. gr. of the sat. solution.}$

P	G	$S \ 25^\circ/4^\circ$
0	3.43	1.0760
11.11	2.952	1.0327
23.8	2.448	0.9891
65.2	1.048	0.8800
91.8	0.504	0.8376
93.97	0.423	0.8335
96.6	0.398	0.8322
100	0.344	0.8283

(Herz and Kuhn, Z. anorg. 1908, 60. 158.)



Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.

G = g.  $\text{Hg}(\text{CN})_2$  in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.819	0.8552
8.1	0.790	0.8549
17.85	0.730	0.8527
56.6	0.521	0.8386
88.6	0.387	0.8311
91.2	0.384	0.8306
95.2	0.364	0.8293
100	0.344	0.8283

(Herz and Kuhn, l. c.)

Sp. gr. at 16°/4° of  $\text{Hg}(\text{CN})_2$  + alcohol, containing 8.2206 %  $\text{Hg}(\text{CN})_2$  = 0.85273; containing 5.8652 % = 0.8348 +.

Sp. gr. of 16°/4° of  $\text{Hg}(\text{CN})_2$  + pyridine containing 29.6018 %  $\text{Hg}(\text{CN})_2$  = 1.28155; containing 23.2275 % = 1.20198.

(Schönrock, Z. phys. Ch. 1893, 11. 771.)

1 l. ether dissolves 0.01 mol. at 25°. (Sherrill, Z. phys. Ch. 1903, 43. 735.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 84.)

100 g. glycerol dissolve 27 g.  $\text{Hg}(\text{CN})_2$  at 15.5°. (Ossendowski, Pharm. J. 1907, 79. 575.)

Nearly insol. in  $\text{C}_6\text{H}_6$ . (Sherrill, Z. phys. Ch. 1903, 43. 735.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

100 g. boiling methyl acetate dissolve 3.2 g. (Steiner, Dissert, 1906.)

Solubility of  $\text{Hg}(\text{CN})_2$  in ethyl acetate + Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.

$\text{Hg}(\text{CN})_2$  = millimols  $\text{Hg}(\text{CN})_2$  in 10 cc. of the solution.

P	$\text{Hg}(\text{CN})_2$	Sp. gr.
0	4.34	1.0810
4.39	4.295	1.0797
96.76	1.056	1.9374
100	0.714	0.09097

(Herz and Anders, Z. anorg. 1907, 52. 165.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Solubility in organic solvents at 18–20°.

100 g. tetrachlormethane dissolve 0.001 g.  $\text{Hg}(\text{CN})_2$ .

100 g. bromoform dissolve 0.005 g.  $\text{Hg}(\text{CN})_2$ .

100 g. ethyl bromide dissolve 0.013 g.  $\text{Hg}(\text{CN})_2$ .

100 g. ethylene dibromide dissolve 0.001 g.  $\text{Hg}(\text{CN})_2$ .

(Sulc, Z. anorg. 1900, 25. 401.)

100 g. acetonitrile dissolve 9.58 g.  $\text{Hg}(\text{CN})_2$  at 18°. (Naumann and Schier, B. 1914, 47. 249.)

Solubility in benzonitrile at 18° = 1.093 g. in 100 g. (Naumann, B. 1914, 47. 1370.)

Sl. sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Very sol. in liquid methyl amine. (Gibbs, J. Am. Chem. Soc. 1906, 28. 1419.)

Sol. in paratoluidine. (Werner, Z. anorg. 1897, 15. 7.)

Mol. weight determined in pyridine and benzonitrile. (Werner, Z. anorg. 1897, 15. 20 and 32.)

100 g. pyridine dissolve 64.8 g.  $\text{Hg}(\text{CN})_2$  at 18°. (Schroeder, Z. anorg. 1905, 44. 6.)

Solubility in pyridine.

Mols. per 100 $\text{Hg}(\text{CN})_2$	Temp. of Solidification	Mols. per 100 $\text{Hg}(\text{CN})_2$	Temp. of Solidification
7.1	9	22.9	45
8.7	11	23.7	46
10.1	12.3	25.3	53
10.4	12.2	26.0	54.5
11.3	13	26.6	56.6
12.9	13.5	27.5	68
13.8	14.5	27.7	70
15.8	16.5	29.0	86
15.9	20.5	32.0	111
17.3	22.5	33.8	122.5
18.4	28.5	34.4	125
19.3	32	38.3	141
20.6	38	....	....
22.3	42	....	....

(Staronka, Ans. Ak. Wiss. Krakau, 1910. 372.)

Solubility in quinoline.

Mols. per 100 $\text{Hg}(\text{CN})_2$	Temp. of Solidification	Mols. per 100 $\text{Hg}(\text{CN})_2$	Temp. of Solidification
4.2	45°	13.2	137°
6.0	54	17.4	161
8.2	89(61)	22.5	180
9.2	99(61)	27.1	192

(Staronka, l. c.)

Solubility in aniline.

Mols. per 100 $\text{Hg}(\text{CN})_2$	Temp. of Solidification	Mols. per 100 $\text{Hg}(\text{CN})_2$	Temp. of Solidification
3.7	....	14.2	77° (?)
4.9	26° (?)	18.2	83.5 (?)
5.7	30.5 (?)	19.7	84 (?)
7.7	35 (?)	23.4	88.5 (?)
9.2	38.5 (?)	....	....

(Staronka, l. c.)

Mercuric nickel cyanide ammonia,  $2\text{Hg}(\text{CN})_2$ ,  $4\text{Ni}(\text{CN})_2$ ,  $5\text{NH}_3$  +  $2\text{H}_2\text{O}$ .

(Papiermeister, Dissert. 1896.)

$5\text{Hg}(\text{CN})_2$ ,  $18\text{Ni}(\text{CN})_2$ ,  $8\text{NH}_3$  +  $15\text{H}_2\text{O}$ .

(Papiermeister, Dissert. 1896.)

**Mercuric potassium cyanide,  $\text{Hg}(\text{CN})_2, 2\text{KCN}$ .**

Sol. in 4.4 pts. cold  $\text{H}_2\text{O}$ ; sl. sol. in alcohol; decomp. by acids.

100 g.  $\text{H}_2\text{O}$  dissolve 22.7 g. (Fronmüller, B. 1878, 11. 92.)

Abundantly sol. in liquid  $\text{NH}_3$ . (Franklin, Z. phys. Ch. 1909, 69. 295.)

**Mercuric silver cyanide, basic,  $\text{Hg}(\text{CN})_2, \text{HgO}, 7\text{AgCN}$ .**

Ppt. (Bloxxam, B. 16. 2669.)

**Mercuric silver cyanide mercuric sulphate,  $\text{Hg}(\text{CN})_2, 2\text{AgCN}, \text{HgSO}_4 + \text{H}_2\text{O}$ .****Mercuric sodium cyanide,  $\text{Hg}(\text{CN})_2, \text{NaCN} + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 4141.)

**Mercuric strontium cyanide,  $\text{Hg}(\text{CN})_2, \text{Sr}(\text{CN})_2 + 5\text{H}_2\text{O}$ .**

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 4142.)

**Mercuric strontium cyanide iodide,  $\text{Sr}(\text{CN})_2, \text{HgI}_2, \text{Hg}(\text{CN})_2 + 7\text{H}_2\text{O}$ .**

(Varet, C. R. 1895, 121. 499.)

**Mercuric thallium cyanide,  $\text{Hg}(\text{CN})_2, 2\text{TlCN}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 7.9 pts. at  $1^\circ$ , and 10.3 pts. at  $10^\circ$ . (Fronmüller, B. 11. 92.)

**Mercuric zinc cyanide,  $4\text{Zn}(\text{CN})_2, \text{Hg}(\text{CN})_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Dunstan, Chem. Soc. 6. 666.)

**Mercuric zinc cyanide mercuric bromide ammonia,  $\text{Hg}(\text{CN})_2, \text{Zn}(\text{CN})_2, \text{HgBr}_2, 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1889, 109. 810.)

**Mercuric cyanide ammonia,  $\text{Hg}(\text{CN})_2, \text{NH}_3$ .**

Very sol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and alcohol. (Varet, C. R. 1889, 109. 903.)

Sl. sol. in  $\text{H}_2\text{O}$ . (Schmidt, B. 1894, 27. 232.)

$5\text{Hg}(\text{CN})_2, 2\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Easily decomp. (Varet, Bull. Soc. (3) 6. 221.)

**Mercuric cyanide bromide,  $\text{Hg}(\text{CN})_2, \text{HgBr}_2$ .**

Very sl. sol. even in boiling  $\text{H}_2\text{O}$ . (Prussia, Gazz. ch. it. 1898, 23, (2), 114.)

**Mercuric cyanide barium bromide,  $2\text{Hg}(\text{CN})_2, \text{BaBr}_2 + 6\text{H}_2\text{O}$ .**

Easily sol. especially in hot  $\text{H}_2\text{O}$  and alcohol. (Varet, C. R. 1895, 121. 398.)

**Mercuric cyanide cadmium bromide,  $\text{Hg}(\text{CN})_2, \text{CdBr}_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 5. 8.)

$2\text{Hg}(\text{CN})_2, \text{CdBr}_2 + 4.5 \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1890, 111. 680.)

**Mercuric cyanide cadmium bromide ammonia,  $2\text{Hg}(\text{CN})_2, \text{CdBr}_2, 4\text{NH}_3 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1891, 112. 535.)

**Mercuric cyanide calcium bromide,  $2\text{Hg}(\text{CN})_2, \text{CaBr}_2 + 5\text{H}_2\text{O}$ .**

Sol. in 1 pt. cold, and 0.25 pt. boiling  $\text{H}_2\text{O}$ ; also in 2 pts. cold, and 1 pt. boiling 90% alcohol. (Custer.)

$+ 7\text{H}_2\text{O}$ . (Varet, C. R. 1895, 121. 399.)

**Mercuric cyanide cupric bromide ammonia,  $2\text{Hg}(\text{CN})_2, \text{CuBr}_2, 4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 6. 221.)

**Mercuric cyanide lithium bromide,  $2\text{Hg}(\text{CN})_2, 2\text{LiBr} + 7\text{H}_2\text{O}$ .**

Deliquescent. (Varet, C. R. 111. 526.)

**Mercuric cyanide magnesium bromide.**

See Magnesium mercuric cyanide mercuric bromide.

$\text{Hg}(\text{CN})_2, 2\text{KBr}$ . Very sol. in  $\text{H}_2\text{O}$ . (Harth, Z. anorg. 1897, 14. 351.)

**Mercuric cyanide potassium bromide,  $\text{Hg}(\text{CN})_2, \text{KBr} + 2\text{H}_2\text{O}$ .**

Sol. in 13.34 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and less than 1 pt. boiling  $\text{H}_2\text{O}$ . (Brett.)

Sol. without decomp. in hot dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . (Brett.)

Contains  $1\frac{1}{2}\text{H}_2\text{O}$ . (Berthelot, A. ch. (5) 29. 226.)

**Mercuric cyanide sodium bromide,  $\text{Hg}(\text{CN})_2, \text{NaBr} + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Mercuric cyanide strontium bromide,  $2\text{Hg}(\text{CN})_2, \text{SrBr}_2 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Varet, C. R. 1895, 121. 399.)

**Mercuric cyanide zinc bromide,  $\text{HgBr}_2, \text{Hg}(\text{CN})_2, \text{Zn}(\text{CN})_2 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 5. 8.)

**Mercuric cyanide zinc bromide ammonia,  $\text{HgBr}_2, \text{Hg}(\text{CN})_2, \text{Zn}(\text{CN})_2, 4\text{NH}_3$ .**

As the corresponding chloride. (Varet.)

**Mercuric cyanide chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{HgCl}_2$ .

Sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol, which dissolves out  $\text{HgCl}_2$ .

**Mercuric cyanide ammonium chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_4\text{Cl}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Poggiale.)  
 $\text{Hg}(\text{CN})_2$ ,  $4\text{NH}_4\text{Cl}$ .

**Mercuric cyanide barium chloride**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{BaCl}_2 + 4\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol +  $6\text{H}_2\text{O}$ . (Dexter.)

**Mercuric cyanide barium chloride ammonia**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{BaCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 6. 221.)

**Mercuric cyanide cadmium chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{CdCl}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 5. 8.)

**Mercuric cyanide calcium chloride**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{CaCl}_2 + 6\text{H}_2\text{O}$ .

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Varet, C. R. 1895, 121. 349.)

**Mercuric cyanide cerium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  $\text{CeCl}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ahlén, Bull. Soc. (2) 27. 365.)

**Mercuric cyanide cobaltous chloride**,  $\text{Hg}(\text{CN})_2$ ,  $2\text{CoCl}_2 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Poggiale.)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{CoCl}_2 + 7\text{H}_2\text{O}$ . (Dexter.)

**Mercuric cyanide cupric chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$ .

Efflorescent.  
Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1888, 107. 1002.)

$2\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2 + 6\text{H}_2\text{O}$ . Efflorescent.

Very sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, C. R. 1888, 107. 1002.)

**Mercuric cyanide cupric chloride ammonia**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{CuCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 6. 221.)

**Mercuric cyanide didymium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  $\text{DiCl}_2 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ahlén.)

**Mercuric cyanide erbium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  $\text{ErCl}_3 + 8\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ahlén.)

**Mercuric cyanide hydrazine chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{N}_2\text{H}_4$ ,  $\text{HCl}$ .

Very sol. in  $\text{H}_2\text{O}$ .

Nearly insol. in alcohol and ether. (Fer-ratini, Gazz. ch. it. 1912, 42. (1), 154.)

**Mercuric cyanide ferric chloride**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{FeCl}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .

(Dexter.)

**Mercuric cyanide lanthanum chloride**,  $3\text{Hg}(\text{CN})_2$ ,  $\text{LaCl}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ahlén.)

**Mercuric cyanide magnesium chloride**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{MgCl}_2 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. alcohol. (Poggiale.)

**Mercuric cyanide manganous chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{MnCl}_2 + 3\text{H}_2\text{O}$ .

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Poggiale.)

**Mercuric cyanide nickel chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{NiCl}_2 + 6\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Poggiale.)  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{NiCl}_2 + 7\text{H}_2\text{O}$ . (Dexter.)

**Mercuric cyanide chloride nickel chloride oxychloride**,  $11\text{Hg}(\text{CN})_2$ ,  $8\text{HgCl}_2$ ,  $2\text{NiCl}_2$ ,  $8\text{Ni}(\text{OH})\text{Cl} + 76\text{H}_2\text{O}$ .

(Papiermeister, Dissert. 1898.)

**Mercuric cyanide potassium chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{KCl} + \text{H}_2\text{O}$ .

Sol. in 6.75 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Brett.)  
Sol. in alcohol.

**Mercuric cyanide sodium chloride**,  $\text{Hg}(\text{CN})_2$ ,  $\text{NaCl}$ .

Easily sol. especially in hot  $\text{H}_2\text{O}$ ; insol. in alcohol. (Poggiale.)

**Mercuric cyanide strontium chloride**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{SrCl}_2 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. alcohol. (Varet, C. R. 1895, 121. 349.)

**Mercuric cyanide yttrium chloride**,  $3\text{Hg}(\text{CN})_2$ ,  $\text{YCl}_3 + 8\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ahlén, Bull. Soc. (2) 27. 365.)

**Mercuric cyanide zinc chloride**,  $2\text{Hg}(\text{CN})_2$ ,  $\text{ZnCl}_2 + 6\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Kane.)  
 $\text{HgCl}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2 + 7\text{H}_2\text{O}$ . Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Varet, Bull. Soc. (3) 5. 8.)

**Mercuric cyanide zinc chloride ammonia**,  $\text{HgCl}_2$ ,  $\text{Hg}(\text{CN})_2$ ,  $\text{ZnCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet, Bull. Soc. (3) 6. 221.)  
 $\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{CN})_2$ ,  $\text{HgCl}_2$ ,  $6\text{NH}_3$ . (Varet, C. R. 106. 1080.)

**Mercuric cyanide potassium chromate.**

See Chromate mercuric cyanide, potassium.

**Mercuric cyanide potassium ferrocyanide,**  
 $3\text{Hg}(\text{CN})_2, \text{K}_4\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}.$ 

Readily sol. in  $\text{H}_2\text{O}$ .

**Mercuric cyanide hydrazine,  $\text{Hg}(\text{CN})_2,$   
 $\text{N}_2\text{H}_4.$** 

Very sol. in  $\text{H}_2\text{O}$  with partial decomp. (Hofmann and Marburg, A. 1899, 305. 215.)  
 $\text{Hg}(\text{CN})_2, \text{N}_2\text{H}_4$ . Ppt. (Franzen, Z. anorg. 1911, 70. 154.)

**Mercuric cyanide potassium hydroxide,**  
 $\text{Hg}(\text{CN})_2, \text{KOH}.$ 

(Hofmann and Wagner, B. 1908, 41. 321.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$ . (Hofmann and Wagner, B. 1908, 41. 1630.)

$2\text{Hg}(\text{CN})_2, \text{KOH} + \text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .  
 (Hofmann and Wagner, B. 1908, 41. 320.)

**Mercuric cyanide sodium hydroxide,**  
 $\text{Hg}(\text{CN})_2, \text{NaOH} + 1\frac{1}{2}\text{H}_2\text{O}$  or  $\text{H}_2\text{O}.$ 

(Hofmann and Wagner, B. 1908, 41. 1631.)

**Mercuric cyanide barium iodide,  $2\text{Hg}(\text{CN})_2,$   
 $\text{BaI}_2 + 4\text{H}_2\text{O}.$** 

Slowly deliquescent. Sol. in 16.5 pts. cold, and 0.4 pt. boiling  $\text{H}_2\text{O}$ . Sol. in 22.5 pts. cold, and 1.6 pts. hot 90% alcohol. Solution is decomp. on boiling. (Custer.)

**Mercuric cyanide cadmium iodide,  $\text{Hg}(\text{CN})_2,$   
 $\text{Cd}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}.$** 

See Cadmium mercuric cyanide mercuric iodide.

**Mercuric cyanide caesium iodide,  $\text{Hg}(\text{CN})_2,$   
 $\text{CaI}.$** 

Recryst. from  $\text{H}_2\text{O}$  without decomp.  
 Decomp. by acids. (Mathewson and Wells, Am. Ch. J. 1903, 30. 433.)

**Mercuric cyanide calcium iodide,  $2\text{Hg}(\text{CN})_2,$   
 $\text{CaI}_2 + 6\text{H}_2\text{O}.$** 

Sl. efflorescent. More sol. in  $\text{H}_2\text{O}$  than corresponding Sr. comp. (Custer.)

**Mercuric cyanide lithium iodide,  $\text{Hg}(\text{CN})_2,$   
 $2\text{Li}(\text{CN})_2, \text{HgI}_2 + 7\text{H}_2\text{O}.$** 

See Cyanide, lithium mercuric mercuric iodide.

**Mercuric cyanide magnesium iodide,**  
 $\text{Hg}(\text{CN})_2, \text{Mg}(\text{CN})_2, \text{HgI}_2 + 8\text{H}_2\text{O}.$ 

See Cyanide, magnesium mercuric mercuric iodide.

**Mercuric cyanide potassium iodide,  $\text{Hg}(\text{CN})_2,$   
 $\text{KI}.$** 

Sol. in 16 pts. cold, and less hot  $\text{H}_2\text{O}$ . Sol. in 96 pts. cold alcohol of 34° Baumé. (Cail-  
 lot.) Sl. sol. in ether. Decomp. by acids.  
 $3\text{Hg}(\text{CN})_2, 2\text{KI} + \frac{1}{2}\text{H}_2\text{O}$ . (Berthelot.)

**Mercuric cyanide sodium iodide,  $\text{Hg}(\text{CN})_2,$   
 $\text{NaI} + 2\text{H}_2\text{O}.$** 

Sol. in  $4\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at 18°, and  $\frac{1}{7}$  pt. boiling  $\text{H}_2\text{O}$ .

Sol. in 2 pts. boiling, and  $6\frac{1}{2}$  pts. cold 90% alcohol. (Custer.)

**Mercuric cyanide strontium iodide,**  
 $2\text{Hg}(\text{CN})_2, \text{SrI}_2 + 6\text{H}_2\text{O}.$ 

Sol. in 7 pts.  $\text{H}_2\text{O}$  at 18°, and  $\frac{1}{2}$  pt. at b.-pt.  
 Sol. in 4 pts. 90% alcohol at 18°, and  $\frac{1}{2}$  pt. at b.-pt. (Custer.)

**Mercuric cyanide zinc iodide,  $2\text{Hg}(\text{CN})_2,$   
 $\text{ZnI}_2 + 6\text{H}_2\text{O}.$** 

Efflorescent; sol. in  $\text{H}_2\text{O}$ .

**Mercuric cyanide iodide potassium cyanide,**  
 $\text{HgI}_2, \text{Hg}(\text{CN})_2, 2\text{KCN}.$ 

Easily decomp. by dil. acids. (Rupp. Apoth. Ztg., 23. 374.)

**Mercuric cyanide cadmium nitrate,**  
 $2\text{Hg}(\text{CN})_2, \text{Cd}(\text{NO}_3)_2 + 7\text{H}_2\text{O}.$ 

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Ny-  
 lander, J. B. 1859 271.)

**Mercuric cyanide cobalt nitrate,  $2\text{Hg}(\text{CN})_2,$   
 $\text{Co}(\text{NO}_3)_2 + 7\text{H}_2\text{O}.$** 

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Ny-  
 lander.)

**Mercuric cyanide copper nitrate,  $\text{Hg}(\text{CN})_2,$   
 $\text{Cu}(\text{NO}_3)_2 + 5\text{H}_2\text{O}.$** 

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Ny-  
 lander.)

**Mercuric cyanide ferrous nitrate,  $2\text{Hg}(\text{CN})_2,$   
 $\text{Fe}(\text{NO}_3)_2 + 7\text{H}_2\text{O}.$** 

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Ny-  
 lander.)

**Mercuric cyanide manganous nitrate,**  
 $\text{Hg}(\text{CN})_2, \text{Mn}(\text{NO}_3)_2 + 5\text{H}_2\text{O}.$ 

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Ny-  
 lander.)

$2\text{Hg}(\text{CN})_2, \text{Mn}(\text{NO}_3)_2 + 7\text{H}_2\text{O}$ . As above.

**Mercuric cyanide nickel nitrate,  $2\text{Hg}(\text{CN})_2,$   
 $\text{Ni}(\text{NO}_3)_2 + 7\text{H}_2\text{O}.$** 

Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Ny-  
 lander.)

**Mercuric cyanide silver nitrate,  $2\text{Hg}(\text{CN})_2,$   
 $\text{AgNO}_3 + 2\text{H}_2\text{O}.$** 

Sl. sol. in cold, more readily in hot  $\text{H}_2\text{O}$ .  
 Sol. with decomp. in  $\text{HNO}_3 + \text{Aq}$ .

As sol. in alcohol as in  $\text{H}_2\text{O}$ .

**Mercuric cyanide zinc nitrate,  $2\text{Hg}(\text{CN})_2,$   
 $\text{Zn}(\text{NO}_3)_2 + 7\text{H}_2\text{O}.$** 

Sol. in  $\text{H}_2\text{O}$  with decomp. (Not decomp. by  
 alcohol. (Nylander, J. B. 1859. 271.)

**Mercuric cyanide nitrate silver cyanide, basic,**  
 $\text{Hg}(\text{NO}_3)_2\text{CN}$ ,  $10\text{AgCN}$ ,  $\text{Hg}(\text{OH})\text{NO}_2$ .  
 (Schmidt, Z. anorg. 1895, 9. 431.)

**Mercuric cyanide potassium selenocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KSeCN}$ .

Sl. sol. in cold, much more easily sol. in hot  $\text{H}_2\text{O}$  or alcohol. Traces dissolve in ether. (Cameron and Davy, C. N. 44. 63.)

**Mercuric cyanide nickel sulphate,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NiSO}_4 \cdot 9\text{H}_2\text{O}$ .

(Papiermeister, Dissert. 1898.)

**Mercuric cyanide ammonium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NH}_4\text{SCN}$ .

Easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 23. 71.)

**Mercuric cyanide barium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Ba}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .

Permanent. Sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide cadmium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Cd}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .

Permanent. Sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide calcium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Ca}(\text{SCN})_2 \cdot 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide cerium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Ce}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .

Easily sol. in hot  $\text{H}_2\text{O}$ . (Jolin.)

**Mercuric cyanide didymium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Di}(\text{SCN})_3 \cdot 6\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide erbium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $2\text{Er}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide lanthanum sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{La}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide magnesium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Mg}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .

Permanent. Easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide potassium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{KSCN}$ .

Permanent. Easily sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

+  $2\text{H}_2\text{O}$ . (Philip, Z. Ch. 1867. 552.)

**Mercuric cyanide rubidium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{Rb}(\text{SCN})$ .

Sol. in hot  $\text{H}_2\text{O}$  without decomp. (Grossmann, B. 1904, 37. 1259.)

**Mercuric cyanide samarium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Sm}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide sodium sulphocyanide,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{NaSCN} \cdot 2\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 23. 71.)

**Mercuric cyanide strontium sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Sr}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .

Efflorescent. (Cleve.)

**Mercuric cyanide yttrium sulphocyanide,**  
 $3\text{Hg}(\text{CN})_2$ ,  $\text{Y}(\text{SCN})_3 \cdot 12\text{H}_2\text{O}$ .

Sl. sol. in warm, much less in cold  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide zinc sulphocyanide,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{SCN})_2 \cdot 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Mercuric cyanide zinc sulphocyanide ammonia,**  
 $2\text{Hg}(\text{CN})_2$ ,  $\text{Zn}(\text{SCN})_2$ ,  $3\text{NH}_3$ .

Not efflorescent. Decomp. by  $\text{H}_2\text{O}$ .

**Mercuric cyanide potassium thiosulphate,**  
 $\text{Hg}(\text{CN})_2$ ,  $\text{K}_2\text{S}_2\text{O}_3$ .

Permanent. Sol. in  $\text{H}_2\text{O}$ . (Kessler.)

+  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 24. 1355.)

**Molybdenum hydroxyl potassium cyanide,**  
 $\text{K}_3\text{Mo}(\text{OH})_2(\text{CN})_3$ .

(Rosenheim and Koss, Z. anorg. 1906, 49. 155.)

$\text{K}_3\text{Mo}(\text{OH})_2(\text{CN})_3$ . Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim and Koss.)

**Molybdenum cyanide with MCN.**

See Molybdocyanide M.

**Molybdenyl potassium cyanide,**  
 $\text{MoO}_2(\text{CN})_2$ ,  $2\text{KCN}$ .

Very sol. in  $\text{H}_2\text{O}$ . Aqueous solution is stable in presence of alkalis.

Insol. in alcohol. (Péchar, C. R. 1894, 118. 805.)

$\text{MoO}_2(\text{CN})_2$ ,  $3\text{KCN}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann, Z. anorg. 1896, 12. 287.)

+  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann.)

+  $4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann.)

**Nickel cyanide,  $\text{Ni}(\text{CN})_2 \cdot x\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Insol. in conc.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$  + Aq, but decomp. by heating there-with. Sol. in  $\text{NH}_4\text{OH}$ , warm  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4$  succinate + Aq; also in  $\text{KCN}$  + Aq. Sl. sol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3$  + Aq. (Wittstein.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+3H<sub>2</sub>O, +3¼H<sub>2</sub>O, +3¾H<sub>2</sub>O, +4¼H<sub>2</sub>O, and +5¼H<sub>2</sub>O. (Papiermeister, Dissert. 1898.)

+4H<sub>2</sub>O. (Hofmann and Hœchtlén, B. 1903, 36. 1149.)

**Nickel potassium cyanide**, Ni(CN)<sub>2</sub>, 2KCN + H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. Decomp. by acids, with residue of insol. Ni(CN)<sub>2</sub>.

+½H<sub>2</sub>O. (Rammelsberg.)

**Nickel sodium cyanide**, Ni(CN)<sub>2</sub>, 2NaCN + 3H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; decomp. by acids with residue of Ni(CN)<sub>2</sub>.

**Nickel strontium cyanide**, Ni(CN)<sub>2</sub>, Sr(CN)<sub>2</sub>, +xH<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Handl, J. B. 1859. 273.)

**Nickel cyanide ammonia**, Ni(CN)<sub>2</sub>, NH<sub>3</sub> + ½H<sub>2</sub>O.

Scarcely attacked by H<sub>2</sub>O or dil. acids.

Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. conc. NH<sub>4</sub>OH + Aq. (NH<sub>4</sub>)<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq. (NH<sub>4</sub>)<sub>2</sub>S + Aq. and KCN + Aq. Decomp. by boiling with NaOH or KOH. (Bernoulli and Grether, Ch. Z. 1901, 25. 436.)

**Nickel cyanide trihydrazine**, Ni(CN)<sub>2</sub>, (N<sub>2</sub>H<sub>4</sub>)<sub>3</sub>.

Ppt. (Franzen, Z. anorg. 1911, 70. 155.)

**Osmium cyanide**, Os(CN)<sub>2</sub>(?).

Insol. in H<sub>2</sub>O; not attacked by acids.

See also Osmocyanhydric acid.

**Osmium potassium cyanide.**

See Osmocyanide, potassium.

**Palladous cyanide**, Pd(CN)<sub>2</sub>.

Insol. in H<sub>2</sub>O. Insol. in dil. acids. Sol. in KCN or NH<sub>4</sub>OH + Aq. also in conc. HCN + Aq.

**Platinous cyanide**, Pt(CN)<sub>2</sub>.

Insol. in H<sub>2</sub>O, alkalis, or acids. Sol. in KCN + Aq. When freshly pptd., sol. in NH<sub>4</sub>OH + Aq.

**Platinous cyanide with MCN.**

See Platinocyanide, M.

**Potassium cyanide**, KCN.

Deliquescent. Very sol. in H<sub>2</sub>O.

100 pts. KCN + Aq. sat. at b.-pt. 103.3°, contain 55 pts. KCN, i. e. 100 pts. H<sub>2</sub>O dissolve 122.2 pts. KCN at 103.3°. (Griffiths.)

KCN + Aq. containing 3.25% KCN has sp. gr. = 1.0154; 6.5% KCN, 1.0316. (Kohlrausch, W. Ann. 1879. 1.)

KCN + Aq. containing 9.64% KCN has sp. gr. 20°/20° = 1.0514.

KCN + Aq. containing 14.42% KCN has sp. gr. 20°/20° = 1.0768. (Le Blanc and Rohland, Z. phy. ch. 1896, 19. 278.)

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Almost insol. in absolute alcohol.

Sol. in 80 pts. 95% alcohol when boiling, and easily sol. in 35% alcohol. (Geiger, A. 1. 50.)

100 pts. absolute methyl alcohol dissolve 4.91 pts. at 19.5°; 100 pts. absolute ethyl alcohol dissolve 0.87 pt. at 19.5°. (de Bruyn, Z. phys. Ch. 10. 783.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

100 g. glycerol dissolve 32 g. KCN at 15.5°. (Ossendowski, Pharm. J. 1907, 79. 575.)

Sol. in CS<sub>2</sub> when pure. (Loughlin, J. B. 1875. 234.)

Wholly insol. in CS<sub>2</sub>. (Moldenhauer, Z. anal. 16. 199.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

**Potassium chromium tetroxide pentacyanide**, K<sub>4</sub>(CrO<sub>4</sub>)<sub>2</sub>(CN)<sub>5</sub> + 5H<sub>2</sub>O.

Very hygroscopic.

Sol. in H<sub>2</sub>O. (Riesefeld, B. 1908, 41. 3548.)

**Potassium chromium tetroxide dicyanide ammonia**, K<sub>2</sub>CrO<sub>4</sub>(CN)<sub>2</sub>NH<sub>3</sub> + 5H<sub>2</sub>O.

Hygroscopic in the air.

Easily sol. in H<sub>2</sub>O and in NH<sub>4</sub>OH + Aq. (Riesefeld, B. 1908, 41. 3545.)

**Potassium rhodium cyanide.**

See Rhodocyanide, potassium.

**Potassium ruthenium cyanide.**

See Ruthenocyanide, potassium.

**Potassium silver cyanide**, KCN, AgCN.

Sol. in 4.7 pts. H<sub>2</sub>O at 15°, 4 pts. at 20°, and in much less at higher temp. Sol. in 25 pts. 85% alcohol. (Baup, A. ch. (3) 53. 464.)

**Potassium silver sodium cyanide**, 2KCN, NaCN, 3AgCN.

Sol. in 4.4 pts. H<sub>2</sub>O at 15°, and 22 pts. 85% alcohol at 17°. (Baup.)

**Potassium tungsten cyanide.**

See Tungstocyanide, potassium.

**Potassium uranyl cyanide**,

(UO<sub>2</sub>)(CN)<sub>2</sub>, 2KCN.

Ppt. Sol. in H<sub>2</sub>O. Sl. sol. in presence of large excess of KCN. (Aloy, A. ch. 1901, (7) 24. 417.)

**Potassium vanadium cyanide**, K<sub>3</sub>V(CN)<sub>6</sub>.

Readily sol. in H<sub>2</sub>O; decomp. slowly in neutral aq. solution, rapidly in acid aq. solution;

insol. in alcohol. (Locke, Am. Ch. J. 1898, 20. 601.)

$K_4V(CN)_8 + 3H_2O$ . Sol. in  $H_2O$ .

Insol. in alcohol and ether. (Petersen, Z. anorg. 1904, 38. 345.)

**Potassium zinc cyanide,  $2KCN, Zn(CN)_2$ .**

100 pts.  $H_2O$  dissolve 11 pts. at  $20^\circ$ . (Sharwood, Eng. Min. J. 1904, 77. 845.)

**Potassium cyanide molybdenum dioxide,  $4KCN, MoO_3 + 5H_2O$ .**

Sol. in  $H_2O$ . Insol. in alcohol. (Hofmann, Z. anorg. 1896, 12. 287.)

+  $6H_2O$ . "Potassium dioxotetracyanomolybdate."

Very sol. in  $H_2O$ . (Winkler, Dissert. 1908.)

+  $8H_2O$ . (Rosenheim, Kohn and Garfunkel, Z. anorg. 1910, 65. 174.)

+  $10H_2O$ . Decomp. by conc.  $HCl, HNO_3$ , and  $H_2SO_4$ .

Not acted upon by cold dil. acids. (v. der Heide and Hofmann, Z. anorg. 1896, 12. 285.)

$5KCN, MoO_3 + 8H_2O$ . Sol. in  $H_2O$ . Insol. in alcohol. (Kalischer, Dissert. 1902.)

**Potassium cyanide molybdenum dioxide hydroxylamine,  $4KCN, MoO_3, NH_4OH + H_2O$ .**

Sol. in  $H_2O$ .

Decomp. by dil. acids. (v. der Heide and Hofmann, Z. anorg. 1896, 12. 282.)

**Potassium cyanide molybdenum sulphide,  $6KCN, Mo_2S_3 + 5H_2O$ .**

Easily sol. in  $H_2O$ . Decomp. by dil. acids. (Hofmann, Z. anorg. 1896, 12. 289.)

Very sol. in  $H_2O$ . Slowly decomp. in the cold by dil. mineral acids. (v. der Heide and Hofmann, Z. anorg. 1896, 12. 289.)

**Potassium cyanide molybdenum sulphocyanide,  $2KCN, MoS_2(CN)_2$ .**

(Péchar, C. R. 1894, 118. 806.)

$5KCN, Mo_2S_4(CN)_2 + 7H_2O$ . Sol. in  $H_2O$ . Stable toward dil. acids and alkalis. (Hofmann, Z. anorg. 1896, 12. 289.)

**Potassium cyanide molybdenum sulphonycyanide,  $4KCN, Mo_2SO(CN)_2 + 4H_2O$ .**

Sol. in  $H_2O$ . Stable toward dil. acids. (Hofmann, Z. anorg. 1896, 12. 289.)

**Potassium cyanide nitrite,  $KCN, KNO_2 + \frac{1}{2}H_2O$ .**

Sol. in  $H_2O$ ; decomp. slowly by  $H_2O$ ; explosive. (Hofmann, Z. anorg. 1895, 10. 260-261.)

**Potassium cyanide sulphur dioxide,  $KCN, SO_2 + H_2O$ .**

Much more sol. in hot than cold  $H_2O$ . (Étard, C. R. 88. 649.)

$KCN, HCN, 2SO_2 + 3H_2O$ . Very sl. sol. in cold  $H_2O$ ; decomp. by hot  $H_2O$ . (Étard.)

**Rubidium tungsten cyanide.**

See Tungstocyanide, rubidium.

**Rhodium cyanide,  $Rh(CN)_3$ .**

Ppt. Not decomp. by acids. Sol. in  $KCN + Aq.$  (Martius, A. 117. 361.)

**Rhodium cyanide with  $3KCN$ .**

See Rhodicyanide, potassium.

**Ruthenium cyanide with  $4MCN$ .**

See Ruthenocyanide, M.

**Silver cyanide,  $AgCN$ .**

Sl. sol. in  $H_2O$ .

$2.2 + 10^{-4}$  g. sol. in 1 liter of  $H_2O$  at  $19.96^\circ$ . (Böttger, Z. phys. ch. 1903, 46. 603.)

1 l. solution in  $H_2O$  contains 0.000043 g.  $AgCN$  at  $17.5^\circ$ . (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Solubility in  $H_2O$  at  $25^\circ = 2.22 + 10^{-4}$  mol. per l. (Lucas, Z. anorg. 1904, 41. 198.)

Insol. in dil. acids. Decomp. by conc. acids. Not sol. to any extent in  $HCN + Aq.$

Freshly pptd.  $AgCN$  is not dissolved by cold dil.  $HNO_3$ , but is attacked by very dil.  $HNO_3$  on boiling. From dry  $AgCN$  is dissolved 5% by boiling 1 hour with 1%  $HNO_3 + Aq.$  Conc.  $HNO_3$  dissolves more. (Brunck, B. 1901, 34. 1605.)

Sol. in  $NH_4OH + Aq.$  Sol. in boiling  $KCl, NaCl, CaCl_2, BaCl_2$ , or  $MgCl_2 + Aq.$  but very slowly sol. therein at ord. temp. Sol. in  $Na_2S_2O_3, K_4Fe(CN)_6, (NH_4)_2CO_3, (NH_4)_2SO_4, NH_4NO_3$ , and  $NH_4$  succinate +  $Aq.$  and in large amt. of hot  $NH_4Cl + Aq.$  (Wittstein.)

Sol. in  $KCN, NaCN, Ba(CN)_2, Ca(CN)_2$ , or  $Sr(CN)_2 + Aq.$  Insol. in  $KOH$ , or  $NaOH + Aq.$  Sol. in conc. boiling  $AgNO_3 + Aq.$  (Wöhler.)

Sol. in 431.7 pts. 5%  $NH_4OH + Aq.$  (sp. gr. 0.998) at  $12^\circ$ ; in 184.5 pts. 10%  $NH_4OH + Aq.$  (sp. gr. 0.96) at  $18^\circ$ . (Longi, Gazz. ch. it. 13. 87.)

Sl. sol. in Na citrate +  $Aq.$

Sol. in  $Hg(NO_3)_2 + Aq.$

1 l. of a 3-N solution of  $AgNO_3$  dissolves 1.216 g.  $AgCN$  at  $25^\circ$ . (Hellwig, Z. anorg. 1900, 25. 177.)

Very sol. in  $(NH_4)_2S_2O_8 + Aq.$  (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 105.)

Moderately sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sl. sol. in liquid  $HF$ . (Franklin, Z. anorg. 1905, 46. 2.)

Abundantly sol. in quinoline at  $60^\circ$ . (Varet, C. R. 1893, 116. 60.)

Sl. sol. in ethyl amine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Insol. in methyl acetate. (Bezold, Dissert. 1906; Naumann, B. 1909, 42. 3790); ethyl

acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

**Silver hydrogen cyanide**,  $\text{AgCN}$ ,  $\text{HCN}$ .  
(Euler, B. 1903, 36. 1859.)

**Silver sodium cyanide**,  $\text{AgCN}$ ,  $\text{NaCN}$ .

Sol. in 5 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  and in much less hot  $\text{H}_2\text{O}$ . Sol. in 24 pts. 85% alcohol at  $20^\circ$ . (Baup, A. ch. (3) 53. 468.)

**Silver thallous cyanide**,  $\text{AgCN}$ ,  $\text{TlCN}$ .

Easily sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 4.7 pts. at  $0^\circ$ , and 7.4 pts. at  $16^\circ$ . (Fronmüller, B. 11. 92.)

**Silver tungsten cyanide.**

See Tungstocyanide, silver.

**Silver cyanide ammonia**,  $\text{AgCN}$ ,  $\text{NH}_3$ .

Efflorescent. Decomp. on air.

Very sol. in ammonia at  $-10^\circ$ . (Joannis, C. R. 1894, 118. 1151.)

**Silver cyanide hydrazine**,  $\text{AgCN}$ ,  $\text{N}_2\text{H}_4$ .

Decomp. in the air.

Decomp. by  $\text{H}_2\text{O}$ . (Fransen, Z. anorg. 1911, 70. 153.)

**Silver cyanide nitrate**,  $2\text{AgCN}$ ,  $\text{AgNO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .

**Sodium cyanide**,  $\text{NaCN}$ .

Sol. in  $\text{H}_2\text{O}$  and 75% alcohol.  
+  $\frac{1}{2}\text{H}_2\text{O}$ , and  $2\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Joannis, A. ch. (5) 26. 484.)

**Sodium tungsten cyanide.**

See Tungstocyanide, sodium.

**Sodium zinc cyanide**,  $\text{NaCN}$ ,  $\text{Zn}(\text{CN})_2 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding K Zn salt. (Rammelsberg.)  
+  $8\text{H}_2\text{O}$ . (Loebe, Dissert. 1902.)

**Sodium cyanide molybdenum dioxide**,  $4\text{NaCN}$ ,  $\text{MoO}_3 + 6\text{H}_2\text{O}$ .

(Winkler, Dissert. 1909.)

+  $14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Garfunkel and Kohn, Z. anorg. 1910, 66. 174.)

**Sodium cyanide molybdenum dioxide hydroxylamine**,  $4\text{NaCN}$ ,  $\text{MoO}_3$ ,  $\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

As K comp. (Winkler, Dissert. 1909.)

**Strontium cyanide**,  $\text{Sr}(\text{CN})_2 + 4\text{H}_2\text{O}$ .

Very unstable; very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Joannis, A. ch. (5) 26. 496.)

**Strontium tungsten cyanide.**

See Tungstocyanide, strontium.

**Strontium zinc cyanide**,  $2\text{Sr}(\text{CN})_2$ ,  $3\text{Zn}(\text{CN})_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Loebe, Dissert. 1902.)

**Thallous cyanide**,  $\text{TlCN}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 16.8 pts. at  $28.5^\circ$ . (Fronmüller, B. 6. 1178.)

**Thallothallic cyanide**,  $\text{Tl}_2(\text{CN})_4 = \text{TlCN}$ ,  $\text{Tl}(\text{CN})_3$ .

Easily sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 27.3 pts. at  $30^\circ$ , 15.3 pts. at  $12^\circ$ , 9.7 pts. at  $0^\circ$ . (Fronmüller, B. 11. 92.)

**Thallous tungsten cyanide.**

See Tungstocyanide, thallous.

**Thallous zinc cyanide**,  $2\text{TlCN}$ ,  $\text{Zn}(\text{CN})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 8.7 pts. at  $0^\circ$ ; 15.2 pts. at  $14^\circ$ ; and 29.6 pts. at  $31^\circ$ . (Fronmüller, B. 11. 92.)

**Tungsten cyanide with MCN.**

See Tungstocyanide, M.

**Zinc cyanide**,  $\text{Zn}(\text{CN})_2$ .

Insol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in alkalis. Easily sol. in  $\text{KCN} + \text{Aq}$ . Sol. in hot  $\text{NH}_4$  salts +  $\text{Aq}$ . (Wittstein.)

Easily sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Gore.)  
Sol. in  $\text{KOH} + \text{Aq}$ . Solution is stable when less than 1 mol.  $\text{Zn}(\text{CN})_2$  to 2 mols.  $\text{KOH}$  is present. When proportion is 1:1,  $\text{ZnO}_2\text{H}_2$  soon separates.

Sol. in dil.  $\text{KCN} + \text{Aq}$ . (Sharwood, J. Am. Chem. Soc. 1903, 25. 587.)

Sl. sol. in conc. Zn salts +  $\text{Aq}$ . 1 l. conc.  $\text{Zn}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  dissolves 4 g., and 1 l. conc.  $\text{ZnSO}_4 + \text{Aq}$  dissolves 2 g.  $\text{Zn}(\text{CN})_2$ . Insol. in  $\text{HCN} + \text{Aq}$ . Easily sol. in dil. acids. (Joannis.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Insol. in methyl acetate. (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Zinc cyanide ammonia**,  $\text{Zn}(\text{CN})_2$ ,  $2\text{NH}_3$ .

Decomp. on air. (Varet, C. R. 105. 1070.)  
+  $\text{H}_2\text{O}$ . Decomp. on air. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Varet.)

**Zinc cyanide dihydrazine**,  $\text{Zn}(\text{CN})_2$ ,  $2\text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Fransen, Z. anorg. 1911, 70. 153.)

**Cyanogen**,  $\text{CN}$ .

$\text{H}_2\text{O}$  absorbs  $4\frac{1}{2}$  vols.  $\text{CN}$  gas at  $20^\circ$ . Alcohol absorbs 23 vols., and ether 5 vols. at the same temperature. (Gay-Lussac.)

The solution gradually decomposes, but this is prevented by traces of acids.



0.221 mol. litre are dissolved in  $H_2O$  at  $0^\circ$ . (Naumann, Z. Electrochem. 1910, 16. 177.)

Oil of turpentine absorbs 5 vols. (Gay-Lussac.) Absorbed by many essential oils.

Very sol. in  $CuCl_2 + Aq$ .

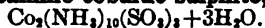
Absorbed with decomp. by  $NH_4OH + Aq$  and other alkaline liquids.

► Absorbed by aniline. (Jacquemain, C. R. 100. 1006.)

### Cyclotriborene, $B_3H_3$ .

Insol. in  $H_2O$ . (Ramsay and Hatfield, Proc. Chem. Soc. 1901, 17. 152.)

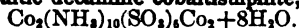
### Decamine cobaltic sulphite,



Sol. in  $H_2O$ . (Vortmann and Magdeburg, B. 22. 2636.)

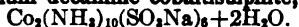
### Decamine cobaltisulphurous acid.

#### Cobaltic decamine cobaltisulphite,



Ppt. (Vortmann and Magdeburg, B. 22. 2635.)

#### Sodium decamine cobaltisulphite,



Sol. in  $H_2O$ . (Vortmann and Magdeburg, B. 22. 2635.)

### Diamide, $N_2H_4$ .

See Hydrazine.

### Diamine chromium sulphocyanhydric acid, $Cr(NH_3)_3(SCN)_3, HSCN + H_2O$ .

Sol. in  $H_2O$ . (Nordenskiöld, Z. anorg. 1. 130.)

### Diamine chromium diaquo sulphocyanide, $Cr(NH_3)_2(SCN)_2 + 2H_2O$ .

Sol. in  $H_2O$ , from which it is pptd. by con.  $HCl + Aq$ . (Nordenskiöld, Z. anorg. 1. 137.)

### Ammonium diamine chromium sulphocyanide, $Cr(NH_3)_2(SCN)_2, NH_4SCN$ .

(Reinecke's salt.) Quite easily sol. in  $H_2O$ , less in alcohol, and insol. in benzene. Slowly decomp. by boiling  $H_2O$  or dil. acids. (Nordenskiöld, Z. anorg. 1. 130.)

+  $H_2O$ . Insol. in absolute ether. (Christensen, J. pr. (2) 45. 218.)

### Ammonium diamine chromium sulphocyanide iodide, $Cr(NH_3)_2(SCN)_2, NH_4SCN, I$ .

### Barium ————, $[Cr(NH_3)_2(SCN)_2]_2, Ba(SCN)_2$ .

Sol. in  $H_2O$  and alcohol. (N.)

### Cadmium diamine chromium sulphocyanide, $Cd(SCN)_2, [Cr(NH_3)_2(SCN)_2]_2 + H_2O$ .

Nearly insol. in cold, sl. sol. in hot  $H_2O$ . Sl. sol. in boiling alcohol. (Christensen, J. pr. (2) 45. 371.)

### Cupric ————, $Cu(SCN)_2, [Cr(NH_3)_2(SCN)_2]_2$ .

Insol. in  $H_2O$  or dil. acids. (Reinecke, A. 126. 116.)

### Ferric ————, $[Cr(NH_3)_2(SCN)_2]_3, Fe(SCN)_3$ . (N.)

### Luteocobaltic ————, $Co(NH_3)_4(SCN)_3[Cr(NH_3)_2(SCN)_2]_2$ .

As good as insol. in cold  $H_2O$ . Sl. sol. in hot  $H_2O$  and alcohol. (Christensen, J. pr. (2) 45. 370.)

### Mercuric ————, $[Cr(NH_3)_2(SCN)_2]_2, Hg(SCN)_2$ .

Insol. in  $H_2O$ . (N.)

Insol. in  $H_2O$  and dil. acids. (Reinecke.)

### Potassium ————, $Cr(NH_3)_2(SCN)_2, KSCN$ .

Properties as the  $NH_4$  salt. (N.)

$Cr(NH_3)_2(SCN)_2, KSCN, I$ . As the  $NH_4$  salt. (N.)

### Sodium ————, $NaSCN, Cr(NH_3)_2(SCN)_2$ .

Sol. in  $H_2O$ , alcohol, and ether. (Reinecke.)

### Diamine cobaltic nitrite ammonium nitrite, $Co(NH_3)_2(NO_2)_2, NH_4NO_2$ .

Sol. in  $H_2O$ . (Erdmann.)

### ———— nitrite lead nitrite, $2Co(NH_3)_2(NO_2)_2, Pb(NO_2)_2$ .

Sol. in hot  $H_2O$  with partial decomp.

### ———— nitrite mercurous nitrite, $2Co(NH_3)_2(NO_2)_2, Hg_2(NO_2)_2$ .

Ppt. Not sol. in hot  $H_2O$  without decomp.

### ———— nitrite potassium nitrite, $Co(NH_3)_2(NO_2)_2, KNO_2$ .

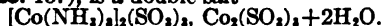
Sol. in  $H_2O$ . (Erdmann, J. pr. 97. 385.)

### ———— nitrite silver nitrite, $Co(NH_3)_2(NO_2)_2, AgNO_2$ .

Ppt. Crystallises out of hot  $H_2O$ . (Erdmann.)

### ———— nitrite thallium nitrite, $Co(NH_3)_2(NO_2)_2, TlNO_2$ .

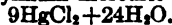
Crystallises out of hot  $H_2O$  without decomp.

**Dichrocobaltic carbonate,**Sol. in  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1901.)**Dichrocobaltic chloride,**  $\text{Co}(\text{NH}_3)_2\text{Cl}_2 + \text{H}_2\text{O}.$ Quite sol. in cold  $\text{H}_2\text{O}$ , dil. acids, conc.  $\text{H}_2\text{SO}_4$ , or dil. alcohol.From solution in conc.  $\text{H}_2\text{SO}_4$ , the salt is precipitated by much  $\text{HCl} + \text{Aq}$ . Composition is  $\text{Co}(\text{NH}_3)_2(\text{OH})_2\text{Cl}_2$ . (Jorgensen, Z. anorg. 5. 189.)— **nitrate,**  $\text{Co}(\text{NH}_3)_2(\text{NO}_3)_2 + 4\text{H}_2\text{O}.$ Deliquescent. Sol. in  $\text{H}_2\text{O}$ . More sol. in dil.  $\text{HNO}_3 + \text{Aq}$  than praseocobaltic nitrate. (Vortmann, B. 15. 1897.)*Anhydrous.* Insol. in  $\text{H}_2\text{O}$  as such, but converted into above salt thereby. (Jorgensen, Z. anorg. 5. 186.)— **nitrite,**  $\text{Co}(\text{NH}_3)_2(\text{NO}_2)_2.$ Difficultly sol. in cold, but rather easily sol. in hot  $\text{H}_2\text{O}$ .— **sulphate,**  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}.$ Easily sol. in  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1900.)— **sulphite,**  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_2 + \text{H}_2\text{O}.$ Nearly insol. in cold, slowly decomp. by hot  $\text{H}_2\text{O}$ . Decomp. by acids or  $\text{KOH} + \text{Aq}$ . Insol. in cold, sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kunzel, J. pr. (1) 72. 209.) According to Geuther (A. 128. 157), is a double salt—**Didymium, Di.**Slowly decomp. by  $\text{H}_2\text{O}$ . Insol. in cold conc.  $\text{H}_2\text{SO}_4$ . Sol. in dil. acids.

Compound of two elements, neodymium and praseodymium. (v. Welsbach, W. A. B. 92. 317.)

**Didymium bromide,**  $\text{DiBr}_2 + 6\text{H}_2\text{O}.$ Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Didymium nickel bromide,**  $2\text{DiBr}_2, 3\text{NiBr}_2 + 18\text{H}_2\text{O}.$ Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 342.)**Didymium zinc bromide,**  $\text{DiBr}_2, 3\text{ZnBr}_2 + 12\text{H}_2\text{O}.$ 

Extremely deliquescent. (Cleve, Bull. Soc. (3) 43. 361.)

**Didymium chloride,**  $\text{DiCl}_2.$ *Anhydrous.* Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Marignac.) $+ 6\text{H}_2\text{O}$ . Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Marignac.)**Didymium mercuric chloride,**  $2\text{DiCl}_2,$ More sol. in  $\text{H}_2\text{O}$  than the corresponding La salt. (Marignac.) $\text{DiCl}_2, 4\text{HgCl}_2 + 11\text{H}_2\text{O}$ . Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ .**Didymium stannic chloride.**

See Chlorostannate, didymium.

**Didymium fluoride,**  $\text{DiF}_2 + \frac{1}{2}\text{H}_2\text{O}.$ 

Precipitate. (Cleve.)

**Didymium hydrogen fluoride,**  $2\text{DiF}_2, 3\text{HF}.$ 

Precipitate. (Smith.)

Does not exist. (Cleve.)

**Didymium potassium fluoride,**  $\text{DiF}_2, \text{KF} + \text{H}_2\text{O}.$ Sol. in  $\text{H}_2\text{O}$ . (Brauner, B. 15. 114.) $+ \frac{1}{2}\text{H}_2\text{O}$ . As above. (B.) $2\text{DiF}_2, 3\text{KF} + \text{H}_2\text{O}$ . As above. (B.)**Didymium hydroxide,**  $\text{Di}_2\text{O}_3\text{H}_2.$ Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ , but is sl. sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)See also  $\text{Di}_2\text{O}_3$ .**Didymium penthydroxide,**  $\text{DiO}_4\text{H}_2 = \text{Di}_2\text{O}_5, 3\text{H}_2\text{O}.$ 

Precipitate. (Brauner, B. 15. 113.)

**Didymium zinc iodide,**  $2\text{DiI}_2, 3\text{ZnI}_2 + 24\text{H}_2\text{O}.$ 

Very deliquescent. (Frerichs and Smith.)

**Didymium oxide,**  $\text{Di}_2\text{O}_3.$ With  $\text{H}_2\text{O}$  slowly forms  $\text{Di}_2\text{O}_3\text{H}_2$ .Sol. in conc., or dil. mineral acids (Marignac), and in acetic acid (Hermann). Sol. in ammonium salts  $+ \text{Aq}$ .Slightly more slowly sol. in conc.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than  $\text{La}_2\text{O}_3$ . (Damour and Deville.)A solution of  $\text{NH}_4\text{NO}_3$  in  $\text{H}_2\text{O}$  that can dissolve 2.9 mols.  $\text{La}_2\text{O}_3$  dissolves 1 mol.  $\text{Di}_2\text{O}_3$ . (Brauner, B. 15. 114.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Didymium peroxide,**  $\text{Di}_4\text{O}_7.$ 

Sol. in acids with decomp. (Frerichs, B. 7. 799.)

Not obtained by Cleve. (B. 11. 910.)

The contradictory statements concerning the composition of Di peroxide are owing to the fact that praseodidymium is the only one of the constituents of Di which easily forms a peroxide. (v. Welsbach.)

**Didymium pentoxide,**  $\text{Di}_2\text{O}_5.$ Sol. in dil.  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  in the cold without evolution of gas, but gas is evolved if treated with conc. acids. Insol. in  $\text{HF} + \text{Aq}$ . Sl. sol. in cold  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .  $= \text{Di}_2\text{O}_3$ . (Cleve.)

**Didymium oxybromide,  $\text{DiOBr}$ .**  
(Frerichs and Smith.)

**Didymium oxychloride,  $\text{DiOCl}$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$ . (Smith.)  
+  $3\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{HNO}_3$  + Aq.  
(Marignac.) Sl. sol. in  $\text{HCl}$  + Aq. (Hermann.)

**Didymium oxysulphide,  $\text{Di}_2\text{O}_3\text{S}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  + Aq without residue. (Marignac.)

**Didymium sulphide,  $\text{Di}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by dil. acids.  
(Marignac, A. ch. (3) 38. 159.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Disulphuric acid,  $\text{H}_2\text{S}_2\text{O}_7$ .**

See Disulphuric acid.

**Dithionic acid (Hyposulphuric acid),  $\text{H}_2\text{S}_2\text{O}_6$ .**

Known only in aqueous solution, which is stable only when dil. Can be evaporated in vacuo until sp. gr. = 1.347, but decomp. upon further evaporation. (Welter and Gay-Lussac, A. ch. 10. 312.)

**Dithionates.**

All dithionates are sol. in  $\text{H}_2\text{O}$ .

**Aluminum dithionate,  $\text{Al}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$ .**

Extremely deliquescent. Easily sol. in  $\text{H}_2\text{O}$  or absolute alcohol. (Klüss, A. 246. 218.)

**Aluminum ammonium dithionate,  $\text{Al}_2(\text{S}_2\text{O}_6)_3, (\text{NH}_4)_2\text{S}_2\text{O}_6 + 27\text{H}_2\text{O}$ .**

Sl. deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Klüss, A. 246. 303.)

**Ammonium dithionate,  $(\text{NH}_4)_2\text{S}_2\text{O}_6$ .**

Very sol. in  $\text{H}_2\text{O}$ . Sol. in 0.79 pt.  $\text{H}_2\text{O}$  at  $16^\circ$ , with reduction of temp. Not decomp. on boiling. Insol. in absolute alcohol. (Heeren, Pogg. 7. 172.)

Contains  $\frac{1}{2}\text{H}_2\text{O}$ . Sol. in 0.56 pt.  $\text{H}_2\text{O}$  at  $19^\circ$ . (Klüss, A. 246. 194.)

**Ammonium cadmium dithionate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_6, \text{CdS}_2\text{O}_6 + 4\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Klüss, A. 246. 298.)

**Ammonium cobalt dithionate,  $9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{CoS}_2\text{O}_6 + 16\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Klüss.)

**Ammonium cupric dithionate,  $(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{CuS}_2\text{O}_6 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Ammonium ferrous dithionate,  $3(\text{NH}_4)_2\text{S}_2\text{O}_6, \text{Fe}_2\text{S}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Klüss, A. 246. 300.)

**$9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{Fe}_2\text{S}_2\text{O}_6 + 16\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Klüss.)**

**Ammonium manganous dithionate,  $9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{MnS}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Klüss, A. 246. 301.)

**Ammonium nickel dithionate,  $9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{NiS}_2\text{O}_6 + 16\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Klüss.)

**Ammonium zinc dithionate,  $5(\text{NH}_4)_2\text{S}_2\text{O}_6, \text{ZnS}_2\text{O}_6 + 9\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Klüss, A. 246. 296.)

**$9(\text{NH}_4)_2\text{S}_2\text{O}_6, 2\text{ZnS}_2\text{O}_6 + 16\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Klüss.)**

**Ammonium dithionate chloride,  $(\text{NH}_4)_2\text{S}_2\text{O}_6, \text{NH}_4\text{Cl}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 24. 3017.)

**Barium dithionate,  $\text{BaS}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Not efflorescent. Sol. in 7.17 pts.  $\text{H}_2\text{O}$  at  $8^\circ$ , 4.04 pts. at  $18^\circ$  and 1.1 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ .

Insol. in alcohol. (Gay-Lussac, Heeren.)

Sol. in 0.994 pt.  $\text{H}_2\text{O}$  at  $102^\circ$ , the boiling-point of the sat. solution. (Baker, Bull. Soc. (2) 44. 166.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $4\text{H}_2\text{O}$ . Very efflorescent. (Heeren.)

**Barium magnesium dithionate,  $\text{BaMg}(\text{S}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 118. 97.)

**Barium rubidium dithionate,  $\text{BaRb}_4(\text{S}_2\text{O}_6)_3 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Solubility is diminished by presence of excess of  $\text{Rb}_2\text{SO}_4$ , but increased by  $\text{BaS}_2\text{O}_6$ . (Bodlander, Chem. Ztg. 14. 1140.)

**Barium sodium dithionate,  $\text{BaNa}_4(\text{S}_2\text{O}_6)_3 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Decomp. by recrystallisation. (Kraut, A. 118. 95.)

+  $6\text{H}_2\text{O}$ . (Schiff.)

**Barium dithionate chloride,  $\text{BaS}_2\text{O}_6, \text{BaCl}_2 + 4\text{H}_2\text{O}$ .**

(Fock and Klüss, B. 23. 3001.)

**Bismuth dithionate, basic,  $\text{Bi}_2\text{O}_3, \text{S}_2\text{O}_6 + 5\text{H}_2\text{O}$ .**

Efflorescent. Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby into the following salt. Easily sol. in dil. acids, especially  $\text{HCl}$  + Aq. (Klüss, A. 246. 183.)

**$4\text{Bi}_2\text{O}_3, 3\text{S}_2\text{O}_6 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Klüss.)**

**Cadmium dithionate.**

Deliquescent in moist air; very sol. in  $\text{H}_2\text{O}$ . (Heeren, Pogg. 7. 183.)

**Cadmium dithionate ammonia,  $\text{CdS}_2\text{O}_6, 4\text{NH}_3$ .**

Decomp. by alcohol; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but decomp. on heating. (Rammelsberg, Pogg. 58. 298.)

**Cæsium dithionate,  $\text{Cs}_2\text{S}_2\text{O}_6$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Chabré, C. R. 1901, 133. 297.)

**Calcium dithionate,  $\text{CaS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Sol. in 2.46 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ ; 0.8 pt. at  $100^\circ$ . Insol. in alcohol. (Heeren, Pogg. 7. 178.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Cerous dithionate,  $\text{Ce}_2(\text{S}_2\text{O}_6)_3 + 24\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Jolin.)  
+3, and  $5\text{H}_2\text{O}$ . (Wyruboff.)

**Chromic dithionate,  $\text{Cr}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Klüss, A. 246. 189.)

$3\text{Cr}_2\text{O}_3, 4\text{S}_2\text{O}_6 + 24\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (Klüss.)

**Cobaltous dithionate,  $\text{CoS}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Not deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Heeren.)

+ $8\text{H}_2\text{O}$ . Sol. in 0.49 pt.  $\text{H}_2\text{O}$  at  $19^\circ$ . Sol. in absolute alcohol. (Klüss, A. 246. 203.)

**Cupric dithionate basic,  $4\text{CuO}, \text{S}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Very al. sol. in  $\text{H}_2\text{O}$ . (Heeren, Pogg. 7. 18.)

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Klüss, A. 246. 208.)

+ $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; sol. in traces in conc.  $\text{CuS}_2\text{O}_6 + \text{Aq}$ . Easily sol. in dil. acids, even  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{S}_2\text{O}_6 + \text{Aq}$ . (Klüss.)

**Cupric dithionate,  $\text{CuS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Not efflorescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Heeren.)

+ $5\text{H}_2\text{O}$ . (Efflorescent. Sol. in 0.64 pt.  $\text{H}_2\text{O}$  at  $18.5^\circ$  (Klüss, A. 246. 204.)

**Cupric dithionate ammonia,  $\text{CuS}_2\text{O}_6, 4\text{NH}_3$ .**

Difficultly sol. in cold  $\text{H}_2\text{O}$ , moderately sol. in  $\text{H}_2\text{O}$  at  $40^\circ$ . Decomp. by much  $\text{H}_2\text{O}$  or by heating the solution above  $60^\circ$ . Decomp. by  $\text{HCl} + \text{Aq}$ . (Heeren.)

Can be recryst. from  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol. in liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 213.)

$\text{CuS}_2\text{O}_6, 9\text{NH}_3$ . Decomp. at ord. temp. in the air.

Insol. in liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, 39. 213.)

**Didymium dithionate,  $\text{Di}_2(\text{S}_2\text{O}_6)_3 + 24\text{H}_2\text{O}$ .**

Extremely sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Erbium dithionate,  $\text{Er}_2(\text{S}_2\text{O}_6)_3 + 18\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  or alcohol; insol. in ether. (Höglund.)

**Glucinum dithionate, basic,  $5\text{GfO}, 2\text{S}_2\text{O}_6 + 14\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Klüss, A. 246. 196.)

**Iron (ferrous) dithionate,  $\text{FeS}_2\text{O}_6 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Decomp. in aqueous solution into  $\text{FeSO}_4$  by boiling. (Heeren, Pogg. 7. 181.)

+ $7\text{H}_2\text{O}$ . Sol. in 0.59 pt.  $\text{H}_2\text{O}$  at  $18.5^\circ$ . (Klüss, A. 246. 198.)

**Iron (ferric) dithionate, basic,  $8\text{Fe}_2\text{O}_3, \text{S}_2\text{O}_6 + 20\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. Very al. sol. in  $\text{H}_2\text{S}_2\text{O}_6 + \text{Aq}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . (Heeren.)

Contains  $14\text{H}_2\text{O}$ . (Klüss, A. 246. 200.)

$3\text{Fe}_2\text{O}_3, \text{S}_2\text{O}_6 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Klüss, A. 246. 201.)

**Lanthanum dithionate,  $\text{La}_2(\text{S}_2\text{O}_6)_3 + 16\text{H}_2\text{O}$ , and  $24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Lead dithionate, basic,  $2\text{PbO}, \text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Very difficultly sol. in  $\text{H}_2\text{O}$ . (Heeren, Pogg. 7. 171.)

$10\text{PbO}, \text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Heeren.)

**Lead dithionate,  $\text{PbS}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Heeren.)

Sol. in 0.869 pt.  $\text{H}_2\text{O}$  at  $20.5^\circ$ . (Baker, C. N. 36. 203.)

**Lead strontium dithionate,  $(\text{Pb}, \text{Sr})\text{S}_2\text{O}_6 + 4\text{H}_2\text{O}$ .**

(Rammelsberg.)

**Lithium dithionate,  $\text{Li}_2\text{S}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Sl. deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg.)

**Magnesium dithionate,  $\text{MgS}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Sol. in 0.85 pt.  $\text{H}_2\text{O}$  at  $13^\circ$ . Solution can be boiled without decomp. (Heeren, Pogg. 7. 179.)

Sol. in 0.692 pt.  $\text{H}_2\text{O}$  at  $17^\circ$ . (Baker, C. N. 36. 203.)

**Manganous dithionate,  $\text{MnS}_2\text{O}_6 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Kraut, A. 118. 98.)

+ $6\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Magniac, J. B. 1855. 380.)

**Mercurous dithionate,  $\text{Hg}_2\text{S}_2\text{O}_6$ .**

Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Mercuric dithionate, basic,  $5\text{HgO}$ ,  $2\text{S}_2\text{O}_6$ .**

Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$ +Aq. (Rammelsberg, Pogg. 59. 472.)

**Mercuric dithionate,  $\text{HgS}_2\text{O}_6+6\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  or on standing. (Klüss, A. 246. 216.)

**Nickel dithionate,  $\text{NiS}_2\text{O}_6+6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsøe.) Sol. in 0.897 pt.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Baker, C. N. 36. 203.)

**Nickel dithionate ammonia,  $\text{NiS}_2\text{O}_6$ ,  $6\text{NH}_3$ .**

Can be recryst. from warm  $\text{NH}_4\text{OH}$ +Aq. Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 58. 295.)

**Nickel dithionate hydrazine,  $\text{NiS}_2\text{O}_6$ ,  $3\text{N}_2\text{H}_4$ .**

Unstable. Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Franzen, Z. anorg. 1908, 60. 267.)

**Potassium dithionate,  $\text{K}_2\text{S}_2\text{O}_6$ .**

Not deliquescent. Sol. in 16.5 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 1.58 pts. at  $100^\circ$ . Insol. in alcohol. (Heeren.)

Sol. in 2.65 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Dumas.)

Sol. in 16.5 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ ; in 1.58 pts. boiling  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Heeren, Pogg. 1826, 7. 72.)

**Praseodymium dithionate,  $\text{Pr}_2(\text{S}_2\text{O}_6)_3+12\text{H}_2\text{O}$ .**

Deliquescent; very sol. in  $\text{H}_2\text{O}$ . (von Schule, Z. anorg. 1898, 18. 361.)

**Rubidium dithionate,  $\text{Rb}_2\text{S}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsøe and Christiansen:)

**Ruthenium dithionate,  $\text{RuS}_2\text{O}_6$ .**

Ppt. from aq. sol. by alcohol. (Antony, Gazz. ch. it. 1898, 23. 139-142.)

**Silver dithionate,  $\text{Ag}_2\text{S}_2\text{O}_6+2\text{H}_2\text{O}$ .**

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Heeren, Pogg. 7. 191.)

**Silver sodium dithionate,  $\text{AgS}_2\text{O}_6$ ,  $\text{Na}_2\text{S}_2\text{O}_6+4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Kraut, A. 118. 96.)

**Silver dithionate ammonia,  $\text{Ag}_2\text{S}_2\text{O}_6$ ,  $4\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  without decomp. (Rammelsberg, Pogg. 58. 298.)

**Sodium dithionate,  $\text{Na}_2\text{S}_2\text{O}_6+2\text{H}_2\text{O}$ .**

Sol. in 2.1 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and in 1.1 pts. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol.

Fuming  $\text{HCl}$ +Aq precipitates the salt from aqueous solution. (Heeren, Pogg. 7. 76.)

+ $6\text{H}_2\text{O}$ . (Kraut, A. 117. 97.)

**Strontium dithionate,  $\text{SrS}_2\text{O}_6+4\text{H}_2\text{O}$ .**

Sol. in 4.5 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , 1.5 pts. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol. (Heeren, Pogg. 7. 177.)

**Thallous dithionate,  $\text{Tl}_2\text{S}_2\text{O}_6$ .**

Very easily sol. in  $\text{H}_2\text{O}$ . (Werther.)

**Thallous dithionate sulphate,  $3\text{Tl}_2\text{S}_2\text{O}_6$ ,  $\text{Ti}_2\text{SO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Wyruboff, Ann. Phys. Beibl. 8. 802.)

**Thorium dithionate,  $\text{Th}(\text{S}_2\text{O}_6)_3+4\text{H}_2\text{O}$  (?)**

Very unstable. (Klüss, A. 246. 188.)

**Tin (stannous) dithionate,  $\text{SnS}_2\text{O}_6$ .**

Known only in solution.

$8\text{SnO}$ ,  $\text{S}_2\text{O}_6+9\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids, even dithionic acid+Aq. (Klüss, A. 246. 186.)

**Uranous dithionate,  $6\text{UO}_2$ ,  $\text{S}_2\text{O}_6+10\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in warm  $\text{HCl}$ +Aq. (Klüss, A. 246. 191.)

$7\text{UO}_2$ ,  $\text{S}_2\text{O}_6+8\text{H}_2\text{O}$ . As above.

$8\text{UO}_2$ ,  $\text{S}_2\text{O}_6+21\text{H}_2\text{O}$ . As above.

**Divanadyl dithionate,  $(\text{VO}_2)_2\text{S}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Bevan, C. N. 38. 294.)

**Yttrium dithionate,  $\text{Y}_2(\text{S}_2\text{O}_6)_3+18\text{H}_2\text{O}$ .**

Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , but difficultly sol. in alcohol. Insol. in ether. (Cleve, Bull. Soc. (2) 21. 344.)

**Zinc dithionate,  $\text{ZnS}_2\text{O}_6+6\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; decomp. on boiling. (Heeren, Pogg. 7. 183.)

**Zinc dithionate ammonia,  $\text{ZnS}_2\text{O}_6$ ,  $4\text{NH}_3$ .**

Decomp. with  $\text{H}_2\text{O}$ ; sol. in warm, less sol. in cold  $\text{NH}_4\text{OH}$ +Aq. (Rammelsberg, Pogg. 58. 297.)

+ $\text{H}_2\text{O}$ . Ppt. (Ephraim, B. 1915, 43. 640.)

**Dysprosium, Dy.**

(Lecoq de Boisbaudran, C. R. 102. 1005.)

**Dysprosium chloride,  $\text{DyCl}_3+6\text{H}_2\text{O}$ .**

Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Urbain, C. R. 1908, 146. 129.)

**Europium.****Europium chloride,  $\text{EuCl}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . Stable in very dil. aqueous solution, but decomp. when the solution is concentrated at  $100^\circ$ . (Urbain, C. R. 1911, 153. 1157.)

**Erbium, Er.**

Decomposes  $\text{H}_2\text{O}$ . (Höglund.)

The so-called element "erbium" can be further decomp. into simple substances. (Krüss, Z. anorg. 3. 353.)

**Erbium bromide,  $\text{ErBr}_3 + 9\text{H}_2\text{O}$ .**

Very deliquescent.

**Erbium chloride,  $\text{ErCl}_3 + 6\text{H}_2\text{O}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Höglund.)

**Erbium mercuric chloride,  $\text{ErCl}_3, 5\text{HgCl}_2 + x\text{H}_2\text{O}$ .**

Deliquescent. (Cleve.)

**Erbium fluoride,  $\text{ErF}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{HF} + \text{Aq}$ . (Höglund, Bull. Soc. (2) 18. 193.)

**Erbium hydroxide,  $\text{Er}_2\text{O}(\text{OH})_4$ .**

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Easily sol. in acids. Decomp. ammonium salts by boiling therewith.

**Erbium iodide,  $\text{ErI}_3$ .**

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in ether. (Höglund.)

**Erbium oxide,  $\text{Er}_2\text{O}_3$ .**

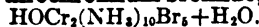
Difficultly but completely sol. in warm  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$ . Decomp.  $\text{NH}_3$  salts by boiling therewith.

**Erbium peroxide,  $\text{Er}_2\text{O}_5$ .**

Precipitate. (Cleve, Bull. Soc. (2) 43. 53.)

**Erbium sulphide.**

Decomp. in moist air and with acids.

**Erythrochromium bromide,**

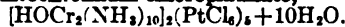
Very easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HBr} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jörgensen, J. pr. (2) 25. 398.)

— **bromide, basic,  $\text{HOCr}_2(\text{NH}_3)_{10}(\text{OH})\text{Br}_3 + \text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

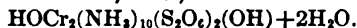
— **chloriodide,  $\text{HOCr}_2(\text{NH}_3)_{10}\text{ClI}_4 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Jörgensen.)

**Erythrochromium chloroplatinate,**

Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

— **dithionate, basic,**



Insol. in  $\text{H}_2\text{O}$ . Easily sol. in very dil.  $\text{HNO}_3$ ,  $\text{HBr}$ ,  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Jörgensen.)

— **nitrate,  $\text{HOCr}_2(\text{NH}_3)_{10}(\text{NO}_3)_3 + \text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in conc.  $\text{HNO}_3$  with decomp. Very sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Jörgensen.)

— **nitrate, basic,  $\text{HOCr}_2(\text{NH}_3)_{10}(\text{NO}_3)_4\text{OH} + 3\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in cold  $\text{H}_2\text{O}$ . (Jörgensen.)

— **sulphate,  $[\text{HOCr}_2(\text{NH}_3)_{10}]_2(\text{SO}_4)_3$ .**

Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

**Tetraferriammonium,  $\text{Fe}_3\text{N}$ .**

See Iron nitride.

**Ferric acid.****Barium ferrate,  $\text{BaFeO}_4 + \text{H}_2\text{O}$ .**

Ppt. Can be boiled for some time with  $\text{H}_2\text{O}$  without decomp. Decomp. by mineral acids. Sol. in dil. acetic acid. (Freymy, A. ch. (3) 12. 373.)

Insol. in  $\text{H}_2\text{O}$ ; not readily acted upon by acids when dry. (Rosen, J. Am. Chem. Soc. 1895, 17. 766.)

Ppt. Easily decomp. by acids. (Moeser, Arch. Pharm. 1895, 233. 526.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Calcium ferrate,  $\text{CaFeO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rosell, J. Am. Chem. Soc. 1895, 17. 760-69.)

**Potassium ferrate,  $\text{K}_2\text{FeO}_4$ .**

Very deliquescent. Easily sol. in cold  $\text{H}_2\text{O}$  with evolution of much heat. Decomp. by standing or warming. Decomp. by acids or alkalis. (Freymy, A. ch. (3) 12. 369.)

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Moeser, Arch. Pharm. 1895, 233. 524.)

Quickly decomp. by potassium tartrate or racemate, sugar, or albumen without separation of  $\text{Fe}_2\text{O}_3\text{H}_2$ , by alcohol with separation of  $\text{Fe}_2\text{O}_3\text{H}_2$ . Potassium oxalate, acetate, formate, and benzoate, also citrate decomp. much more slowly. Insol. in conc.  $\text{KOH} + \text{Aq}$ . (Wackenroder, A. 33. 41.)

**Sodium ferrate,  $\text{Na}_2\text{FeO}_4$ .**

Sol. in  $\text{H}_2\text{O}$  and in conc.  $\text{NaOH} + \text{Aq}$ . (Freymy, l. c.)

**Strontium ferrate, SrFeO<sub>4</sub>.**

Sl. sol. in H<sub>2</sub>O by which it is decomp.

Decomp. by acids.

Sol. in aqueous solutions of Na and K salts with partial decomp.

Insol. in sat. SrBr<sub>2</sub>+Aq., alcohol and ether. (Eidmann, B. 1903, **36**, 2290.)

**Ferricomolybdic acid.**

**Ammonium ferricomolybdate, 3(NH<sub>4</sub>)<sub>2</sub>O, Fe<sub>2</sub>O<sub>3</sub>, 12MoO<sub>3</sub>+19H<sub>2</sub>O.**

Ppt. (Hall, J. Am. Chem. Soc. 1907, **29**, 697.)

**Ferricyanhydric acid,**

H<sub>2</sub>Fe(CN)<sub>3</sub>, (or H<sub>2</sub>Fe<sub>2</sub>(CN)<sub>12</sub>).

Easily sol. in H<sub>2</sub>O or alcohol. Solution decomposes slowly by standing, more rapidly by heating. Insol. in ether.

**Ferricyanides.**

The alkali, and alkaline-earth ferricyanides are sol. in H<sub>2</sub>O; the others are insol. The ferricyanides of metals, the oxides of which are sol. in NH<sub>4</sub>OH, or KOH+Aq., are themselves sol. in those reagents.

**Ammonium ferricyanide, (NH<sub>4</sub>)<sub>3</sub>Fe(CN)<sub>6</sub>+3H<sub>2</sub>O.**

Permanent. Readily sol. in H<sub>2</sub>O (and alcohol?).

**Ammonium ferrous ferricyanide,**

NH<sub>4</sub>FeFe(CN)<sub>6</sub>+1½H<sub>2</sub>O.

Sol. in H<sub>2</sub>O and not pptd. by alcohol from aqueous solution. More stable than the corresponding K salt.

**Ammonium lead ferricyanide,**

NH<sub>4</sub>PbFe(CN)<sub>6</sub>+3H<sub>2</sub>O.

**Ammonium potassium ferricyanide,**

(NH<sub>4</sub>)<sub>2</sub>KFe(CN)<sub>6</sub>.

Sol. in H<sub>2</sub>O. (Schaller, Bull. Soc. (2) **1**, 275.)

**Barium ferricyanide, Ba<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>+20H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O; insol. in alcohol. (Schuler, W. A. B. **77**, 692.)

**Barium potassium ferricyanide, BaKFe(CN)<sub>6</sub>+3H<sub>2</sub>O.**

Permanent. Easily sol. in H<sub>2</sub>O, less in alcohol.

**Barium ferricyanide bromide, Ba<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>, 2BaBr<sub>2</sub>+20H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O. Boiling alcohol does not dissolve out BaBr<sub>2</sub>. (Rammelsberg, J. pr. (2) **39**, 463.)

**Bismuth ferricyanide, Bi<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>3</sub>.**

Insol. in H<sub>2</sub>O, but decomp. by boiling therewith. (Muir, Chem. Soc. **32**, 40.)

**Cadmium ferricyanide ammonia,**

Cd<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>, 6NH<sub>3</sub>+3H<sub>2</sub>O.

Effloresces to form—

Cd<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>, 4NH<sub>3</sub>+2H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Wyruboff, A. hc. (5) **10**, 413.)

**Calcium ferricyanide, Ca<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>+10, or 12H<sub>2</sub>O.**

Deliquescent. Sol. in H<sub>2</sub>O and dil. alcohol.

**Calcium potassium ferricyanide,**

CaKFe(CN)<sub>6</sub>.

Sol. in H<sub>2</sub>O.

**Cerous ferricyanide, CeFe(CN)<sub>6</sub>+4H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O; easily decomp. (Jolin.)

**Chromic ferricyanide (?).**

Ppt.

**Cobaltous ferricyanide, Co<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>.**

Insol. in H<sub>2</sub>O and HCl+Aq. Sol. in NH<sub>4</sub>OH+Aq.

**Cobaltous ferricyanide ammonia,**

Co<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>, 4NH<sub>3</sub>+6H<sub>2</sub>O.

**Cobaltic ferricyanide ammonia.**

See Luteo,- purpureo,- etc. cobaltic ferricyanide.

**Cuprous ferricyanide, (Cu<sub>2</sub>)<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>.**

Sol. in NH<sub>4</sub>OH+Aq; insol. in NH<sub>4</sub> salts+Aq. (Wittstein.)

**Cupric ferricyanide, Cu<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>.**

Insol. in H<sub>2</sub>O or NH<sub>4</sub> salts+Aq. Sol. in NH<sub>4</sub>OH, and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. (Wittstein.)

Insol. in HCl+Aq.

**Iron (ferrous) ferricyanide, Fe<sub>3</sub>[Fe(CN)<sub>6</sub>]<sub>2</sub>+xH<sub>2</sub>O.**

(Turnbull's blue.) Properties as ferric ferrocyanide (Prussian blue), with which it is perhaps identical. (Gintl, Z. anal. **21**, 110.)

**Iron (ferrosoferric) ferricyanide,**

Fe<sub>13</sub>(CN)<sub>28</sub>=Fe<sup>II</sup><sub>4</sub>Fe<sup>III</sup><sub>9</sub>[Fe(CN)<sub>6</sub>]<sub>4</sub>.

(Prussian green.) Insol. in H<sub>2</sub>O or conc. HCl+Aq, but slowly decomp. by boiling therewith.

Fe<sub>3</sub>(CN)<sub>6</sub>+4H<sub>2</sub>O=Fe<sup>II</sup><sub>4</sub>Fe<sup>III</sup><sub>9</sub>[Fe(CN)<sub>6</sub>]<sub>4</sub>+12H<sub>2</sub>O. Properties as above. (Reynolds, Chem. Soc. **54**, 767.)

**Iron (ferrous) potassium ferricyanide,**

KFe<sub>2</sub>(CN)<sub>6</sub>=KFeFe(CN)<sub>6</sub>+4, or 3H<sub>2</sub>O.

(Soluble Prussian blue.) Sol. in H<sub>2</sub>O, but insol. in salts+Aq or alcohol.

Salt of the same composition, called "Williamson's blue," is insol. in  $H_2O$ .

**Lead ferricyanide, basic**,  $Pb_2[Fe(CN)_6]_2 \cdot 3PbO \cdot H_2O + 11H_2O$ .  
(Schuler.)

**Lead ferricyanide**,  $Pb_2[Fe(CN)_6]_2 + 16H_2O$ .  
Sl. sol. in  $H_2O$ ; more sol. in hot, than cold  $H_2O$ , but decomp. on boiling. (Gmelin.)  
 $+4H_2O$ . Easily sol. in  $H_2O$ ; sl. sol. in alcohol. (Schuler, W. A. B. 77. 692.)

**Lead potassium ferricyanide**,  $PbKFe(CN)_6 + 3H_2O$ .  
Sol. in 4.75 pts.  $H_2O$  at  $16^\circ$ , and the solution decomp. on standing. (Schuler.)  
 $+1\frac{1}{2}H_2O$ . Efflorescent. Much more sol. in  $H_2O$  than the Pb salt. Insol. in alcohol. (Wyrouboff.)

**Lead ferricyanide nitrate**,  $Pb_2[Fe(CN)_6]_2 \cdot Pb(NO_3)_2 + 12H_2O$ .  
Sol. in 13.31 pts.  $H_2O$  at  $16^\circ$ . (Schuler.)  
 $+11H_2O$ . (Joannis, A. ch. (5) 26. 528.)

**Magnesium ferricyanide**,  $Mg_2[Fe(CN)_6]_2$ .  
Sol. in  $H_2O$ .

**Magnesium potassium ferricyanide**,  $MgKFe(CN)_6$ .  
(Reindel, J. pr. 103. 166.)

**Manganous ferricyanide**,  $Mn_2[Fe(CN)_6]_2$ .  
Insol. in  $H_2O$ , acids,  $NH_4OH$ , or  $NH_4$  salts + Aq.

**Mercurous ferricyanide**,  $Hg_2Fe(CN)_6$ .  
Ppt. (Fernekes, J. Am. Chem. Soc. 1906, 28. 604.)

**Mercuric ferricyanide**,  $Hg_2[Fe(CN)_6]_2$ .  
Very sol. in  $H_2O$ . Solution quickly decomp. (Fernekes, J. Am. Chem. Soc. 1906, 28. 603.)

**Nickel ferricyanide ammonia**,  $Ni_2[Fe(CN)_6]_2 \cdot 4NH_3 + H_2O$ .  
Sol. in  $NH_4OH$  + Aq. (Reynoso, A. ch. (3) 30. 254.)

**Nickel ferricyanide**,  $Ni_2[Fe(CN)_6]_2(?)$ .  
Ppt. Insol. in  $HCl$  + Aq.

**Potassium ferricyanide**,  $K_3Fe(CN)_6$ , (or  $K_4Fe_2(CN)_{12}$ ).  
Permanent. Easily sol. in  $H_2O$ .

100 pts.  $H_2O$  dissolve pts.  $K_3Fe(CN)_6$  at  $t^\circ$ .

$t^\circ$	Pts. salt	$t^\circ$	Pts. salt	$t^\circ$	Pts. salt
4.4	33.0	15.6	40.8	100	77.5
10	36.6	37.8	58.8	104.4	82.6

(Wallace, Chem. Soc. 7. 80.)

100 pts.  $H_2O$  at  $13^\circ$  dissolve 38 pts., and the solution has sp. gr. = 1.1630. (Schiff, A. 113. 350.)

1 l. sat. solution in  $H_2O$  at  $25^\circ$  contains 385.5 g.  $K_3Fe(CN)_6$ . (Grube, Z. Electrochem. 1914, 20. 342.)

Sp. gr. of  $K_3Fe(CN)_6$  + Aq at  $13^\circ$ .

% salt	Sp. gr.	% salt	Sp. gr.	% salt	Sp. gr.
1	1.0061	11	1.0595	21	1.1202
2	1.0103	12	1.0653	22	1.1266
3	1.0155	13	1.0712	23	1.1331
4	1.0208	14	1.0771	24	1.1396
5	1.0261	15	1.0831	25	1.1462
6	1.0315	16	1.0891	26	1.1529
7	1.0370	17	1.0952	27	1.1596
8	1.0426	18	1.1014	28	1.1664
9	1.0482	19	1.1076	29	1.1732
10	1.0538	20	1.1039	30	1.1802

(Schiff.)

Sp. gr. of  $K_3Fe(CN)_6$  + Aq at  $25^\circ$ .

Concentration of $K_3Fe(CN)_6$ + Aq.	Sp. gr.
1—normal	1.0574
$\frac{1}{2}$ —"	1.0289
$\frac{1}{4}$ —"	1.0143
$\frac{1}{8}$ —"	1.0092

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Sat.  $K_3Fe(CN)_6$  + Aq boils at  $104.4^\circ$ . (Wallace.)

1 l. sat. solution at  $25^\circ$  of  $K_3Fe(CN)_6$  +  $K_4Fe(CN)_6$  contains 338.1 g.  $K_3Fe(CN)_6$  and 79.02 g.  $K_4Fe(CN)_6$ . (Grube.)

Solubility of  $K_3Fe(CN)_6$  +  $K_4Fe(CN)_6$  in  $KOH$  + Aq at  $25^\circ$ .

KOH Normality	g. per l.	
	$K_3Fe(CN)_6$	$K_4Fe(CN)_6$
0.4687	309	66.64
0.9628	275.3	55.19
1.949	200.8	35.95

(Grube.)

Solubility in  $KOH$  + Aq at  $25^\circ$ .

KOH Normality	g. $K_3Fe(CN)_6$ per l.
0.4687	342.7
0.9628	302.3
1.949	215.1

(Grube, Z. Electrochem, 1914, 20. 342.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)



Insol. in absolute alcohol, and only sl. sol. in dil. alcohol.

Sol. in acetone. (Naumann, B. 1904, **37**, 4328.)

Insol. in methyl acetate (Naumann, B. 1909, **42**, 3790); ethyl acetate. (Naumann, B. 1910, **43**, 314.)

Insol. in benzonitrile. (Naumann, B. 1914, **47**, 1370.)

**Potassium sodium ferricyanide,**  
 $\text{KNa}_2\text{Fe}(\text{CN})_6$ .

Sol. in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{NaFe}(\text{CN})_6$ . Sol. in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{Na}_2[\text{Fe}(\text{CN})_6]_2$ . Sol. in  $\text{H}_2\text{O}$ .  
+  $3\text{H}_2\text{O}$ .

**Potassium ferricyanide iodide,**  $\text{K}_3\text{Fe}(\text{CN})_6$ ,  
 $\text{KI}$ .

Very unstable.

**Silver ferricyanide,**  $\text{Ag}_3\text{Fe}(\text{CN})_6$ .

1 l.  $\text{H}_2\text{O}$  dissolves 0.00066 g.  $\text{Ag}_3\text{Fe}(\text{CN})_6$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, **67**, 108.)

Sol. in  $\text{NH}_4\text{OH}$ , and hot  $(\text{NH}_4)_2\text{CO}_3$  + Aq, but insol. in  $\text{NH}_4$  salts + Aq.

Insol. in  $\text{Hg}(\text{NO}_3)_2$  + Aq. (Wackenroder, A. **41**, 317.)

**Silver ferricyanide ammonia,**  $2\text{Ag}_3\text{Fe}(\text{CN})_6$ ,  
 $3\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Gintl.)

$2\text{Ag}_3\text{Fe}(\text{CN})_6$ ,  $5\text{NH}_3$ . (Carlo, Gazz. ch. it. 1910, **40**, (2) 477.)

**Sodium ferricyanide,**  $\text{Na}_3\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$ .

Deliquescent. Sol. in 5.3 pts. cold, and 1.5 pts. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol, but not pptd. thereby from aqueous solution. (Bette.)

**Ferrinitrososulphydic acid.**

See *Ferroheptanitrososulphydic acid*.

**Ferrocyanhydric acid,**  $\text{H}_4\text{Fe}(\text{CN})_6$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol.

100 pts.  $\text{H}_2\text{O}$  dissolve 15 pts. acid at  $14^\circ$ . (Joannis, A. ch. (5) **26**, 514.)

Insol. in ether, and much less sol. in ether-alcohol than in alcohol. Insol. in conc.  $\text{HCl}$  + Aq.

**Ferrocyanides.**

The ferrocyanides of the alkali and alkaline-earth metals are sol. in  $\text{H}_2\text{O}$ ; the others are insol., but sol. in alkalies + Aq in case the base is sol. therein.

**Aluminum ferrocyanide,**  $\text{Al}_4[\text{Fe}(\text{CN})_6]_3 + 17\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

Sl. sol. in  $\text{HCl}$  + Aq with partial decomp. (Wyrouboff, A. ch. (5) **8**, 446.)

**Ammonium ferrocyanide,**  $(\text{NH}_4)_4\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol.

+  $\text{H}_2\text{O}$ . (Berzelius.)

**Ammonium cadmium ferrocyanide ammonia,**  
 $(\text{NH}_4)_2\text{Cd}_4[\text{Fe}(\text{CN})_6]_2, 2\text{NH}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wyrouboff, A. ch. (5) **10**, 413.)

**Ammonium calcium ferrocyanide,**  
 $(\text{NH}_4)_2\text{CaFe}(\text{CN})_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Kunheim and Zimmerman, Dingl. **252**, 478.)

100 g. sat. solution in  $\text{H}_2\text{O}$  contain 0.25S g. at  $16^\circ$ . (Brown, J. phys. Ch. 1898, **2**, 51.)

**Ammonium cuprous ferro cyanide,**  
 $(\text{NH}_4)_2\text{Cu}_2\text{Fe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. in the air. (Messner, Z. anorg. 1895, **8**, 382.)

**Ammonium cupric ferrocyanide,**  
 $(\text{NH}_4)_2\text{CuFe}(\text{CN})_6$ .

Ppt.

+  $x\text{H}_2\text{O}$ . Very unstable. Insol. in  $\text{H}_2\text{O}$ ; decomp. by boiling  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895, **8**, 384.)

**Ammonium lithium ferrocyanide,**  
 $(\text{NH}_4)_2\text{Li}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Wyrouboff, A. ch. (4) **21**, 270.)

**Ammonium magnesium ferrocyanide,**  
 $(\text{NH}_4)_2\text{MgFe}(\text{CN})_6$ .

1 l. sat. solution at  $17^\circ$  contains 2.48 g.  $(\text{NH}_4)_2\text{MgFe}(\text{CN})_6$ . (Robinson, Chem. Soc. 1909, **96**, 1353.)

**Ammonium manganous ferrocyanide,**  
 $(\text{NH}_4)_2\text{MnFe}(\text{CN})_6$ .

Ppt. (Blum, Z. anal. **30**, 284.)

**Ammonium potassium ferrocyanide,**  
 $\text{NH}_4\text{K}_3\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Easily sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol.

$(\text{NH}_4)_2\text{K}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

**Ammonium potassium ferrocyanide ammonium chloride,**  $(\text{NH}_4)_3\text{KFe}(\text{CN})_6$ ,  
 $2\text{NH}_4\text{Cl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Étard, J. pr. (2) **31**, 430.)

**Ammonium ferrocyanide bromide,**  
 $(\text{NH}_4)_4\text{Fe}(\text{CN})_6, 2\text{NH}_4\text{Br}$ .

Permanent. Very sol. in  $\text{H}_2\text{O}$ .

**Ammonium ferrocyanide chloride,**  
 $(\text{NH}_4)_4\text{Fe}(\text{CN})_6, 2\text{NH}_4\text{Cl} + 3\text{H}_2\text{O}$ .

Permanent. Very sol. in  $\text{H}_2\text{O}$ , but less so than  $\text{NH}_4\text{Cl}$ . (Bunsen.)

**Antimony ferrocyanide**,  $\text{Sb}_4[\text{Fe}(\text{CN})_6]_3 + 25\text{H}_2\text{O}$ .

Ppt. (Atterberg.)

**Barium ferrocyanide**,  $\text{Ba}_2\text{Fe}(\text{CN})_6 + 6\text{H}_2\text{O}$ .

Permanent. Sl. sol. in  $\text{H}_2\text{O}$ .

Sol. in 584 pts. cold, and 116 pts. boiling  $\text{H}_2\text{O}$  (Duflos, 1832); sol. in 1800 pts. cold  $\text{H}_2\text{O}$  (Porrett, 1814); sol. in 1920 pts. cold, and about 100 pts. boiling  $\text{H}_2\text{O}$  (Thomson); sol. in 2000 pts. cold, and 100 pts. boiling  $\text{H}_2\text{O}$ . (Ure's Dict.)

Sol. in 1000 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 100 pts. at  $75^\circ$ . (Wyruboff, A. ch. (4) 16. 292.)

Sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or conc.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Barium cupric ferrocyanide**,  $\text{BaCuFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895, 8. 389.)

**Barium potassium ferrocyanide**,

$\text{BaK}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Sol. in 38 pts. cold, and 9.5 pts. boiling  $\text{H}_2\text{O}$  (Duflos, 1832); in 36.4 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ , and 11.9 pts. at b.-pt. (Mosander.)

Not more sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . Sol. in dil., insol. in conc.  $\text{HCl} + \text{Aq}$ . (Rose.)  $+ 5\text{H}_2\text{O}$ . Sol. in 300 pts.  $\text{H}_2\text{O}$  at ord. temp. (Wyruboff.)

**Bismuth ferrocyanide**,  $\text{Bi}_2\text{Fe}(\text{CN})_6 + 5\text{H}_2\text{O}$  (?).

Sl. sol. in pure  $\text{H}_2\text{O}$ . (Wyruboff.)

$\text{Bi}_4[\text{Fe}(\text{CN})_6]_3$ . Ppt. (Muir, Chem. Soc. 31. 657.)

**Bismuth potassium ferrocyanide**,  $\text{BiKFe}(\text{CN})_6 + 7\text{H}_2\text{O}$ , or  $4\text{H}_2\text{O}$ .

Ppt.

**Cadmium potassium ferrocyanide**,

$\text{CdK}_2\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .

Formula given by Wyruboff is  $\text{Cd}_3\text{K}_4[\text{Fe}(\text{CN})_6]_4 + 11\text{H}_2\text{O}$  (?).

**Calcium ferrocyanide**,  $\text{Ca}_2\text{Fe}(\text{CN})_6 + 12\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Sol. in 0.66 pt.  $\text{H}_2\text{O}$  at  $90^\circ$  and not pptd. by cooling, and is apparently less sol. in warm than cold  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (4) 16. 280.)

**Calcium cuprous ferrocyanide**,

$\text{CaCu}_2\text{Fe}(\text{CN})_6$ . (Messner, Z. anorg. 1894, 8. 387.)

**Calcium cupric ferrocyanide**,  $\text{CaCuFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895, 8. 388.)

**Calcium potassium ferrocyanide**,

$\text{CaK}_2\text{Fe}(\text{CN})_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Kunheim and Zimmerman, Dingl. 252. 478.)

$+ 3\text{H}_2\text{O}$ . Sol. in 795 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 145 pts. at b.-pt., with decomp. in the latter case.

Sol. in dil., insol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{HNO}_3$  of 1.2 sp. gr. (Mosander.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

**Calcium sodium ferrocyanide**,

$\text{CaNa}_2[\text{Fe}(\text{CN})_6]$ .

Sol. in  $\text{H}_2\text{O}$ .

**Calcium strontium ferrocyanide**,

$\text{CaSrFe}(\text{CN})_6 + 10\text{H}_2\text{O}$ .

Efflorescent. Sol. in about 3 pts.  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (4) 21. 278.)

**Cerium ferrocyanide**,  $\text{Ce}_4[\text{Fe}(\text{CN})_6]_3 + 30\text{H}_2\text{O}$ .

Ppt. (Wyruboff.)

**Cerium potassium ferrocyanide**,

$\text{CeKFe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Ppt. (Jolin.)

$+ 4\text{H}_2\text{O}$ . (Wyruboff.)

**Chromic ferrocyanide**,  $\text{Cr}_2[\text{Fe}(\text{CN})_6]_3 + 20\text{H}_2\text{O}$ .

Ppt.

**Cobaltous ferrocyanide**,  $\text{Co}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$ .

Wholly insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{SO}_4$  with decomp. Insol. in  $\text{HCl} + \text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

**Cobaltous ferrocyanide ammonia**,

$\text{Co}_2\text{Fe}(\text{CN})_6, 8\text{NH}_3 + 10\text{H}_2\text{O}$ .

Ppt. Decomp. on standing. (Curda, Z. Ch. 1869. 369.)

$\text{Co}_2\text{Fe}(\text{CN})_6, 12\text{NH}_3 + 9\text{H}_2\text{O}$ . As above. (Curda.)

**Cobaltous potassium ferrocyanide**,

$\text{CoK}_2\text{Fe}(\text{CN})_6$ .

Ppt. (Wyruboff.)

$\text{Co}_4\text{K}_4[\text{Fe}(\text{CN})_6]_4$  (?). Ppt. Insol. only in presence of an excess of  $\text{K}_4\text{Fe}(\text{CN})_6$ . (Wyruboff.)

**Columbium potassium ferrocyanide**,

$\text{Cb}_{16}\text{K}[\text{Fe}(\text{CN})_6]_2 + 67\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Wyruboff.)

$\text{Cb}_{12}\text{K}_2\text{Fe}(\text{CN})_6 + 39\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ . (W.)

$(\text{CbO})_4\text{K}_4[\text{Fe}(\text{CN})_6]_4 + 10\text{H}_2\text{O}$  (?). Ppt. (Atterberg.)

**Cuprous ferrocyanide**,  $\text{Cu}_4\text{Fe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

**Cupric ferrocyanide, basic,  $\text{CuFe}(\text{OH})_2(\text{CN})_4$ .**

Ppt. (Bong, Bull. Soc. 23. 231.)

**Cupric ferrocyanide,  $\text{Cu}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$  or acids. Insol. in  $\text{NH}_4$  salts + Aq. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{Aq}$  and in  $\text{KCN} + \text{Aq}$ .Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)+  $10\text{H}_2\text{O}$ . Sol. in excess of  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$ , especially if hot. (Wyruboff.)**Cupric ferrocyanide ammonia (cuprammonium ferrocyanide),  $\text{Cu}_2\text{Fe}(\text{CN})_6 \cdot 4\text{NH}_3 + \text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Bunsen.) $\text{Cu}_2\text{Fe}(\text{CN})_6 \cdot 8\text{NH}_3 + \text{H}_2\text{O}$ .**Cuprous magnesium ferrocyanide,** $\text{Cu}_2\text{MgFe}(\text{CN})_6$ .

Very unstable. Decomp. in air.

Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895, 8. 385.)**Cupric magnesium ferrocyanide,** $\text{CuMgFe}(\text{CN})_6$ .Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ .

Very unstable. (Messner, Z. anorg. 1895, 8. 387.)

**Cuprous potassium ferrocyanide,** $\text{Cu}_2\text{K}_3\text{Fe}(\text{CN})_6$ .Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . Decomp. by acids. Insol. in alcohol. (Messner, Z. anorg. 1895, 8. 378.)+  $1\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether.Decomp. by acids. Sol. in  $\text{KCN} + \text{Aq}$ . $\text{K}_2\text{Cu}_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .+  $5\text{H}_2\text{O}$ . (Wonfor.)+  $6\text{H}_2\text{O}$ . (Wyruboff.)**Cupric potassium ferrocyanide,  $\text{K}_2\text{CuFe}(\text{CN})_6 + \text{H}_2\text{O}$ .**Insol. in cold, sl. decomp. by boiling  $\text{H}_2\text{O}$ .  $\text{K}_2\text{Cu}_2[\text{Fe}(\text{CN})_6]_2 + 12\text{H}_2\text{O}$ . Ppt.**Cuprous sodium ferrocyanide,** $\text{Cu}_2\text{Na}_3\text{Fe}(\text{CN})_6$ .Decomp. by boiling  $\text{H}_2\text{O}$ ; insol. in alcohol; insol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Messner, Z. anorg. 1895, 8. 373.)**Cupric sodium ferrocyanide,** $\text{CuNa}_2\text{Fe}(\text{CN})_6$ .Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Moissan, Z. anorg. 1895, 8. 376.)**Cupric strontium ferrocyanide,** $\text{CuSrFe}(\text{CN})_6$ .Insol. in  $\text{H}_2\text{O}$ . (Messner, Z. anorg. 1895, 8. 389.)**Didymium potassium ferrocyanide,** $\text{DiKFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Ppt. (Cleve.)

+  $2\text{H}_2\text{O}$ . (Wyruboff.)**Erbium potassium ferrocyanide,  $\text{ErKFe}(\text{CN})_6$** +  $x\text{H}_2\text{O}$ .

(Höglund.)

**Gallium ferrocyanide.**Sol. in boiling  $\text{HCl} + \text{Aq}$ . (de Boisbaudran, C. R. 99. 526.)**Glucinum ferrocyanide,  $\text{Gl}_2\text{Fe}(\text{CN})_6 \cdot 4\text{H}_2\text{O} \cdot \text{H}_2$** +  $7\text{H}_2\text{O}$  (?).Sol. in  $\text{H}_2\text{O}$ . (Atterberg.)**Iron (ferric) ferrocyanide,  $\text{Fe}_7(\text{CN})_{18} =$**  $\text{Fe}_4[\text{Fe}(\text{CN})_6]_2 + x\text{H}_2\text{O}$ .(Prussian blue.) Insol. in  $\text{H}_2\text{O}$ , alcohol, ether, or oils. Decomp. slowly by boiling  $\text{H}_2\text{O}$ . Insol. in dil. mineral acids. Sol. in conc.  $\text{HCl} + \text{Aq}$  and conc.  $\text{H}_2\text{SO}_4$  without decomp. Sol. in  $\text{H}_2\text{C}_2\text{O}_4$  or  $\text{NH}_4$  tartrate + Aq. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$ . Not pptd. in presence of tartrates or citrates.**Iron (ferrous) potassium ferrocyanide,** $\text{FeK}_2\text{Fe}(\text{CN})_6$ .Insol. in  $\text{H}_2\text{O}$ . Decomp. on air.**Iron (ferric) potassium ferrocyanide,** $\text{FeKFe}(\text{CN})_6$ .

Is probably ferrous potassium ferricyanide, which see.

**Iron (ferric) ferrocyanide ammonia,** $\text{Fe}_4[\text{Fe}(\text{CN})_6]_2 \cdot 6\text{NH}_3 + 9\text{H}_2\text{O}$ .Insol. in  $\text{NH}_4$  tartrate + Aq.**Lanthanum potassium ferrocyanide,** $\text{LaKFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Ppt.

**Lead ferrocyanide,  $\text{Pb}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ , acids, or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Wyruboff, A. ch. (5) 8. 480.)Sl. sol. in conc.  $\text{H}_2\text{SO}_4$ , from which it is pptd. by  $\text{H}_2\text{O}$ . (Berzelius.)Sol. in hot  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4$  succinate + Aq; insol. in other  $\text{NH}_4$  salts + Aq. (Wittstein.)Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Brett.)

Not pptd. in presence of Na citrate. (Spiller.)

**Lithium ferrocyanide,  $\text{Li}_2\text{Fe}(\text{CN})_6 + 9\text{H}_2\text{O}$ .**Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .**Lithium potassium ferrocyanide,** $\text{Li}_2\text{K}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ . Sol. in 1.5 pts.  $\text{H}_2\text{O}$  at ord. temp. (Wyruboff, A. ch. (4) 21. 274.)

**Magnesium ferrocyanide**,  $\text{Mg}_2\text{Fe}(\text{CN})_6 + 6\text{H}_2\text{O}$ .

Sol. in 3 pts. cold  $\text{H}_2\text{O}$ . (Bette, A. 22. 148.)

**Magnesium potassium ferrocyanide**,  $\text{MgK}_2\text{Fe}(\text{CN})_6$ .

Sol. in 1575 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 238 pts. at  $100^\circ$ . Solution is decomp. by boiling. (Storer's Dict.)

1 l. sat. solution at  $17^\circ$  contains 1.95 g.  $\text{MgK}_2\text{Fe}(\text{CN})_6$ . (Robinson, Chem. Soc. 1909, 75. 1353.)

**Manganous ferrocyanide**,  $\text{Mn}_2\text{Fe}(\text{CN})_6 + 7\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .

**Manganic ferrocyanide**,  $\text{Mn}_2\text{Fe}_3(\text{CN})_{12}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily decomp. in the air. Sol. in  $\text{HCl}$ . (Straus, Z. anorg. 1895, 9. 8.)

**Manganous potassium ferrocyanide**,  $\text{MnK}_2\text{Fe}(\text{CN})_6$ .

Ppt. (Berzelius.)  
 $5\text{Mn}_2\text{Fe}(\text{CN})_6 + 4\text{K}_4\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O} (?)$ .  
Ppt. Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Wyruboff.)

**Mercuric potassium ferrocyanide**,  $\text{K}_2\text{HgFe}(\text{CN})_6$ .

Insol. in  $\text{H}_2\text{O}$ . Appreciably sol. in  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$ . (Fernekes, J. Am. Chem. Soc. 1906, 28. 87.)

**Molybdenum ferrocyanide**,  $\text{Mo}_2\text{Fe}(\text{CN})_6 + 20\text{H}_2\text{O} (?)$ .

Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Wyruboff.)  
 $\text{Mo}_2\text{Fe}(\text{CN})_6 + 8\text{H}_2\text{O} (?)$ . (W.)  
 $+ 14\text{H}_2\text{O} (?)$ . Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (W.)

**Molybdenum potassium ferrocyanide**,  $\text{K}_4\text{Mo}_2\text{Fe}(\text{CN})_{12} + 40\text{H}_2\text{O} (?)$ .

(Wyruboff.)  
 $\text{K}_2(\text{MoO}_4)_3[\text{Fe}(\text{CN})_6]_2 + 2\text{MoO}_3 + 20\text{H}_2\text{O} (?)$ . (Atterberg.)  
 $\text{K}_4\text{Mo}_2\text{Fe}(\text{CN})_{12} + 2\text{MoO}_3 + 12\text{H}_2\text{O} (?)$ . (Atterberg.)

**Nickel ferrocyanide**,  $\text{Ni}_2\text{Fe}(\text{CN})_6 + 11\text{H}_2\text{O}$ , or  $14\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ .

**Nickel ferrocyanide ammonia**,  $\text{Ni}_2\text{Fe}(\text{CN})_6 + 4\text{NH}_3 + \text{H}_2\text{O}$ .

Completely insol. in  $\text{H}_2\text{O}$  and not attacked thereby; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  to form—  
 $\text{Ni}_2\text{Fe}(\text{CN})_6 + 10\text{NH}_3 + 4\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Reynoso, A. ch. (3) 30. 252.)

$\text{Ni}_2\text{Fe}(\text{CN})_6 + 2\text{NH}_3 + 4$ , and  $9\text{H}_2\text{O}$ . Hygro-

scopic. Easily decomp. (Gintl, J. B. 1868. 304.)

$\text{Ni}_2\text{Fe}(\text{CN})_6 + 8\text{NH}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (G.)

$\text{Ni}_2\text{Fe}(\text{CN})_6 + 12\text{NH}_3 + 9\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but less so than the above compounds. (G.)

**Nickel potassium ferrocyanide**,  $\text{NiK}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Ppt. (Wyruboff.)

**Osmium ferrocyanide**,  $\text{Os}_2\text{Fe}(\text{CN})_6$ .

Ppt. (Martius, A. 117. 368.)

**Potassium ferrocyanide**,  $\text{K}_4\text{Fe}(\text{CN})_6$ .

Permanent. Easily sol. in cold, and more easily in hot  $\text{H}_2\text{O}$ .

Sol. in 4.23 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 23.6 pts. salt at  $15^\circ$ . (Schiff, A. 113. 350.)

100 pts.  $\text{H}_2\text{O}$  dissolve 27.8 pts. at  $12.2^\circ$ ; 65.8 pts. at  $37.7^\circ$ ; 87.6 pts. at  $65.5^\circ$ ; and 90.6 pts. at  $96.3^\circ$ . (Thomson.)

Sol. in 4 pts. cold, and 2 pts. boiling  $\text{H}_2\text{O}$ . (Wittstein.)

100 pts.  $\text{H}_2\text{O}$  dissolve 29.2 pts. salt at  $15^\circ$ , and solution has sp. gr. = 1.1441. (Michel and Kraft, A. ch. (3) 41. 478.)

Solubility of  $\text{K}_4\text{Fe}(\text{CN})_6$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$-2^\circ$	$+7^\circ$	$14^\circ$	$30^\circ$	$56^\circ$
10.8	15.4	17.9	23.0	31.7%
$60^\circ$	$75^\circ$	$89^\circ$	$98^\circ$	$157^\circ$
34.0	39.1	41.9	42.6	46.8%

(Étard, A. ch. 1894, (7) 2. 546.)

$\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  sat. at  $8^\circ$  has sp. gr. = 1.13. (Anthon.)

Sp. gr. of  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  at  $15^\circ$ .

% hydrous salt	Sp. gr.	% hydrous salt	Sp. gr.	% hydrous salt	Sp. gr.
1	1.0058	8	1.0479	15	1.0932
2	1.0116	9	1.0542	16	1.0999
3	1.0175	10	1.0605	17	1.1067
4	1.0234	11	1.0669	18	1.1136
5	1.0295	12	1.0734	19	1.1205
6	1.0356	13	1.0800	20	1.1275
7	1.0417	14	1.0866	..	....

(Schiff, A. 113. 199.)

Sp. gr. of  $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{K}_4\text{Fe}(\text{CN})_6 + \text{Aq}$ .	Sp. gr.
1—normal	1.0617
$1/8$ —"	1.0300
$1/6$ —"	1.0150
$1/4$ —"	1.0074
$1/16$ —"	1.0037

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Solubility in KOH + Aq at 25°.

KOH Normality	g. $K_4Fe(CN)_6 + 3H_2O$ per l.
0.09984	308.5
0.2496	283.5
0.4963	247.1
0.7036	217.4
0.9415	184.8
1.395	132.1
1.883	86.12

(Grube, Z. Electrochem, 1914, 20. 342.)

$K_4Fe(CN)_6 + NaCl + Aq$  sat. at 20° contains 26.6 g. NaCl and 17.8 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ ; sat. at 93° it contains 27.4 g. NaCl and 35.9 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ . (Conroy, J. Soc. Chem. Ind. 1898, 17. 105.)

$K_4Fe(CN)_6 + KCl + Aq$  sat. at 21° contains 27.2 g. KCl and 4.2 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ ; sat. at 99° it contains 39.6 g. KCl and 17.0 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ . (Conroy.)

$K_4Fe(CN)_6 + Na_2CO_3 + Aq$  sat. at 22° contains 29.9 g.  $Na_2CO_3$  and 26.7 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ ; sat. at 97° it contains 42.0 g.  $Na_2CO_3$  and 27.5 g.  $K_4Fe(CN)_6$  per 100 g.  $H_2O$ . (Conroy.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol even when dilute.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

+  $3H_2O$ . 1 l. sat. solution in  $H_2O$  contains 319.4 g.  $K_4Fe(CN)_6 + 3H_2O$ . (Grube, Electrochem, Z. 1914, 20. 342.)

Two modifications with different solubilities.

25.0 g. of  $\alpha$  modification are contained in 100 g. of solution at 20°.

24.6 g. of  $\beta$  modification are contained in 100 g. of solution at 20°. (Briggs, Chem. Soc. 1911, 99. 1024.)

32.0 g.  $K_4Fe(CN)_6$  (anhydrous) are dissolved in 100 g.  $H_2O$  at 25°. (Wagner, Z. phys. Ch. 1910, 71. 428.)

**Potassium samarium ferrocyanide,**

Precipitate. (Cleve.)

**Potassium sodium ferrocyanide,**

Sol. in  $H_2O$ .

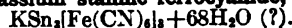
$K_2Na_3Fe(CN)_6 + 8H_2O$ . Easily sol. in  $H_2O$ .  $K_2NaFe(CN)_6 + 3H_2O$ . Permanent. Easily sol. in  $H_2O$ ; insol. in alcohol.

**Potassium sodium ferrocyanide nitrate,**

Sol. in  $H_2O$ . (Martius.)

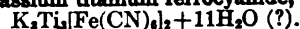
**Potassium strontium ferrocyanide,**

Easily decomp. Sol. in  $H_2O$ ; sl. sol. in alcohol. (Wyrouboff, A. ch. (4) 21. 276.)

**Potassium stannic ferrocyanide,**

Ppt. (Wyrouboff.)

$K_4Sn_{10}[Fe(CN)_6]_{11} + 230H_2O$  (?). (Atterberg.)

**Potassium titanium ferrocyanide,**

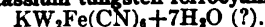
Ppt. Sol. in  $K_4Fe(CN)_6 + Aq$ . (Wyrouboff.)



Ppt. (Wyrouboff.)

$K_2(TiO)_3[Fe(CN)_6]_2 + 23H_2O$  (?). Ppt. (Atterberg.)

$K_2(TiO)_{11}[Fe(CN)_6]_6 + 110H_2O$  (?). Ppt. (Atterberg.)

**Potassium tungsten ferrocyanide,**

Sol. in  $H_2O$ . (Wyrouboff.)

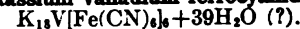
$K_2W_6Fe(CN)_6 + 20H_2O$  (?). Sol. in  $H_2O$ . (W.)

**Potassium uranium ferrocyanide,**

Ppt. (Wyrouboff.)

$K_2(UO_2)_3[Fe(CN)_6]_2 + 6H_2O$ . Ppt. (Atterberg.)

$K_4(UO_2)_6[Fe(CN)_6]_4 + 12H_2O$ . Sol. in  $H_2O$ . (Atterberg.)

**Potassium vanadium ferrocyanide,**

Ppt. Sl. sol. in  $H_2O$ . (Wyrouboff.)

$K_6(VO)_3[Fe(CN)_6]_3 + 60H_2O$  (?). Ppt. (Atterberg.)

**Potassium ytterbium ferrocyanide,**

Ppt. Sol. in excess  $K_4Fe(CN)_6 + Aq$ . (Cleve, Z. anorg. 1902, 32. 140.)

**Potassium yttrium ferrocyanide,**

Ppt. (Wyrouboff, A. ch. (5) 8. 444.)

**Potassium zinc ferrocyanide,**

Absolutely insol. in  $H_2O$ . (Wyrouboff, A. ch. (5) 8. 485.)

**Potassium ferrocyanide carbonyl,**

See Carbonyl ferrocyanide, potassium.

**Rubidium ferrocyanide,  $Rb_4Fe(CN)_6 + 2H_2O$ .**

Sol. in less than 1 pt.  $H_2O$  at ord. temp. with great absorption of heat. (Wyrouboff, A. ch. (4) 16. 307.)

**Silver ferrocyanide**,  $\text{Ag}_4\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq. Sol. in  $\text{KCN}$  + Aq.

Decomp. by warm  $\text{NH}_4\text{OH}$  + A-. (Weith, Z. Ch. (2) 5. 381.)

**Silver ferrocyanide ammonia**,  $\text{Ag}_4\text{Fe}(\text{CN})_6 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$ .

(Wyruboff.)  
+  $6\text{H}_2\text{O}$ . (Gintl.)

**Sodium ferrocyanide**,  $\text{Na}_4\text{Fe}(\text{CN})_6 + 12\text{H}_2\text{O}$ .

Efflorescent. Less sol. in  $\text{H}_2\text{O}$  than  $\text{K}_4\text{Fe}(\text{CN})_6$ . Sol. in 4.5 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . (John.)

100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 22 pts. (Ure's Dict.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$18^\circ$	$20^\circ$	$42^\circ$	$53^\circ$	
16.7	17.875	30.2	37.1	pts. $\text{Na}_4\text{Fe}(\text{CN})_6$ ,
$58^\circ$	$60^\circ$	$77^\circ$	$80^\circ$	
41.7	42.5	54.8	59.2	pts. $\text{Na}_4\text{Fe}(\text{CN})_6$ ,
	$96^\circ$	$98^\circ$	$98.5^\circ$	
	62.1	61.6	6.30	pts. $\text{Na}_4\text{Fe}(\text{CN})_6$ .

(Conroy, J. Soc. Chem. Ind. 1898; 17. 104.)

+  $10\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$18^\circ$	$20^\circ$	$42^\circ$	
29.45	31.85	58.5	pts. $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$ ,
$53^\circ$	$58^\circ$	$60^\circ$	
75.9	88.4	90.2	pts. $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$ ,
$77^\circ$	$80^\circ$	$96^\circ$	
129.5	146.0	157.0	pts. $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$ ,
$98^\circ$	$98.5^\circ$		
156.5	161.0	pts. $\text{Na}_4\text{Fe}(\text{CN})_6 + 10\text{H}_2\text{O}$ .	

(Conroy.)

**Strontium ferrocyanide**,  $\text{Sr}_2\text{Fe}(\text{CN})_6 + 15\text{H}_2\text{O}$ .

Efflorescent. Sol. in 2 pts. cold, and less than 1 pt. boiling  $\text{H}_2\text{O}$ . (Bette.)

Excessively sol. in  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (4) 16. 280.)

+  $8\text{H}_2\text{O}$ . (Wyruboff.)

**Thallous ferrocyanide**,  $\text{Tl}_4\text{Fe}(\text{CN})_6 + 2\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 0.37 pt. at  $18^\circ$ , and 3.93 pts. at  $101^\circ$ . (Lamy.)

Sol. in  $\text{KCN}$  + Aq. (Kühlmann.)

**Thorium ferrocyanide**,  $\text{ThFe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Ppt. (Cleve, Bull. Soc. (2) 24. 355.)

**Tin (stannous) ferrocyanide**,  $\text{Sn}_2\text{Fe}(\text{CN})_6 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or acids; sl. sol. in  $\text{NH}_4\text{OH}$  + Aq. (Wyruboff.)

**Tin (stannic) ferrocyanide**,  $\text{Sn}_4[\text{Fe}(\text{CN})_6]_2 + 18\frac{1}{2}\text{H}_2\text{O}$  (?).

(Wyruboff.)

**Titanium ferrocyanide**,  $\text{Ti}_7[\text{Fe}(\text{CN})_6]_2$  (?).

Ppt. (Wyruboff.)

**Uranium ferrocyanide**,  $\text{UFe}(\text{CN})_6 + 10\text{H}_2\text{O}$ .

Ppt. (Wyruboff.)

**Vanadyl ferrocyanide**,  $(\text{VO})_2\text{Fe}(\text{CN})_6 + 11\text{H}_2\text{O}$ .

Ppt. (Atterberg.)

**Yttrium ferrocyanide**,  $\text{Y}_4[\text{Fe}(\text{CN})_6]_3$ .

Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Popp, A. 131. 179.)

**Zinc ferrocyanide**,  $\text{Zn}_2\text{Fe}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or acids.

Insol. in  $\text{HCl}$  + Aq. (Lea, Sil. Am. J. (2) 31. 191.)

Sol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4$  salts + Aq. (Wittstein.)

Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}$  + Aq. (Brett.)  
Sl. sol. in boiling  $\text{K}_4\text{Fe}(\text{CN})_6$ , or  $\text{K}_4\text{Fe}(\text{CN})_6$  + Aq. (Gore.)

$\text{Na}_4\text{Fe}(\text{CN})_6$  +  $\text{NaCl}$  + Aq sat. at  $21^\circ$  contains 29.0 g.  $\text{NaCl}$  and 5.8 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ ; sat. at  $90^\circ$  it contains 24.7 g.  $\text{NaCl}$  and 21.3 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ . (Conroy, J. Soc. Chem. Ind. 1898, 17. 105.)  
 $\text{Na}_4\text{Fe}(\text{CN})_6$  +  $\text{Na}_2\text{CO}_3$  + Aq sat. at  $22^\circ$  contains 22.6 g.  $\text{Na}_2\text{CO}_3$  and 6.5 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ ; sat. at  $95^\circ$  it contains 29.8 g.  $\text{Na}_2\text{CO}_3$  and 36.8 g.  $\text{Na}_4\text{Fe}(\text{CN})_6$  per 100 g.  $\text{H}_2\text{O}$ . (Conroy.)

Very sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Insol. in alcohol.

+  $4\text{H}_2\text{O}$ . Absolutely insol. in  $\text{H}_2\text{O}$ . (Wyruboff, A. ch. (5) 8. 485.)

+  $8\text{H}_2\text{O}$ . (Weith, A. 147. 329.)

+  $10\text{H}_2\text{O}$ . (Pebal, A. 233. 165.)

**Ferrotetranitrososulphydic acid**,

$\text{H}_2\text{S}_2(\text{NO})_4\text{Fe}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol; more easily in ether; very sol. in  $\text{CS}_2$  or  $\text{CHCl}_3$ . Not obtained in a pure state. (Pawel, B. 15. 2600.)

**Ethyl ferrotetranitrososulphide**,

$(\text{C}_2\text{H}_5)_2\text{S}_2(\text{NO})_4\text{Fe}_2$ .

Insol. in  $\text{H}_2\text{O}$ , difficultly sol. in alcohol, more easily in ether, and very easily in  $\text{CS}_2$ ,  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5\text{I}$ , or  $\text{C}_6\text{H}_6$ . (Pawel, B. 15. 2609.)

**Ferrous** —,  $\text{FeS}_2(\text{NO})_4\text{Fe}_2$ .

More difficultly sol. in  $\text{H}_2\text{O}$  and alcohol than the *hepta* salt.

Sol. in ether.

**Potassium** —,  $\text{K}_2\text{S}_2(\text{NO})_4\text{Fe}_2 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Easily sol. in alcohol; insol. in ether. (Pawel, B. 15. 2600.)

True composition of "nitrosulphide of

iron and potassium" of Roussin. (A. ch. (3) 52. 297.) (Pawel, B. 13. 1949.)

**Sodium ferrotetranitrososulphide**,  
 $\text{Na}_2\text{S}_2(\text{NO})_4\text{Fe}_3+8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; easily sol. in alcohol; insol. in ether. (Pawel.)

True composition of "nitrosulphide of iron and sodium" of Roussin. (Pawel.)

**Thallium** —,  $\text{Tl}_2\text{S}_2(\text{NO})_4\text{Fe}_3$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Pawel.)

**Ferroheptanitrososulphydic acid**,  
 $\text{HS}_2(\text{NO})_7\text{Fe}_4$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, and ether. Easily sol. in  $\text{CS}_2$  or  $\text{CHCl}_3$ . (Pawel, B. 15. 2604.)

May be called Ferrinitrososulphydic acid.

**Ammonium ferroheptanitrososulphide**,  
 $\text{NH}_4\text{S}_2(\text{NO})_7\text{Fe}_4+\text{H}_2\text{O}$ .

Less easily sol. in  $\text{H}_2\text{O}$  than the K compound. (Pawel, B. 15. 2600.)

"Binitrosulphide of iron" of Roussin. Sol. in about 2 pts. boiling  $\text{H}_2\text{O}$ ; very al. sol. in cold  $\text{H}_2\text{O}$ . Very sol. in alcohols, methyl, ethyl, or amyl, and in  $\text{HC}_2\text{H}_3\text{O}_2$ . Miscible with ether. Insol. in  $\text{CS}_2$  or  $\text{CHCl}_3$ .

Decomp. by conc.  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4$ . Not attacked by  $\text{H}_2\text{C}_2\text{O}_4$ , or  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq.

Insol. in  $\text{NH}_4\text{OH}$ , and  $\text{KOH}$  + Aq. (Roussin, A. ch. (3) 52. 286.)

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofmann, Z. anorg. 1895, 9. 299.)

**Barium** —.

Easily sol. in  $\text{H}_2\text{O}$ . (Pawel.)

**Cesium** —,  $\text{Fe}_4(\text{NO})_7\text{S}_2\text{Cs}+\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Difficultly sol. in alcohol and ether. (Pawel.)

Sparingly sol. in  $\text{H}_2\text{O}$ . (Hofmann, Z. anorg. 1895, 9. 298.)

**Calcium** —.

Easily sol. in  $\text{H}_2\text{O}$ . (Pawel.)

**Ferrous** —,  $\text{Fe}[\text{S}_2(\text{NO})_7\text{Fe}_4]_2+8\text{H}_2\text{O}$ .

More easily sol. in  $\text{H}_2\text{O}$  than Na salt. (Pawel.)

**Lead** —.

Difficultly sol. in  $\text{H}_2\text{O}$ . (Pawel.)

**Magnesium** —.

Easily sol. in  $\text{H}_2\text{O}$ . (Pawel.)

**Potassium** —,  $\text{KS}_2(\text{NO})_7\text{Fe}_4$ .

Sol. in  $\text{H}_2\text{O}$ , alcohol, and very sol. in ether with slight decomp. (Pawel, B. 15. 2600.)

**Rubidium ferroheptanitrososulphide**,  
 $\text{RbS}_2(\text{NO})_7\text{Fe}_4$ .

Less soluble in  $\text{H}_2\text{O}$  than the  $\text{NH}_4$  salt. (Pawel.)

+  $\text{H}_2\text{O}$ . Ppt. (Hofmann, Z. anorg. 1895, 9. 298.)

**Sodium** —,  $\text{NaS}_2(\text{NO})_7\text{Fe}_4+2\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than the potassium salt. (Pawel.)

**Thallium** —,  $\text{TlS}_2(\text{NO})_7\text{Fe}_4+\text{H}_2\text{O}$ .

Very difficultly sol. in  $\text{H}_2\text{O}$ . More easily sol. in alcohol. (Pawel.) (Hofmann, Z. anorg. 1895, 9. 297.)

**Ferrodinitrosothiosulphonic acid**.

**Ammonium ferrodinitrosothiosulphonate**,  
 $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_2\text{NH}_4+\text{H}_2\text{O}$ .

Can be cryst. from warm  $\text{H}_2\text{O}$  without decomp. (Hofmann, Z. anorg. 1895, 8. 321.)

**Cesium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_2\text{Cs}$ .

Sparingly sol. in  $\text{H}_2\text{O}$ . (Hofmann.)

**Potassium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_2\text{K}+\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  without decomp. at  $180^\circ$ . Sol. in 50% alcohol.

Sol. in  $\text{H}_2\text{SO}_4$  without decomp. (Hofmann.)

**Rubidium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_2\text{Rb}+\text{H}_2\text{O}$ .

Less sol. in  $\text{H}_2\text{O}$  than the corresponding Na salt. (Hofmann.)

**Sodium** —,  $\text{Fe}(\text{NO})_2\text{S}_2\text{O}_2\text{Na}+2\text{H}_2\text{O}$ .

Closely resembles K salt, but is more sol. in  $\text{H}_2\text{O}$  and alcohol. (Hofmann.)

**Ferrotungstic acid**.

Sol. in  $\text{H}_2\text{O}$ . (Laurent, C. R. 31. 693.)

**Ammonium manganous ferrotungstate**,  
 $12(\text{NH}_4)_2\text{O}$ ,  $6\text{MnO}$ ,  $2\text{Fe}_2\text{O}_3$ ,  $3\text{H}_2\text{O}$ ,  
 $45\text{WO}_3+81\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Laurent.)

**Barium ferrotungstate**,  $21\text{BaO}$ ,  $2\text{Fe}_2\text{O}_3$ ,  
 $45\text{WO}_3+27\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Laurent.)

**Potassium ferrotungstate**,  $9\text{K}_2\text{O}$ ,  $2\text{Fe}_2\text{O}_3$ ,  
 $12\text{H}_2\text{O}$ ,  $45\text{WO}_3+54\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Laurent.)  
 $18\text{K}_2\text{O}$ ,  $2\text{Fe}_2\text{O}_3$ ,  $3\text{H}_2\text{O}$ ,  $45\text{WO}_3+54\text{H}_2\text{O}$ . (Laurent.)

**Ferrous acid**.

**Barium ferrite**,  $\text{BaO}$ ,  $\text{Fe}_2\text{O}_3$ .

Ppt. (List, B. 11. 1512.)

**Calcium ferrite,  $4\text{CaO}, \text{Fe}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ , or sugar +  $\text{H}_2\text{O}$ . Decomp. by the weakest acids, but not by boiling  $\text{KOH} + \text{Aq.}$  (Pelouze, A. ch. (3) 33. 5.)

$\text{CaO}, \text{Fe}_2\text{O}_3$ . (List.)

$3\text{CaO}, \text{Fe}_2\text{O}_3$ . Much less readily attacked by  $\text{H}_2\text{O}$  and acids than the silicates. (Hilpert, B. 1909, 42. 4581.)

$3\text{CaO}, 2\text{Fe}_2\text{O}_3$ . As above. (Hilpert, B. 1909, 42. 4581.)

**Calcium ferrite chloride,  $\text{CaO}, \text{Fe}_2\text{O}_3, \text{CaCl}_2$ .**

Not decomp. by  $\text{H}_2\text{O}$ . (Chatelier, C. R. 99. 276.)

**Cupric ferrite,  $\text{CuO}, \text{Fe}_2\text{O}_3$ .**

Ppt. (List.)

+  $5\text{H}_2\text{O}$ . (List.)

**Ferrous argentous ferrite,  $2\text{FeO}, \text{Ag}_2\text{O}, \text{Fe}_2\text{O}_3$  (?)**

Easily decomp. by  $\text{HCl} + \text{Aq.}$  Not completely sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  Easily sol. in conc.  $\text{HNO}_3$ . Decomp. by acetic acid. (Rose, Pogg. 10. 323.)

**Magnesium ferrite,  $\text{MgO}, \text{Fe}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Not attacked by boiling conc.  $\text{HNO}_3$ . (Deville, C. R. 52. 1264.)

Min. *Magnesioferrite*. Difficultly sol. in  $\text{HCl} + \text{Aq.}$  (Rammelsberg, Pogg. 107. 451.)

+  $4\text{H}_2\text{O}$ . Ppt. (List, B. 11. 1512.)

$6\text{MgO}, \text{Fe}_2\text{O}_3 + 9\text{H}_2\text{O}$ . Ppt.

+  $15\text{H}_2\text{O}$ . Min. *Pyroaurite*.

**Manganous ferrite,  $\text{MnO}, \text{Fe}_2\text{O}_3$ .**

Ppt. (List.)

**Nickel ferrite,  $\text{NiO}, \text{Fe}_2\text{O}_3$ .**

Ppt. (List.)

**Potassium ferrite,  $3\text{K}_2\text{O}, 4\text{Fe}_2\text{O}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq.}$ ,  $\text{NaOH} + \text{Aq.}$ , etc., but only slowly by  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Salm-Horstmar, J. pr. 55. 349.)

$\text{K}_2\text{Fe}_2\text{O}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (Rousseau and Bernheim, C. R. 107. 240.)

**Silver (argentous) ferrite,  $\text{Ag}_2\text{O}, \text{Fe}_2\text{O}_3$  (?)**

Decomp. by dil.  $\text{HNO}_3 + \text{Aq.}$  (Rose, Pogg. 10. 323.)

**Sodium ferrite,  $\text{Na}_2\text{O}, \text{Fe}_2\text{O}_3$ .**

$\text{Na}_2\text{O}$  is dissolved out by  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq.}$  Not easily decomp. by  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Salm-Horstmar.)

**Zinc ferrite,  $\text{ZnO}, \text{Fe}_2\text{O}_3$ .**

Sol. in boiling conc.  $\text{HCl} + \text{Aq.}$  (Ebelmen, A. ch. (3) 33. 47.)

Min. *Franklinite*.

**Flavocobaltic compounds.**

See also Xanthocobaltic compounds.

**Flavocobaltic chloraurate,  $(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4\text{AuCl}_4$ .**

More easily sol. than the chloroplatinate. Not wholly insol. in absolute alcohol. (Jürgensen, Z. anorg. 5. 159.)

— chloroplatinate,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{PtCl}_6$   
As the chloroplatinite. (Jürgensen.)

— chloroplatinite,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{PtCl}_6$ .  
Somewhat sol. in  $\text{H}_2\text{O}$ , and not insol. in 50% alcohol. (Jürgensen.)

— chromate,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{Cr}_2\text{O}_7$ .  
Ppt. (Jürgensen.)

— nitrate,  $\text{Co}(\text{NO}_2)_2(\text{NH}_3)_4\text{NO}_3$ .

Sol. in about 33 pts. cold  $\text{H}_2\text{O}$ ; insol. in  $\text{HNO}_3$ . (Jürgensen.)

$\text{Co}(\text{NO}_2)_2(\text{NH}_3)_4\text{NO}_3$ ,  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Jürgensen.)

— cobaltic nitrite,  $3(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4$ ,  
 $\text{Co}_2(\text{NO}_2)_4 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Jürgensen, Z. anorg. 5. 179.)

— diamine cobaltic nitrite,

$(\text{NO}_2)_2\text{Co}(\text{NH}_2)_4$ ,

$(\text{NO}_2)_2(\text{NH}_2)_2\text{Co}(\text{NO}_2)_2$ .

Very al. sol. in  $\text{H}_2\text{O}$ . (Jürgensen.)

— sulphate,  $[(\text{NO}_2)_2\text{Co}(\text{NH}_3)_4]_2\text{SO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ , more easily in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Jürgensen.)

**Fluoborhydric acid,  $\text{HBF}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  very rapidly. (Landolph, C. R. 86. 803.)

**Aluminum fluoboride,  $2\text{AlF}_3, 3\text{BF}_3$ .**

Sol. in  $\text{H}_2\text{O}$  only when acidulated; sol. in acids. (Berzelius.)

**Ammonium fluoboride,  $\text{NH}_4\text{BF}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Sol. in 4 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 1.02–1.05 pts. boiling  $\text{H}_2\text{O}$ . (Stolba, Chem. techn. Cent. Anz. 7. 459.) Sl. sol. in alcohol.

**Barium fluoboride,  $\text{Ba}(\text{BF}_4)_2 + 2\text{H}_2\text{O}$ .**

Deliquescent; easily sol. in  $\text{H}_2\text{O}$ ; decomp. by alcohol. (Berzelius.)

**Cæsium fluoboride,  $\text{CsBF}_4$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 0.92 pt.  $\text{CsBF}_4$  at  $20^\circ$ , and 0.04 pt. at  $100^\circ$ . (Godeffroy, B. 9. 1367.)  
0.02 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Erdmann, Arch. Pharm. 1894, 232. 21.)

**Calcium fluoboride,  $\text{Ca}(\text{BF}_4)_2$ .**

Decomp. by  $\text{H}_2\text{O}$ , with formation of a sol. acid salt and an insol. basic salt. (Berzelius.)



**Cupric fluoboride,  $\text{Cu}(\text{BF}_4)_2$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Lead fluoboride,  $\text{Pb}(\text{BF}_4)_2$ .**

Sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  or alcohol into an acid soluble, and a basic insoluble salt. (Berzelius.)

**Lithium fluoboride,  $\text{LiBF}_4$ .**

Hygroscopic. Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Magnesium fluoboride.**

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Potassium fluoboride,  $\text{KBF}_4$ .**

Sol. in 223 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Stolba.)

Sol. in 70.4 pts. cold  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in 15.94 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Stolba.)

1.43 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Erdmann, Arch. Pharm. 1894, 232. 21.)

Not more sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ ; sol. in hot  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{M}_2\text{CO}_3 + \text{Aq}$ . (Berzelius.) More sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose, Pogg. 80. 276.) Insol. in 20%  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Stromeyer.) Insol. in cold, sl. sol. in boiling alcohol.

**Rubidium fluoboride,  $\text{RbBF}_4$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 0.55 pt. at  $20^\circ$ , and 1.0 pt. at  $100^\circ$ . (Godeffroy, B. 9. 1337.)

0.55 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Erdmann, Arch. Pharm. 1894, 232. 21.)

**Sodium fluoboride,  $\text{NaBF}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in alcohol. (Berzelius.)

**Yttrium fluoboride.**

Sol. in  $\text{H}_2\text{O}$  with excess of acid. (Berzelius.)

**Zinc fluoboride,  $\text{Zn}(\text{BF}_4)_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Fluoboric acid,  $\text{HBF}_4$ .**

See Fluoborhydric acid.

$\text{H}_4\text{B}_2\text{O}_7$ ,  $3\text{HF}$  and  $\text{H}_4\text{B}_2\text{O}_7$ ,  $2\text{HF}$  (?). Fume on air, and are decomp. with  $\text{H}_2\text{O}$ . (Lundolph, B. 12. 1583.)

$\text{HBO}_2$ ,  $3\text{HF}$ . Decomp. by  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 59. 644.)

Is either a mixture, or a solution of  $\text{HBO}_2$  in  $\text{HF}$ , and is decomp. by distillation, and the salts are decomp. by recrystallisation. (Basarow, C. R. 78. 1698.)

**Potassium fluoborate,  $\text{K}_2\text{B}_2\text{O}_5\text{F}_2$  (?).**

Sl. deliquescent. Scarcely sol. in boiling alcohol. (Schiff, A. Suppl. 5. 175.)

See Boron trioxide potassium fluoride,  $\text{B}_2\text{O}_3$ ,  $2\text{KF}$ .

**Fluochromic acid.****Ammonium fluochromate,  $\text{NH}_4\text{CrO}_2\text{F}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Varenne, C. R. 91. 989.)

**Potassium fluochromate,  $\text{KCrO}_2\text{F}$ .**

Efflorescent. Sol. in  $\text{H}_2\text{O}$ , with gradual decomp. (Streng, A. 129. 225.)

**Fluocolumbic acid.**

See also Fluoxycolumbic acid.

**Ammonium fluocolumbate fluoxycolumbate,  $(\text{NH}_4)_2\text{C}_2\text{B}_2\text{F}_{10}$ ,  $2\text{C}_2\text{B}_2\text{OF}_8$ ,  $\text{NH}_4\text{F}$ .****Cadmium fluocolumbate,  $\text{Cd}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 28\text{H}_2\text{O}$ .**

Insol. in, and decomp. by  $\text{H}_2\text{O}$ . (Streng.)

**Cobalt fluocolumbate,  $\text{Co}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 28\text{H}_2\text{O}$ .**

Insol. in, and decomp. by  $\text{H}_2\text{O}$ . (Streng.)

**Copper fluocolumbate,  $\text{Cu}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 9\text{H}_2\text{O}$ .**

Insol. in, and decomp. by  $\text{H}_2\text{O}$ .

**Ferrous fluocolumbate,  $\text{Fe}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 19\text{H}_2\text{O}$ .**

As above.

**Manganous fluocolumbate,  $\text{Mn}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 28\text{H}_2\text{O}$ .****Mercuric fluocolumbate,  $\text{Hg}_2\text{C}_2\text{B}_2\text{F}_{10} + 8\text{H}_2\text{O}$ .**

As above.

**Nickel fluocolumbate,  $\text{Ni}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 19\text{H}_2\text{O}$ .**

As above.

**Potassium fluocolumbate,  $\text{K}_2\text{C}_2\text{B}_2\text{F}_{10}$ .**

Decomp. by solution in  $\text{H}_2\text{O}$ . (Marignac A. ch. (4) 8. 34.)

**Rubidium fluocolumbate,  $\text{Rb}_2\text{C}_2\text{B}_2\text{F}_{10}$ .**

Sol. in  $\text{H}_2\text{O}$  and  $\text{HF} + \text{Aq}$ . Insol. in alcohol. (Pennington, J. Am. Chem. Soc. 1896, 18. 58.)

**Zinc fluocolumbate,  $\text{Zn}_2\text{H}_2\text{C}_2\text{B}_2\text{F}_{10} + 28\text{H}_2\text{O}$ .**

Insol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$ . (Santesson, Bull. Soc. (2) 24. 52.)

**Fluodithionic acid.****Cæsium monofluodithionate,**

$\text{S}_2\text{O}_6(\text{OH})\text{FCs}_2 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ ; very unstable. (Weinland, Z. anorg. 1899, 21. 66.)

**Potassium difluodithionate,  $\text{S}_2\text{O}_6\text{F}_2\text{K}_2 + 3\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ ; very unstable. (Weinland.)

**Rubidium difluodithionate**,  $\text{S}_2\text{O}_3\text{F}_2\text{Rb}_2 + 3\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ ; very unstable. (Weinland.)

**Fluogermanic acid**,  $\text{H}_2\text{GeF}_4$ .

Known only in solution. (Winkler, J. pr. (2) 36. 177.)

**Potassium fluogermanate**,  $\text{K}_2\text{GeF}_6$ .

Sol. in 173.98 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Winkler.)

Sol. in 184.61 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Krüss and Nilson, B. 20. 1696.)

Sol. in 34.07 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Winkler.)

Sol. in 38.76 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Krüss and Nilson.)

Insol. in alcohol.

**Difluoiodic acid**.

**Ammonium difluoiodate**,  $\text{NH}_4\text{IO}_2\text{F}_2$ .

Like K salt.

Sol. in 40%  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 20. 30.)

Sol. in  $\text{H}_2\text{O}$ . Easily decomp. (Weinland, B. 1897, 30. 868.)

**Cesium difluoiodate**,  $\text{CsIO}_2\text{F}_2$ .

(Weinland, Z. anorg. 1899, 20. 36.)

**Cesium hydrogen difluoiodate**,

$\text{CsIO}_2\text{F}_2, \text{HIO}_2\text{F}_2 + 2\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, Z. anorg. 1899, 22. 257.)

**Potassium difluoiodate**,  $\text{KIO}_2\text{F}_2$ .

Sol. in  $\text{H}_2\text{O}$ . Decomp. in moist air. (Weinland, B. 1897, 30. 867.)

Decomp. in air. Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. without decomp. in 40%  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 20. 31.)

**Rubidium difluoiodate**,  $\text{RbIO}_2\text{F}_2$ .

Resembles K salt. Sol. in  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 20. 35.)

**Rubidium hydrogen difluoiodate**,

$\text{RbIO}_2\text{F}_2, \text{HIO}_2\text{F}_2 + 2\text{H}_2\text{O}$ .

Sol. in 40-60%  $\text{HF} + \text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 260.)

**Sodium difluoiodate**,  $\text{NaIO}_2\text{F}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1897, 30. 868.)

Sol. in  $\text{HF}$ . (Weinland, Z. anorg. 1899, 20. 37.)

**Fluomanganic acid**,  $\text{H}_2\text{MnF}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol and ether in absence of  $\text{H}_2\text{O}$ . (Nicklès, C. R. 65. 107.)

**Ammonium fluomanganate**,  $(\text{NH}_4)_2\text{MnF}_6$ .

More sol. than the K salt. (Nicklès, C. R. 65. 107.)

True composition is  $(\text{NH}_4)_4\text{Mn}_2\text{F}_{10} = 4\text{NH}_4\text{F}, \text{Mn}_2\text{F}_6$ . (Christensen, J. pr. (2) 34. 41.)

**Cobalt fluomanganate**,  $2\text{CoF}_3, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Christensen.)

**Nickel fluomanganate**,  $2\text{NiF}_3, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Christensen.)

**Potassium fluomanganate**,  $\text{K}_2\text{MnF}_6$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Nicklès, C. R. 65. 107.)

Composition is  $\text{K}_4\text{Mn}_2\text{F}_{10} = 4\text{KF}, \text{Mn}_2\text{F}_6$ . Also with  $2\text{H}_2\text{O}$ . (Christensen, J. pr. (2) 34. 41.)

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$  with decomp. Can be recryst. from 40%  $\text{HF} + \text{Aq}$ . Insol. in acetic acid. (Weinland and Lauenstein, Z. anorg. 1899, 20. 41.)

**Rubidium fluomanganate**,  $\text{Rb}_2\text{MnF}_6 + 2\text{H}_2\text{O}$ .

As the K salt. (Weinland and Lauenstein, Z. anorg. 1899, 20. 44.)

**Silver fluomanganate**,  $\text{Ag}_2\text{Mn}_2\text{F}_8 + 14\text{H}_2\text{O}$ .

(Christensen, J. pr. (2) 34. 41.)

**Sodium fluomanganate**,  $4\text{NaF}, \text{Mn}_2\text{F}_6$ .

Decomp. by much  $\text{H}_2\text{O}$ . (Christensen.)

**Zinc fluomanganate**,  $2\text{ZnF}_2, \text{Mn}_2\text{F}_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Christensen.)

**Fluomolybdic acid**.

See Fluoxyhypomolybdic, and Fluoxymolybdic acids.

**Fluopalladous acid**.

**Potassium fluopalladite**,

Sl. sol. in  $\text{H}_2\text{O}$ .

**Sodium fluopalladite**.

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Fluoperboric acid**.

**Ammonium fluoperborate**,

$\text{NH}_4\text{OOB}(\text{F})\text{OOB}(\text{F})\text{OONH}_4$ .

Ppt. Insol. in ether. (Petrenko, C. C. 1902, I. 1191.)

**Potassium fluoperborate**,  $\text{K}_2\text{B}_4\text{F}_{10} + \text{H}_2\text{O}$ .

Dry salt is rather stable.

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. rapidly when warmed; at ordinary

temp. the decomp. proceeds slowly. Insol. in alcohol. (Melikoff, B. 1899, 32. 3350.)

$\text{KOOB(F)OOb(F)OK} + 1\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Insol. in ether. (Petrenko, C. C. 1902, I. 1191; J. Russ. phys. chem. Soc. 34. 37.)

### Fluoperuranic acid.

Potassium fluoperuranate,  $\text{K}_4\text{U}_2\text{F}_{10}\text{O}_{11} + 4\text{H}_2\text{O} = 3\text{UO}_2\text{KF} + \text{UO}_2\text{F}_2 + \text{KF} + 4\text{H}_2\text{O}$ .

Ppt. (Lordkipanidse, C. C. 1900, II. 525.)

Sodium fluoperuranate,  $\text{UO}_2\text{NaF} + 5\text{H}_2\text{O}$ .

Ppt. (Lordkipanidse, C. C. 1900, II. 525.)

Fluophosphamide,  $\text{PF}_3(\text{NH}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Poulenc, A. ch. (6) 24. 566.)

### Fluophosphoric acid.

Monocassium monofluophosphate,  $\text{P}(\text{OH})_2(\text{OCs})\text{F}$ .

Like the K salt. (Weinland, Z. anorg. 1899, 21. 43.)

Monopotassium monofluophosphate,  $\text{P}(\text{OH})_2(\text{OK})\text{F}$ .

Sol. in 40% HF + Aq; decomp. in the air. (Weinland, Z. anorg. 1899, 21. 44.)

Potassium monofluophosphate,  $\text{KHF}_2\text{PO}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ ; unstable. (Weinland, B. 1898, 31. 124-125.)

Morbidium monofluophosphate,  $\text{P}(\text{OH})_2(\text{ORb})\text{F}$ .

Sol. in 40% HF + Aq. (Weinland, Z. anorg. 1899, 21. 47.)

Rubidium monofluophosphate,  $\text{RbHF}_2\text{PO}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1898, 31. 124.)

### Fluoplatinic acid.

Ammonium fluoplatinate.

Secomp. by  $\text{H}_2\text{O}$  to a sol. acid, and an insol. basic salt. Insol. in alcohol. (Berzelius.)

Potassium fluoplatinate.

Deliquescent. Insol. in alcohol. Decomp. by  $\text{H}_2\text{O}$ . (Berzelius.)

Sodium fluoplatinate.

Decomp. by  $\text{H}_2\text{O}$ . (Berzelius.)

### Fluor- and Fluoro-

See Fluor-

Fluorhydric (Hydrofluoric) acid, HF or  $\text{H}_2\text{F}_2$ .

Attracts  $\text{H}_2\text{O}$  from air with great avidity. Very sol. in  $\text{H}_2\text{O}$  with evolution of much heat.

Sat. solution has sp. gr. 1.25. (H. Davy.)

On boiling the aqueous solution an acid of constant composition is obtained, which boils at  $120^\circ$ , has sp. gr. 1.15, and contains 35.37% HF (Bineau, A. ch. (3) 7. 257.) The residual acid after boiling contains 36 to 38% HF, and by standing over CaO gives off HF until an acid containing 32.5 to 32.7% HF is formed. Weaker acids increase their strength to 32.2 to 32.4% HF, while an acid containing 32.5% HF remains unchanged. (Roscoe, A. 116. 218.)

Does not attack gutta-percha. Sol. in  $\text{H}_2\text{SO}_4$ .

Sp. gr. of HF + Aq at  $15^\circ$ .

Sp. gr.	% HF	Sp. gr.	% HF	Sp. gr.	% HF
1.01	2.90	1.10	29.00	1.19	55.10
1.02	5.80	1.11	31.90	1.20	58.00
1.03	8.70	1.12	34.80	1.21	60.90
1.04	11.60	1.13	37.70	1.22	63.80
1.05	14.50	1.14	40.60	1.23	66.70
1.06	17.40	1.15	43.50	1.24	69.60
1.07	20.30	1.16	46.40	1.25	72.50
1.08	23.20	1.17	49.30	....	...
1.09	26.10	1.18	52.20	....	...

(Hart, J. Anal. Ch. 3. 372.)

Sp. gr. of HF + Aq at ord. temp.

Deg. Baumé	Sp. gr.	% HF
1	1.0069	2.32
2	1.0139	4.04
3	1.0211	5.76
4	1.0283	7.48
5	1.0356	9.20
6	1.0431	10.92
7	1.0506	12.48
8	1.0583	14.04
9	1.0661	15.59
10	1.074	17.15
11	1.082	18.86
12	1.0901	21.64
13	1.0983	24.42
14	1.1067	27.20
15	1.1152	29.98
16	1.1239	32.78
17	1.1326	35.15
18	1.1415	37.53
19	1.1506	39.91
20	1.1598	42.29
21	1.1691	44.67
22	1.1786	47.04
23	1.1883	49.42
24	1.1981	51.57
25	1.2080	53.72
26	1.2182	55.87
27	1.2285	58.02

Sp. gr. of HF+Aq at ord. temp.—*Continued.*

Deg. Baumé	Sp. gr.	% HF
28	1.2390	60.17
29	1.2497	62.32
30	1.2605	64.47
31	1.2716	66.61
32	1.2828	68.76
33	1.2943	70.91
34	1.3059	73.06
35	1.3177	75.21
36	1.3298	77.36
37	1.3421	79.51
38	1.3546	81.66
39	1.3674	83.81
40	1.3804	85.96
41	1.3937	88.10
42	1.4072	90.24
43	1.4211	92.39
44	1.4350	94.54
45	1.4493	96.69

(Eckelt, Ch. Z. 1898, 22. 225.)

Sp. gr. of HF+Aq at 0°.

% HF	Sp. gr.	% HF	Sp. gr.
0.484	1.005	71.73	1.262
1.504	1.009	72.21	1.260
2.48	1.012	78.05	1.260
4.80	1.017	84.27	1.235
7.75	1.035	87.72	1.212
15.85	1.065	88.11	1.210
24.47	1.097	88.82	1.207
28.48	1.110	89.02	1.202
29.83	1.120	89.15	1.200
34.23	1.130	89.82	1.190
38.50	1.145	90.20	1.185
41.00	1.155	90.64	1.175
41.15	1.155	91.04	1.165
41.92	1.157	92.09	1.152
47.52	1.182	92.81	1.135
48.49	1.187	92.91	1.130
50.97	1.200	94.26	1.095
55.09	1.217	95.84	1.065
55.39	1.220	97.50	1.035
57.66	1.230	98.22	1.022
61.66	1.245	100.05	1.0005
65.19	1.255	....	...

(Hill, Roy. Soc. Proc. 1909, 83. A. 144.)

Sp. gr. of HF+Aq at 18°.

% HF	Sp. gr.
0.484	1.003
1.504	1.005
2.48	1.009
4.80	1.017
7.75	1.028
15.85	1.058
24.47	1.087
29.83	1.103

(Hill.)

Aq. solution of sp. gr. 1.138 at 18° contains 43.2% HF and has a constant bpt. of 111° at 750 mm. (Deussen, Z. anorg. 1906, 49. 297.)

The strongest acid that can be obtained by distillation contains 48.17% HF and boils at 125–125.5°. (Gore.)

**Fluorides.**

The alkali fluorides, also AgF and SnF<sub>2</sub>, are sol. in H<sub>2</sub>O; the fluorides of Fe, Sr, and Cd are sl. sol.; the others are insol. in H<sub>2</sub>O. Most fluorides are sol. in acids, especially HF +Aq.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 822.)

See under each element.

**Fluorine, F<sub>2</sub>.**

Decomposes H<sub>2</sub>O and all organic solvent with great violence. (Moissan, C. R. 103. 202 and 256.)

Liquified at –185° to a yellowish liquid which does not dissolve glass nor ignite cooled Si, B, C, S, P, or Fe. (Moissan, C. R. 1897, 124. 1202–1204.)

**Fluomolybdic acid.**

**Ammonium fluomolybdate**, (NH<sub>4</sub>)MoF<sub>4</sub>+H<sub>2</sub>O.

Somewhat more sol. in H<sub>2</sub>O than the K salt. Hydrolysed by H<sub>2</sub>O. (Rosenheim, Z. anorg. 1905, 46. 321.)

(NH<sub>4</sub>)<sub>2</sub>Mo<sub>2</sub>F<sub>7</sub>+2H<sub>2</sub>O. (Rosenheim.)

**Potassium fluomolybdate**, KMoF<sub>4</sub>+H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O. (Rosenheim.)

**Fluoselenic acid.**

**Ammonium monofluoselenate**,

SeO<sub>2</sub>(OH)F(NH<sub>4</sub>)<sub>2</sub>.

Not hygroscopic.

Easily sol. H<sub>2</sub>O with decomp.

Sol. in HF. (Weinland, Z. anorg. 1899, 21. 58.)

**Tripotassium difluodiselenate**, Se<sub>2</sub>O<sub>7</sub>F<sub>2</sub>K<sub>3</sub>H+H<sub>2</sub>O.

Decomp. in the air; sol. in H<sub>2</sub>O with decomp.; sol. in HF. (Weinland.)

**Trirubidium difluodiselenate**, Se<sub>2</sub>O<sub>7</sub>F<sub>2</sub>Rb<sub>3</sub>H+H<sub>2</sub>O.

Decomp. in the air; sol. in H<sub>2</sub>O with decomp.; sol. in HF. (Weinland, Z. anorg. 1899, 21. 57.)

**Fluosilicic acid,  $\text{H}_2\text{SiF}_6$ .**

Sp. gr. of  $\text{H}_2\text{SiF}_6$  + Aq at  $17.5^\circ$  ( $\text{H}_2\text{O}$  at  $17.5^\circ = 1.000$ ).

% $\text{H}_2\text{SiF}_6$	Sp. gr.	% $\text{H}_2\text{SiF}_6$	Sp. gr.
2	1.0161	20	1.1748
4	1.0324	22	1.1941
6	1.0491	24	1.2136
8	1.0661	26	1.2335
10	1.0834	28	1.2537
12	1.1011	30	1.2742
14	1.1190	32	1.2951
16	1.1373	34	1.3162
18	1.1559	..	....

(Stolba, J. pr. 90. 193.)

+  $2\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Kessler, C. R. 90. 1285.) Solution decomp. into HF and  $\text{SiF}_4$  on evaporation, when it becomes concentrated.

**Fluosilicates.**

Most of the fluosilicates are sol. in  $\text{H}_2\text{O}$ , but the alkali salts (especially K) and the Ba salt are only al. sol. in  $\text{H}_2\text{O}$ .

**Aluminum fluosilicate,  $\text{Al}_2(\text{SiF}_6)_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . After evaporating to dryness, the residue is slowly but completely sol. in  $\text{H}_2\text{O}$ . (Deville, A. ch. (3) 61. 327.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Aluminum fluosilicate silicate,  $\text{Al}_2\text{SiF}_6\text{SiO}_4$ ,  $5\text{Al}_2\text{SiO}_4$ .**

Min. *Topaz*. Insol. in acids.

**Ammonium fluosilicate,  $(\text{NH}_4)_2\text{SiF}_6$ .**

Sol. in 5.38 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  to form a solution of 1.0961 sp. gr.; sol. in 1.8 pts. hot  $\text{H}_2\text{O}$ ; sol. in 45.5 pts. alcohol of 31%. (Stolba, C. C. 1877. 418.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

$3\text{NH}_4\text{F} \cdot \text{SiF}_4 = (\text{NH}_4)_2\text{SiF}_6 \cdot \text{NH}_4\text{F}$ . Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 221.)

**Barium fluosilicate,  $\text{BaSiF}_6$ .**

Sol. in 3802 pts. cold  $\text{H}_2\text{O}$ . (Fresenius, A. 59. 120.)

Sol. in 3731 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$ ; in 3315 pts. at  $21^\circ$ ; in 1175 pts. at  $100^\circ$ . (Stolba, J. pr. 96. 22.)

Sol. in 640–733 pts.  $\text{H}_2\text{O}$  containing a little HCl. (Fresenius.)

488 pts.  $\text{HCl}$  + Aq containing 4.25% HCl dissolve 1 pt. at  $22^\circ$ . (Stolba.)

More sol. in  $\text{HNO}_3$  + Aq than in  $\text{H}_2\text{O}$ . (Fresenius.)

272 pts.  $\text{HNO}_3$  + Aq, containing 8%  $\text{N}_2\text{O}_5$ , dissolve 1 pt. at  $22^\circ$ . (Stolba.)

1 pt.  $\text{BaSiF}_6$  dissolves in 428 pts. sat.  $\text{NH}_4\text{Cl}$  + Aq; in 589 pts. sat.  $\text{NH}_4\text{Cl}$  + Aq + 2 vols.  $\text{H}_2\text{O}$ . (Mallet, Sill. Am. J. (2) 28. 48.)

1 pt.  $\text{BaSiF}_6$  dissolves in 306 pts. sat.  $\text{NH}_4\text{Cl}$  + Aq at  $22^\circ$ ; in 361 pts. 15% solution of  $\text{NH}_4\text{Cl}$ ; in 563 pts. sat. boiling  $\text{NaCl}$  + Aq; in 349 pts. 10% solution of  $\text{NaCl}$  at boiling temp.; in 2185 pts. 10% solution of  $\text{NaCl}$  at  $20^\circ$ ; in 1140 pts. 5% solution of  $\text{NaCl}$  at  $20^\circ$ . (Stolba.)

Nearly absolutely insol. in alcohol. (Fresenius.)

Solubility in a mixture of  $\text{H}_2\text{O}$ , alcohol (96%),  $\text{HCl}$  + Aq (20%),  $\text{H}_2\text{SiF}_6$  + Aq (3.7%).

1 pt.  $\text{BaSiF}_6$  is sol. in pts. of solutions of given composition.

$\text{H}_2\text{O}$	Alcohol	$\text{HCl}$ + Aq	$\text{H}_2\text{SiF}_6$ + Aq	$\text{BaSiF}_6$
50	50	0	0	37,219
74.1	25	0.9	0	5,263
70.8	25	4.2	0	2,860
77.95	20	0.9	1.15	39,061
73.0	25	0.9	1.1	70,679
97.09	0	1.25	1.66	3,247
75.0	25	0	0	16,914

(Fresenius, Z. anal. 29. 143.)

**Cadmium fluosilicate,  $\text{CdSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Extremely sol. in  $\text{H}_2\text{O}$ . Easily sol. in 50% alcohol. (Engelskirchen, Dissert. 1903.)

**Cæsium fluosilicate,  $\text{Cs}_2\text{SiF}_6$ .**

Sol. in 166 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , and much less h<sub>2</sub>t  $\text{H}_2\text{O}$ . Insol. in alcohol. (Preis, J. pr. 103. 410.)

**Calcium fluosilicate,  $\text{CaSiF}_6 \cdot 2\text{H}_2\text{O}$ .**

Sl. sol. in, and partly decomp. by  $\text{H}_2\text{O}$ . Sol. in HF and  $\text{HCl}$  + Aq. Sol. in fluosilicic acid without decomp. Easily sol. in 60% alcohol. (Fleischer.)

**Cerium fluosilicate.**

Very difficulty sol. in  $\text{H}_2\text{O}$ , acetic, or fluosilicic acids. Insol. in alcohol. (Stolba, C. C. 1874. 130.)

**Chromium fluosilicate.**

Deliquescent. (Berzelius.)

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Berlin.)

**Cobaltous fluosilicate,  $\text{CoSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Cuprous fluosilicate,  $\text{Cu}_2\text{SiF}_6$ .**

Insol. in  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 1. 199.)

**Cupric fluosilicate,  $\text{CuSiF}_6 \cdot 6\text{H}_2\text{O}$ .**

Deliquescent in moist, efflorescent in dry air.

Sol. in 0.428 pt.  $\text{H}_2\text{O}$  at  $17^\circ$ . Sp. gr. of solution sat. at  $17^\circ = 1.6241$ .

Sol. in 17.5 pts. alcohol of 62 vol. % at  $20^\circ$ ; in 150 pts. of 85% at  $20^\circ$ ; in 617 pts. of 92% at  $20^\circ$ . (Stolba, J. pr. 102. 7.)

**Insol. in methyl acetate.** (Naumann, B. 1909, 42. 3790.)

Contains  $6\frac{1}{2}$  H<sub>2</sub>O. (Stolba.)  
+  $5\frac{1}{2}$  H<sub>2</sub>O. (Knop and Wolf.)

**Cupric fluosilicate phosphate, CuSiF<sub>6</sub>, Cu<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>.**

**Insol. in H<sub>2</sub>O, but easily sol. in dil. HCl + Aq.** (Thorpe and Rodger, Chem. Soc. 55. 320.)

**Glucinum fluosilicate.**

Known only in solution.

**Iron (ferrous) fluosilicate, FeSiF<sub>6</sub> + 6H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O. (Berzelius.)

**Iron (ferric) fluosilicate, Fe<sub>3</sub>(SiF<sub>6</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Berzelius.)

**Lead fluosilicate, PbSiF<sub>6</sub> + 2H<sub>2</sub>O.**

Deliquescent. Easily sol. in H<sub>2</sub>O.

**Insol. in acetone.** (Naumann, B. 1904, 37. 4329.)

+ 4H<sub>2</sub>O. (Marignac.)

**Lithium fluosilicate, Li<sub>2</sub>SiF<sub>6</sub> + 2H<sub>2</sub>O.**

100 pts. H<sub>2</sub>O at 17° dissolve 73 pts. crystalline salt. (Marignac.)

100 pts. cold H<sub>2</sub>O dissolve 52.6 pts. crystals. Sol. in dil. alcohol. (Stolba, J. pr. 91. 456.)

100 pts. alcohol of 46 vol. % dissolve about 4 pts., and 100 pts. alcohol of 79 vol. % dissolve about 0.4 pt. crystals. (Stolba, Z. anal. 3. 311.)

**Insol. in ether or benzene.**

**Insol. in acetone.** (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Insol. in methyl acetate.** (Naumann, B. 1909, 42. 3790.)

**Insol. in ethyl acetate.** (Naumann, B. 1904, 37. 3601.)

**Magnesium fluosilicate, MgSiF<sub>6</sub> + 6H<sub>2</sub>O.**

Efflorescent. Sol. in 1534 pts. cold H<sub>2</sub>O, forming a solution of 1.235 sp. gr. at 17.5°. Separates out SiO<sub>2</sub> on warming, which nearly all redissolves on cooling. (Stolba, C. C. 1877. 578.)

**Magnesium fluosilicate silicate, Mg<sub>2</sub>Si<sub>2</sub>F<sub>12</sub>, zMg<sub>2</sub>Si<sub>2</sub>O<sub>7</sub>.**

Min. *Humite*; *Chondrodite*. Gelatinises with HCl, or H<sub>2</sub>SO<sub>4</sub> + Aq.

**Manganous fluosilicate, MnSiF<sub>6</sub> + 6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Marignac, J. pr. 83. 202.)

100 pts. dissolve in 71.4 pts. H<sub>2</sub>O at 17.5°, and sp. gr. of solution = 1.44825. Much more sol. in hot H<sub>2</sub>O, and less sol. in alcohol, the stronger the alcohol. (Stolba, C. C. 1883. 292.)

**Mercurous fluosilicate, Hg<sub>2</sub>SiF<sub>6</sub>.**

Sl. sol. in H<sub>2</sub>O without decomp. (Lemaire, C. C. 1897, I. 1046.)

+ 2H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. More easily sol. in acidified H<sub>2</sub>O, but precipitated by HCl + Aq. (Berzelius.)

**Mercuric fluosilicate, basic, HgSiF<sub>6</sub>, HgO + 3H<sub>2</sub>O.**

Decomp. by H<sub>2</sub>O, but sol. in weakest acids. (Berzelius, Pogg. 1. 200.)

**Mercuric fluosilicate, HgSiF<sub>6</sub> + 6H<sub>2</sub>O.**

Deliquescent, and easily sol. in H<sub>2</sub>O. (Finkener, Pogg. 111. 246.)

**Nickel fluosilicate, NiSiF<sub>6</sub> + 6H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O. (Marignac, Ann. Min. (5) 15. 262.)

**Potassium fluosilicate, K<sub>2</sub>SiF<sub>6</sub>.**

Sol. in 833.1 pts. H<sub>2</sub>O at 17.5°, and 104.8 pts. at 100°. (Stolba, J. pr. 103. 396.) Sol. in 3800 pts. cold, and more easily sol. in hot H<sub>2</sub>O. (Fresenius.)

More sol. in HCl + Aq than in H<sub>2</sub>O.

Sol. in 337 pts. HCl + Aq of 26.5% at 14°; in 307 pts. of 25.7% at 15°; in 340 pts. of 14.1% at 14°; in 303 pts. of 13.6% at 15°; in 327 pts. of 9.6% at 14°; in 313 pts. of 9.2% at 15°; in 376 pts. of 2.7% at 14°; in 319 pts. of 2.4% at 15°; in 409 pts. of 1.8% at 14°. (Stolba, l. c.)

Sol. in 428 pts. sat., and 589 pts. dil. NH<sub>4</sub>Cl + Aq. (Mallet.)

Much less sol. in K<sub>2</sub>SO<sub>4</sub>, KNO<sub>3</sub>, or KCl + Aq, but more sol. in NH<sub>4</sub>Cl + Aq than in H<sub>2</sub>O. (Stolba.)

Sol. in 24,066 pts. K<sub>2</sub>SO<sub>4</sub> + Aq containing 9.92% K<sub>2</sub>SO<sub>4</sub> at 17°; in 17,858 pts. containing 6% at 18°; in 19,530 pts. containing 5% at 17°; in 10,721 pts. containing 1% at 17°.

Sol. in 125,000 pts. KNO<sub>3</sub> + Aq containing 18.4% KNO<sub>3</sub> at 15°; in 43,478 pts. containing 8.7% at 15°; in 1735 pts. containing 8.8% at 100°; in 35,814 pts. containing 4.3% at 15°; in 10,203 pts. containing 1.00% at 15°.

Sol. in 40,070 pts. KCl + Aq containing 25% KCl at 17°; in 38,352 pts. containing 18.4% at 17°; in 41,254 pts. containing 13.4% at 14°; in 24,032 pts. containing 6.7% at 12°; in 1200 pts. containing 0.65% at 17°; in 1095 pts. containing 0.45% at 18°.

Sol. in 358 pts. NH<sub>4</sub>Cl + Aq containing 26.3% NH<sub>4</sub>Cl at 17°; in 306 pts. containing 15% at 15°; in 339 pts. containing 10% at 15°; in 436 pts. containing 5% at 15°. (Stolba, J. pr. 103. 306.)

**Insol. in liquid CO<sub>2</sub>.** (Büchner, Z. phys. Ch. 1906, 54. 674.)

**Insol. in liquid NH<sub>3</sub>.** (Gore, Am. ch. J. 1898, 20. 829.)

Completely pptd. from aqueous solution by an equal vol. of alcohol.

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Rubidium fluosilicate,  $Rb_2SiF_6$ .**

Sol. in 625 pts.  $H_2O$  at  $20^\circ$ , and 73.05–74.5 pts. at  $100^\circ$ . More sol. in acidified water.

Insol. in alcohol. (Stolba, J. pr. 101. 1.)

Insol. in  $H_2O$ . (Eggeling, Z. anorg. 1905, 46. 175.)

Less sol. in  $H_2O$  than  $K_2SiF_6$ . (Gossner, Zeit. Kryst. 1904, 38. 149.)

**Silver fluosilicate,  $Ag_2SiF_6 + 4H_2O$ .**

Deliquescent. Easily sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 221.)

**Sodium fluosilicate,  $Na_2SiF_6$ .**

Much more sol. in  $H_2O$  than  $K_2SiF_6$ , especially in hot  $H_2O$ . Addition of acid does not increase solubility. (Berzelius.)

Sol. in 153.3 pts.  $H_2O$  at  $17.5^\circ$ , and 40.66 pts. at  $100^\circ$ . Easily forms supersaturated solutions. (Stolba, Z. anal. 11. 199.)

Much less sol. in  $NaCl + Aq$  than in  $H_2O$ . (Stolba, J. pr. 1865 (1) 96. 26.)

Precipitated completely from aqueous solution by alcohol. (Rose.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Strontium fluosilicate,  $SrSiF_6 + 2H_2O$ .**

Sol. in cold  $H_2O$ , but decomp. somewhat on heating. Sol. in 31.06 pts.  $H_2O$ . (Fresenius.)

Easily sol. in acidified  $H_2O$  without decomp. Sol. in alcohol.

Solubility in a mixture of  $H_2O$ , alcohol (96%),  $HCl + Aq$  (20%),  $H_2SiF_6 + Aq$  (3.7%).  
1 pt.  $SrSiF_6$  is sol. in pts. of solutions of given composition.

$H_2O$	Alcohol	$HCl + Aq$	$H_2SiF_6 + Aq$	$SrSiF_6$
50	50	0	0	15.29
74.1	25	0	0	82.93
70.8	25	4.2	0	50.9
77.95	20	0.9	1.15	55.0
73	25	0.9	1.1	82.97
75	25	0	0	147.4
95.24	0	2.04	2.72	7.3

(Fresenius, Z. anal. 29. 143.)

**Thallous fluosilicate,  $Tl_2SiF_6 + 2H_2O$ .**

Very easily sol. in  $H_2O$ . (Kuhlmann.)

**Thorium fluosilicate,  $Th(OH)_2SiF_6$  (?).**

(Cleve.)

**Tin (stannic) fluosilicate,  $SnF_4, SiF_4$ .**

Very easily sol. in  $H_2O$ . (Berzelius.)

**Uranyl fluosilicate.**

Very sl. sol. in acids. (Berzelius.)

Sol. in alcohol. (Stolba, Z. anal. 3. 71.)

**Vanadium fluosilicate.**

Deliquescent. Sol. in  $H_2O$ . (Guyard, Bull. Soc. (2) 25. 352.)

**Yttrium fluosilicate.**

Insol. in pure, sol. in acidified  $H_2O$ . (Berzelius.)

**Zinc fluosilicate,  $ZnSiF_6 + 6H_2O$ .**

Very easily sol. in  $H_2O$ . (Berzelius.)

**Zirconium fluosilicate.**

Sol. in  $H_2O$ . Solution clouds up on boiling. (Berzelius.)

**Fluostannic acid.**

**Ammonium fluostannate,  $(NH_4)_2SnF_6$ .**

Sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 224.)

$4NH_4F, SnF_4$ . Sol. in  $H_2O$ . (Marignac.)

**Barium fluostannate,  $BaSnF_6$ .**

Slowly sol. in  $H_2O$ .

$+ 3H_2O$ . Sol. in 18 pts.  $H_2O$  at  $18^\circ$ . (Marignac, Ann. Min. (5) 15. 246.)

Decomp. by warming with  $H_2SO_4$ , with evolution of  $HF$ . (Emich, M. 1904, 35. 1912.)

**Calcium fluostannate,  $CaSnF_6 + 2H_2O$ .**

Sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 250.)

**Cadmium fluostannate,  $CdSnF_6 + 6H_2O$ .**

Sol. in  $H_2O$ . (Marignac.)

**Cobaltous fluostannate,  $CoSnF_6 + 6H_2O$ .**

(Gossner, Zeit. Kryst. 1907, 42. 482.)

**Cupric fluostannate,  $CuSnF_6 + 4H_2O$ .**

Not deliquescent. (Marignac, Ann. Min. (5) 15. 291.)

**Lithium fluostannate,  $Li_2SnF_6 + 2H_2O$ .**

Sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 242.)

**Magnesium fluostannate,  $MgSnF_6 + 6H_2O$ .**

Not deliquescent. Sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 256.)

**Manganous fluostannate,  $MnSnF_6 + 6H_2O$ .**

Slowly efflorescent. (Marignac.)

**Nickel fluostannate,  $NiSnF_6 + 6H_2O$ .**

Sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 262.)

**Potassium fluostannate,  $K_2SnF_6 \cdot H_2O$ .**

Two modifications—(a) *Thin plates*. Sol. in 2.3 pts.  $H_2O$  at  $100^\circ$ , and in 15–16 pts. at  $18^\circ$ . (Marignac.)

(b) *Octahedra*. Sol. in 3 pts.  $H_2O$  at  $100^\circ$ , and 27 pts. at  $18^\circ$ . (Marignac.)

Sol. in hot  $H_2O$ . Can be cryst. from hot  $H_2O$ . With conc.  $H_2SO_4$ , HF is evolved. (Emich, M. 1904, 25. 911.)

**Potassium hydrogen fluostannate,  $3KF, HF, SnF_4$ .**

Sol. in  $H_2O$ . (Marignac.)

**Silver fluostannate,  $Ag_2SnF_6 \cdot 4H_2O$ .**

Sl. deliquescent. Easily sol. in  $H_2O$ . (Marignac.)

**Sodium fluostannate,  $Na_2SnF_6$ .**

Sol. in 18–19 pts.  $H_2O$  at  $20^\circ$ . (Marignac.)

**Strontium fluostannate,  $SrSnF_6 \cdot 2H_2O$ .**

Sol. in 5.5 pts.  $H_2O$  at  $18^\circ$ . (Marignac.)

**Zinc fluostannate,  $ZnSnF_6 \cdot 6H_2O$ .**

Sol. in  $H_2O$ . (Marignac.)

**Fluosulphonic acid,  $HSO_3F$ .**

See Sulphuryl hydroxyl fluoride.

**Ammonium fluosulphonate,  $FSO_3NH_4$ .**

Easily sol. in  $H_2O$  from which it can be cryst.

Sol. in ethyl alcohol, more sol. in methyl alcohol. Can be cryst. from abs. alcohol. (Traube, B. 1913, 46. 2528.)

**Sodium fluosulphonate,  $FSO_3Na$ .**

Hydroscopic.

Sol. in alcohol and acetone. (Traube.)

**Fluosulphuric acid.**

**Tricassium difluodisulphate,  $S_2O_7F_2Cs_3H + H_2O$ .**

As the K salt. (Weinland, Z. anorg. 1899, 21. 53.)

**Tripotassium difluodisulphate,  $S_2O_7F_2K_3H + H_2O$ .**

Sol. in HF; quite stable in air; sol. in  $H_2O$  with decomp. (Weinland, Z. anorg. 1899, 21. 51.)

**Trirubidium difluodisulphate,  $S_2O_7F_2Rb_3H + H_2O$ .**

Sol. in HF. (Weinland, Z. anorg. 1899, 21. 53.)

**Fluotantallic acid.**

**Ammonium fluotantalate,  $(NH_4)_2TaF_7$ .**

Very sol. in  $H_2O$ . (Marignac, A. ch. (4) 9. 272.)

$(NH_4)_2TaF_7$ . (Balke, J. Am. Chem. Soc. 1905, 27. 1151.)

**Cæsium fluotantalate,  $CsTaF_6$ .**

Can be recryst. from HF + Aq. (Balke.)  $Cs_2TaF_7$ . Can not be recryst. from  $H_2O$  as it tends to go into  $CsF, TaF_5$ . (Balke, J. Am. Chem. Soc. 1905, 27. 1151.)

$15CsF, TaF_5$ . Sl. sol. in  $H_2O$ . (Pennington, J. Am. Chem. Soc. 1896, 18. 59.)

**Calcium fluotantalate.**

Difficulty sol. in  $H_2O$  (Berzelius.)

**Cupric fluotantalate,  $CuTaF_7 \cdot 4H_2O$ .**

Deliquescent. Easily sol. in  $H_2O$ . (Marignac, A. ch. (4) 9. 294.)

**Lead fluotantalate.**

Difficulty sol. in  $H_2O$ . (Berzelius.)

**Lithium fluotantalate,  $LiF, TaF_5 \cdot 2H_2O$ .**

Can be recryst. from conc. HF. (Balke, J. Am. Chem. Soc. 1905, 27. 1143.)

**Potassium fluotantalate,  $K_2TaF_7$ .**

Sl. sol. in cold, much more easily in hot  $H_2O$ . Decomposes, with formation of a white precipitate on boiling. (Berzelius.)

Much more sol. in HF + Aq. 1 pt. of the salt is sol. in 200 pts.  $H_2O$  containing a trace of HF, and in 150–160 pts. of  $H_2O$  containing a little more HF. (Marignac, A. ch. (4) 9. 267.)

**Potassium hydrogen fluotantalate,  $KF, HF, TaF_5$  (?).**

Sol. in  $H_2O$ . (Berzelius.)

**Rubidium fluotantalate,  $Rb_2TaF_7$ .**

Sol. in HF + Aq. (Pennington, J. Am. Ch. Soc. 1896, 18. 58.)

$3RbF, 2TaF_5$ . (Balke, J. Am. Chem. Soc. 1905, 27. 1151.)

**Sodium fluotantalate,  $3NaF, TaF_5$ .**

Easily sol. in  $H_2O$ .

$Na_2TaF_7 \cdot H_2O$ . Sol. in  $H_2O$ . (Marignac.)

**Thallous fluotantalate,  $Tl_2TaF_7$ .**

Sol. in  $H_2O$ . On boiling the aqueous solution tantalic acid separates.

Decomp. by conc.  $H_2SO_4$ . Difficulty sol. in cold, easily sol. in hot HF. (Ephraim, B. 1909, 42. 4461.)

**Zinc fluotantalate,  $ZnTaF_7 \cdot 7H_2O$ .**

Very deliquescent. Sol. in  $H_2O$ . (Marignac, A. ch. (4) 9. 249.)

**Fluotelluric acid.**

**Ammonium fluotellurate,  $NH_4TeF_6 \cdot H_2O$ .**

Decomp. by  $H_2O$ . (Högbon, Bull. Soc. (2) 35. 60.)



**Barium fluotellurate,  $\text{Ba}(\text{TeF}_6)_2 + \text{H}_2\text{O}$ .**

As above.

**Potassium fluotellurate,  $\text{KTeF}_6$ .**

As above.

$\text{TeO}_5\text{F}_3\text{K}_2 + 3\text{H}_2\text{O}$ . Stable in dry air; only sl. sol. in  $\text{H}_2\text{O}$  with decomp.; sol. in HF. (Weinland, Z. anorg. 1899, 21. 61.)

**Rubidium difluotellurate,  $\text{TeO}_5\text{F}_3\text{Rb}_2 + 3\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in HF. (Weinland, Z. anorg. 1899, 21. 62.)

**Fluotitanic acid.**

Known only in solution as titanium hydrogen fluoride.

**Ammonium fluotitanate,  $(\text{NH}_4)_2\text{TiF}_6$ .**Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

$3\text{NH}_4\text{F}$ ,  $\text{TiF}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Ammonium fluosequititanate,  $6\text{NH}_4\text{F}$ ,  $\text{Ti}_2\text{F}_6$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{F} + \text{Aq}$ . (Petersen, J. pr. (2) 40. 54.)

Insol. in  $\text{NH}_4\text{F} + \text{Aq}$ . (Piccini, C. R. 97. 1064.)

$4\text{NH}_4\text{F}$ ,  $\text{Ti}_2\text{F}_6$ . Properties as the corresponding K salt. (Piccini, B. 18. 257 R.)

**Barium fluotitanate,  $\text{BaTiF}_6$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . More easily sol. in dil.  $\text{HNO}_3$  or  $\text{HCl}$ . (Engelskirchen, Dissert. 1903.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . (Emich, M. 1904, 25. 907.)

**Cadmium fluotitanate,  $\text{CdTiF}_6 + 6\text{H}_2\text{O}$ .**

Extremely sol. in  $\text{H}_2\text{O}$ . Easily sol. in 50% alcohol. (Engelskirchen, Dissert. 1903.)

**Cesium fluotitanate,  $\text{Cs}_2\text{TiF}_6$ .**

More sol. in hot than cold  $\text{H}_2\text{O}$  and much more sol. than the Rb comp. (Engelskirchen, Dissert. 1903.)

$4\text{CsF}$ ,  $\text{TiF}_4$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{Cs}_2\text{TaF}_6$ , and is not decomp. by pure  $\text{H}_2\text{O}$ . (Pennington, J. Am. Chem. Soc. 1896, 18. 60.)

**Calcium fluotitanate,  $\text{CaTiF}_6 + 3\text{H}_2\text{O}$ .**

Decomp. by pure  $\text{H}_2\text{O}$ . Sol. without decomp. in acidified  $\text{H}_2\text{O}$ . (Berzelius.)

Separates a precipitate with cold  $\text{H}_2\text{O}$ , which dissolves on heating. (Marignac, Ann. Min. (5) 15. 250.)

**Cupric fluotitanate,  $\text{CuTiF}_6 + 4\text{H}_2\text{O}$ .**

Sol. in pure  $\text{H}_2\text{O}$  with partial decomp.; easily and completely sol. in acidified  $\text{H}_2\text{O}$ . (Berzelius.)

**Cupric fluotitanate ammonium fluoride,**

$\text{CuTiF}_6$ ,  $\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 267.)

**Cupric fluotitanate potassium fluoride,**

$\text{CuTiF}_6$ ,  $\text{KF} + 4\text{H}_2\text{O}$ .

As the above salt. (Marignac.)

**Ferrous fluotitanate,  $\text{FeTiF}_6 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 120. 287.)

**Ferric fluotitanate.**

Decomp. by  $\text{H}_2\text{O}$ . (Berzelius.)

**Lead fluotitanate.**

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Lithium fluotitanate,  $\text{Li}_2\text{TiF}_6 + 2\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Engelskirchen, Dissert. 1903.)

**Magnesium fluotitanate,  $\text{MgTiF}_6 + 6\text{H}_2\text{O}$ .**

Easily sol. in cold  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 15. 257.)

**Nickel fluotitanate,  $\text{NiTiF}_6 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 120. 282.)

**Potassium fluotitanate,  $\text{K}_2\text{TiF}_6$ .**

Difficultly sol. in cold, much more easily in hot  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0° 3° 6° 10° 14° 20°

0.556 0.667 0.775 0.909 1.042 1.28 pts.  $\text{K}_2\text{TiF}_6$ .

(Marignac, A. ch. (4) 8. 65.)

Sol. in 78.6 pts.  $\text{H}_2\text{O}$  at 21°. Sol. in acids. (Piccini, Gazz. ch. it. 1886, 16. 104.)

Sol. in 78 pts.  $\text{H}_2\text{O}$  at 20°; 9.4 pts. at 100°. By addition of small amount of HF, the solubility is increased. (Weiss and Kaiser, Z. anorg. 1910, 65. 354.)

Sol. in HF. (Marchetti, Z. anorg. 1895, 10. 66.)

+  $\text{H}_2\text{O}$ . Much less sol. in  $\text{H}_2\text{O}$  in presence of  $\text{KBr}$  or  $\text{KI}$ . (Hall, J. Am. Chem. Soc. 1904, 26. 1246.)

Sol. in  $\text{H}_2\text{O}$  or HF with decomp. (Marchetti, Z. anorg. 1895, 10. 66.)

**Potassium fluosesquititanate,  $4\text{KF}$ ,  $\text{Ti}_2\text{F}_6$ .**

Scarcely sol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Piccini, B. 18. 257 R.)

**Rubidium fluotitanate,  $\text{Rb}_2\text{TiF}_6$ .**

Very sl. sol. in cold, somewhat more sol. in hot  $\text{H}_2\text{O}$ . (Engelskirchen, Dissert. 1903.)

**Silver fluotitanate.**

Very deliquescent. (Marignac.)

**Sodium fluotitanate,  $\text{Na}_2\text{TiF}_6$ .**

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding potassium salt. (Marignac, Ann. Min. (5) 15. 238.)

**Sodium hydrogen fluotitanate**,  $\text{Na}_2\text{TiF}_6$ ,  $\text{NaHF}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Strontium fluotitanate**,  $\text{SrTiF}_6 + 2\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ . Solution clouds up on heating. (Marignac.)

**Zinc fluotitanate**,  $\text{ZnTiF}_6 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 60. 304.)

### Fluovanadic acid.

**Ammonium fluovanadate**,  $3\text{NH}_4\text{F}$ ,  $\text{VF}_5$ .

Moderately sol. in  $\text{H}_2\text{O}$ . More easily sol. in dil. acids. Nearly insol. in alcohol or MF + Aq. (Petersen, J. pr. (2) 40. 52.)

$2\text{NH}_4\text{F}$ ,  $\text{VF}_5 + \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Petersen.)

$\text{NH}_4\text{F}$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ . As above. (Petersen.)

**Cadmium fluovanadate**,  $\text{CdF}_2$ ,  $\text{VF}_5 + 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Piccini and Giorgis, Gazz. ch. it. 23, 1. 89.)

**Cobalt fluovanadate**,  $\text{CoF}_2$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Petersen, l. c.)

**Nickel fluovanadate**,  $\text{NiF}_2$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ .

As the Co salt. (Petersen.)

**Potassium fluovanadate**,  $2\text{KF}$ ,  $\text{VF}_5 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. Insol. in  $\text{KF} + \text{Aq}$ . (Petersen, J. pr. (2) 40. 51.)

**Potassium fluovanadate fluoxyvanadate**,

$4\text{KF}$ ,  $\text{VF}_5$ ,  $\text{VOF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , and still more easily in  $\text{HF} + \text{Aq}$ . Sl. sol. in  $\text{KF} + \text{Aq}$ . (Petersen, J. pr. (2) 40. 274.)

**Sodium fluovanadate**,  $5\text{NaF}$ ,  $2\text{VF}_5 + \text{H}_2\text{O}$ .

As the potassium salt. (Petersen.)

**Thallous fluovanadate**,  $\text{TlF}$ ,  $\text{VF}_5 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

Sol. with decomp. in conc.  $\text{H}_2\text{SO}_4$ , dil.  $\text{HNO}_3$ , or cold dil.  $\text{HCl}$ .

Insol. in  $\text{NaOH} + \text{Aq}$ . (Ephraim, B. 1909, 42. 4460.)

$2\text{TlF}$ ,  $\text{VF}_5 + \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

Sol. in conc.  $\text{H}_2\text{SO}_4$ , dil.  $\text{HNO}_3$ , or cold dil.  $\text{HCl}$  with decomp.

Insol. in cold or hot  $\text{NaOH} + \text{Aq}$ . (Ephraim, B. 1909, 42. 4461.)

**Zinc fluovanadate**,  $\text{ZnF}_2$ ,  $\text{VF}_5 + 7\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. on heating. (Piccini and Giorgis.)

### Fluoxycolumbic acid.

**Ammonium fluoxycolumbate**,  $3\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ .

*Cubic salt*. Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 38.)

$2\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ . *Lamellar salt*. Much more sol. in  $\text{H}_2\text{O}$  than  $2\text{KF}$ ,  $\text{CbOF}_3$ . (M.)

$5\text{NH}_4\text{F}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$ . *Hexagonal salt*. (M.)

$\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ . *Rectangular salt*. (M.)

**Ammonium fluoxycolumbate columbium fluoride**,  $3\text{NH}_4\text{F}$ ,  $\text{CbOF}_3$ ,  $\text{CbF}_3$ .

(Marignac.)

**Cupric fluoxycolumbate**,  $\text{CuF}_2$ ,  $\text{CbOF}_3 + 4\text{H}_2\text{O}$ .

Sl. deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 42.)

**Potassium fluoxycolumbate**,  $2\text{KF}$ ,  $\text{CbOF}_3 + \text{H}_2\text{O}$ .

Sol. in 12.5-13 pts.  $\text{H}_2\text{O}$  at  $17-21^\circ$ . Much more sol. in hot  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Marignac.)

$3\text{KF}$ ,  $\text{CbOF}_3$ . Decomp. by  $\text{H}_2\text{O}$  into above salt. (M.)

$5\text{KF}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (M.)

$4\text{KF}$ ,  $3\text{CbOF}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (M.)

$3\text{KF}$ ,  $2\text{Cb}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 287.)

$\text{KF}$ ,  $\text{Cb}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Petersen.)

$2\text{KF}$ ,  $3\text{Cb}_2\text{O}_5\text{F}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HF}$ . (Krüss and Nilson, B. 20. 1689.)

See also Fluoxypercolumbate, potassium.

**Potassium hydrogen fluoxycolumbate**,  $3\text{KF}$ ,  $\text{HF}$ ,  $\text{CbOF}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Sodium fluoxycolumbate**,  $2\text{NaF}$ ,  $\text{CbOF}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

$\text{NaF}$ ,  $\text{CbOF}_3 + \text{H}_2\text{O}$ . (Marignac.)

**Zinc fluoxycolumbate**,  $\text{ZnF}_2$ ,  $\text{CbOF}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (4) 8. 41.)

### Fluoxyhypomolybdic acid.

**Ammonium fluoxyhypomolybdate**,  $\text{MoOF}_5$ ,  $2\text{NH}_4\text{F}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Mauro, Gazz. ch. it. 19. 179.)

$3\text{MoOF}_5$ ,  $5\text{NH}_4\text{F} + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mauro.)

**Cupric fluoxyhypomolybdate**,  $\text{CuF}_2$ ,  $\text{MoOF}_5 + 4\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Mauro, Real. Ac. Linc. 1892, 1. 194.)

**Potassium fluoxyhypomolybdate**,  $\text{MoOF}_3 \cdot 2\text{KF} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$  or  $\text{HCl} + \text{Aq}$ . (Mauro and Panabianco, *Gazz. ch. it.* 12. 80.)

$3\text{MoOF}_3 \cdot 5\text{KF} + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Mauro, *Gazz. ch. it.* 19. 179.)

**Thallous fluoxyhypomolybdate**,  $2\text{TlF} \cdot \text{MoOF}_3$ .

(Mauro, B. 1894, 27R. 109.)

**Zinc fluoxyhypomolybdate**,  $\text{ZnF}_2 \cdot \text{MoOF}_3 + 6\text{H}_2\text{O}$ .

Rapidly deliquescent. Sol. in  $\text{H}_2\text{O}$ .

(Mauro, *Real. Ac. Linc.* 1892. 1. 194.)

**Fluoxyhypovanadic acid.**

See *Fluoxyvanadic acid*.

**Fluoxymanganic acid.**

**Ammonium fluoxymanganate**,  $(\text{NH}_4)_2\text{MnOF}_4$ .

Precipitate. (Nicklès.)

**Potassium fluoxymanganate**,  $\text{K}_2\text{MnOF}_4$ .

Precipitate. (Nicklès, C. R. 65. 107.)

**Sesquifluoxymanganic acid.**

**Potassium sesquifluoxymanganate**,

$\text{K}_4\text{Mn}_2\text{OF}_7 = 4\text{KF} \cdot \text{Mn}_2\text{OF}_4$ .

Precipitate. (Nicklès.)

**Fluoxymolybdic acid.**

See also *Fluoxyhypomolybdic, and fluoxypermolybdic acids*.

**Ammonium fluoxymolybdate**,  $\text{NH}_4\text{F} \cdot \text{MoO}_2\text{F}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Mauro, *Gazz. ch. it.* 20. 109.)

$+ \text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than  $2\text{NH}_4\text{F} \cdot \text{MoO}_2\text{F}_3$ . (Delafontaine, *N. Arch. Sci. ph. nat.* 20. 250.)

Correct formula is  $3\text{NH}_4\text{F} \cdot \text{MoO}_2\text{F}_3$ . (Mauro, *Gazz. ch. it.* 18. 120.)

$2\text{NH}_4\text{F} \cdot \text{MoO}_2\text{F}_3$ . Much more sol. than  $2\text{KF} \cdot \text{MoO}_2\text{F}_3$ . (Delafontaine.)

$3\text{NH}_4\text{F} \cdot \text{MoO}_2\text{F}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Mauro.)

$5\text{NH}_4\text{F} \cdot 3\text{MoO}_2\text{F}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Mauro, *Gazz. ch. it.* 20. 109.)

**Ammonium fluoxymolybdate molybdate**,

$\text{MoO}_2\text{F}_3 \cdot 4\text{NH}_4\text{F} \cdot (\text{NH}_4)_2\text{MoO}_4$ .

Sol. in  $\text{H}_2\text{O}$ , but with decomp. (Mauro, *Gazz. ch. it.* 18. 120.)

**Cadmium fluoxymolybdate**,  $\text{CdF}_2 \cdot \text{MoO}_2\text{F}_3 + 6\text{H}_2\text{O}$ .

Sl. efflorescent. (Delafontaine, J. B. 1867. 236.)

**Cobaltous fluoxymolybdate**,  $\text{CoF}_2 \cdot \text{MoO}_2\text{F}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine, J. B. 1867. 236.)

**Cupric fluoxymolybdate**,  $\text{CuF}_2 \cdot \text{MoO}_2\text{F}_3 + 4\text{H}_2\text{O}$ .

Deliquescent. (Mauro, *Real. Ac. Linc.* 1892. 1. 194.)

**Nickel fluoxymolybdate**,  $\text{NiF}_2 \cdot \text{MoO}_2\text{F}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine, J. B. 1867. 236.)

**Potassium fluoxymolybdate**,  $2\text{KF} \cdot \text{MoO}_2\text{F}_3 + \text{H}_2\text{O}$ .

Easily sol. in boiling  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HF}$ . (Marchetti, *Z. anorg.* 1895. 10. 68.)

$\text{KF} \cdot \text{MoO}_2\text{F}_3 + \text{H}_2\text{O}$ . Gradually efflorescent. (Delafontaine.)

**Rubidium fluoxymolybdate**,  $2\text{RbF} \cdot 2\text{MoO}_2\text{F}_3 + 2\text{H}_2\text{O}$ .

Sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Delafontaine.)

**Sodium fluoxymolybdate**,  $\text{NaF} \cdot \text{MoO}_2\text{F}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine.)

**Thallous fluoxymolybdate**,  $2\text{TlF} \cdot \text{MoO}_2\text{F}_3 + \text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Delafontaine.)

**Zinc fluoxymolybdate**,  $\text{ZnF}_2 \cdot \text{MoO}_2\text{F}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Delafontaine.)

**Fluoxypercolumbic acid.**

**Potassium fluoxypercolumbate**,  $2\text{KF} \cdot \text{CbO}_2\text{F}_3 + \text{H}_2\text{O}$ .

(Piccini, *Z. anorg.* 2. 21.)

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in  $\text{HF}$ . (Marchetti, *Z. anorg.* 1895. 10. 67.)

**Fluoxypermolybdic acid.**

**Ammonium fluoxypermolybdate**,  $\text{MoO}_2\text{F}_3 \cdot 3\text{NH}_4\text{F}$ .

Sol. in  $\text{H}_2\text{O}$ . (Piccini, *Z. anorg.* 1. 51.)

**Cesium fluoxypermolybdate**,  $\text{MoO}_2\text{F}_3 \cdot 2\text{CsF} + \text{H}_2\text{O}$ .

(Piccini.)

**Potassium fluoxypermolybdate**,  $\text{MoO}_2\text{F}_3 \cdot 2\text{KF} + \text{H}_2\text{O}$ .

Not very sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{HF} + \text{Aq}$  without decomp. (Piccini.)

**Rubidium fluoxypermolybdate**,  $\text{MoO}_3\text{F}_3 \cdot 2\text{RbF} + \text{H}_2\text{O}$ .

Somewhat more sol. in  $\text{H}_2\text{O}$  than K salt. Easily sol. in  $\text{HF} + \text{Aq.}$  (Piccini.)

### Fluoxypertantalic acid.

**Potassium fluoxypertantalate**,  $2\text{KF}, \text{TaO}_3\text{F}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Piccini, Z. anorg. 2. 21.)

**Fluoxypertitanic acid**,  $\text{TiO}_3\text{F}_3$ , HF.

Known only in solution. (Piccini, B. 18. 255 R.)

**Ammonium fluoxypertitanate**,  $\text{TiO}_3\text{F}_3 \cdot 2\text{NH}_4\text{F}$ .

Very unstable. (Piccini, Gazz. ch. it. 17. 479.)

$\text{TiO}_3\text{F}_3 \cdot 3\text{NH}_4\text{F}$ . Sol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}_2$ . (Piccini, Z. anorg. 1895, 10. 439.)

$2\text{TiO}_3\text{F}_3 \cdot 3\text{NH}_4\text{F}$ . Sol. in  $\text{H}_2\text{O}$ . (Piccini, B. 18. 698 R.)

**Barium fluoxypertitanate**,  $\text{TiO}_3\text{F}_3 \cdot \text{BaF}_2$ .

Precipitate. Easily sol. in acids. (Piccini, B. 18. 698 R.)

$2\text{TiO}_3\text{F}_3 \cdot 3\text{BaF}_2$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Piccini, Gazz. ch. it. 17. 479.)

**Potassium fluoxypertitanate**,  $\text{TiO}_3\text{F}_3 \cdot 2\text{KF}$ .

Sol. in  $\text{H}_2\text{O}$ . (Piccini, B. 21. 1391.)

Sol. in  $\text{H}_2\text{O}_2$ . (Piccini, Z. anorg. 1895, 10. 438.)

### Fluoxypertungstic acid.

**Potassium fluoxypertungstate**,  $2\text{KF}, \text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ .

(Piccini, Z. anorg. 2. 11.)

### Fluoxytantalic acid.

See also Fluoxypertantalic acid.

**Ammonium fluoxytantalate**,  $3\text{NH}_4\text{F}, \text{TaOF}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . The solution clouds up by standing or on warming. (Joly, C. R. 81. 1266.)

### Fluoxytitanic acid.

See also Fluoxypertitanic acid.

**Barium fluoxytitanate**,  $\text{TiOF}_3 \cdot \text{BaF}_2$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Piccini, Gazz. ch. it. 17. 479.)

### Fluoxytungstic acid.

**Ammonium fluoxytungstate**,  $2\text{NH}_4\text{F}, \text{WO}_3\text{F}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 69. 65.)

$\text{NH}_4\text{F}, \text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Crystallises unchanged from  $\text{H}_2\text{O}$  containing HF. (Marignac.)

**Ammonium fluoxytungstate tungstate**,  $4\text{NH}_4\text{F}, \text{WO}_3\text{F}_3, (\text{NH}_4)_2\text{WO}_4$ .

Incompletely sol. in  $\text{H}_2\text{O}$ . Residue dissolves in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Marignac.)

**Cadmium fluoxytungstate.**

Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Cupric fluoxytungstate**,  $\text{CuF}_2, \text{WO}_3\text{F}_3 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Marignac, C. R. 55. 888.)

**Cupric fluoxytungstate ammonium fluoride**,  $\text{CuF}_2, \text{WO}_3\text{F}_3, \text{NH}_4\text{F} + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Manganese fluoxytungstate.**

Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Nickel fluoxytungstate**,  $\text{NiF}_2, \text{WO}_3\text{F}_3 + 10\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Potassium fluoxytungstate**,  $\text{KF}, \text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ .

Can be recrystallised without decomp. only from  $\text{H}_2\text{O}$  containing HF. (Marignac, A. ch. (3) 69. 70.)

$2\text{KF}, \text{WO}_3\text{F}_3 + \text{H}_2\text{O}$ . Difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Berzelius.) Sol. in 17 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Marignac.)

Can be recrystallised without decomp. from  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  containing HF. (Marignac.)

Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in HF. (Marchetti, Z. anorg. 1895, 10. 71.)

See also Fluoxypertungstate, potassium.

**Silver fluoxytungstate.**

Very easily sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Sodium fluoxytungstate**,  $2\text{NaF}, \text{WO}_3\text{F}_3$ .

More sol. in  $\text{H}_2\text{O}$  than the corresponding K compound. (Berzelius.)

**Thallous fluoxytungstate**,  $\text{TlF}, \text{WO}_3\text{F}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Ephraim and Heymann, B. 1909, 42. 4463.)

$2\text{TlF}, \text{WO}_3\text{F}_3$ . Insol. in  $\text{H}_2\text{O}$  but decomp. thereby. (Ephraim and Heymann, B. 1909, 42. 4462.)

$3\text{TlF}, 2\text{WO}_3\text{F}_3$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Ephraim and Heymann, B. 1909, 42. 4462.)

**Zinc fluoxytungstate**,  $\text{ZnF}_2, \text{WO}_3\text{F}_3 + 10\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Fluoxuyranic acid.****Ammonium fluoxuyranate**,  $3\text{NH}_4\text{F}$ ,  $\text{UO}_2\text{F}_2$ .Easily sol. in  $\text{H}_2\text{O}$ , less in HF. Insol. in alcohol. (Bolton.)100 g. solution sat. at  $27^\circ$  contain 10.11 g. salt.100 g. solution sat. at  $81.3^\circ$  contain 20.71 g. salt.

(Bürger, Dissert. 1904.)

**Barium fluoxuyranate**,  $3\text{BaF}_2$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$ .Traces dissolve in hot  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Bolton.)**Potassium fluoxuyranate**,  $3\text{KF}$ ,  $\text{UO}_2\text{F}_2$ .Sol. in 8 pts.  $\text{H}_2\text{O}$  at  $21^\circ$ . Insol. in alcohol and ether. (Bolton, J. pr. 99. 269.)

Does not exist. (Smithells, Chem. Soc. 43. 125.)

 $4\text{KF}$ ,  $\text{UO}_2\text{F}_2$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Ditte, C. R. 91. 115.) $5\text{KF}$ ,  $2\text{UO}_2\text{F}_2$ . (Baker, Chem. Soc. 35. 760.) $3\text{KF}$ ,  $2\text{UO}_2\text{F}_2 + 2\text{H}_2\text{O}$ . (Baker.)**Sodium fluoxuyranate**,  $\text{NaF}$ ,  $\text{UO}_2\text{F}_2$ . $+2\text{H}_2\text{O}$ . Not efflorescent. $+4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Bolton, J. B. 1866. 212.) $4\text{NaF}$ ,  $\text{UO}_2\text{F}_2$ . (Ditte.)

Does not exist. (Smithells, Chem. Soc. 43. 125.)

**Fluoxuyvanadic acid.****Ammonium fluoxuyvanadate**,  $12\text{NH}_4\text{F}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_3$ .Easily sol. in  $\text{H}_2\text{O}$ , and not attacked by cold conc.  $\text{H}_2\text{SO}_4$ . (Baker, Chem. Soc. 33. 388.)Formula is  $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$ . (Petersen, J. pr. (2) 40. 289.) $3\text{NH}_4\text{F}$ ,  $\text{VO}_2\text{F}$ . Sol. in  $\text{H}_2\text{O}$ . (Petersen, l. c.)Much less sol. in  $\text{H}_2\text{O}$  in presence of  $\text{NH}_4\text{F}$ . (Piccini and Giorgis, Gazz. ch. it. 27. 1. 65.) $+ \text{H}_2\text{O}$ . (Piccini and Giorgis, Gazz. ch. it. 1892. 22. 55.) $3\text{NH}_4\text{F}$ ,  $\text{VOF}_3$ . "Hypovanadate." Quite sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{MF} + \text{Aq}$ . Less sol. in alcohol than in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 195.) $2\text{NH}_4\text{F}$ ,  $\text{VOF}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Petersen.) $+ \text{H}_2\text{O}$ . (Piccini and Giorgis.) $7\text{NH}_4\text{F}$ ,  $4\text{VOF}_3 + 5\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Petersen.) $3\text{NH}_4\text{F}$ ,  $2\text{VOF}_3$ . Sol. in  $\text{H}_2\text{O}$  without decomp. Sol. in conc.  $\text{HF} + \text{Aq}$ . (Piccini and Giorgis, Gazz. ch. it. 24. 1. 68.) $3\text{NH}_4\text{F}$ ,  $2\text{VOF}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. $\text{V}_2\text{O}_5$ ,  $2\text{NH}_4\text{F}$ . (Ditte, C. R. 106. 270.) $\text{V}_2\text{O}_5$ ,  $8\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ . As above. $\text{V}_2\text{O}_5$ ,  $4\text{NH}_4\text{F} + 4\text{H}_2\text{O}$ . As above. Sol. in  $\text{H}_2\text{O}$ .**Ammonium hydrogen fluodioxyvanadate**,  $7\text{NH}_4\text{F}$ ,  $\text{HF}$ ,  $4\text{VOF}_3$ .Very sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 284.)**Ammonium hydrogen trifluoxyvanadate**,  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_3$ .Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{MF} + \text{Aq}$ . (Petersen, J. pr. (2) 40. 280.) $3\text{NH}_4\text{F}$ ,  $3\text{HF}$ ,  $2\text{VOF}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Baker, Chem. Soc. 33. 388.)Identical with  $3\text{HF}$ ,  $9\text{NH}_4\text{F}$ ,  $5\text{VOF}_3$ . (Petersen.)**Barium fluoxyvanadate**,  $\text{BaF}_2$ ,  $\text{VO}_2\text{F}$ .

Ppt. (Ephraim, Z. anorg. 1903. 35. 79.)

**Cadmium fluoxyvanadate**,  $\text{CdF}_2$ ,  $\text{VOF}_3 + 7\text{H}_2\text{O}$ .

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

**Cobalt fluoxyvanadate**,  $\text{CoF}_2$ ,  $\text{VOF}_3 + 7\text{H}_2\text{O}$ ."Hypovanadate." Sol. in  $\text{H}_2\text{O}$ . (Piccini and Giorgis.)**Nickel fluoxyvanadate**,  $\text{NiF}_2$ ,  $\text{VOF}_3 + 7\text{H}_2\text{O}$ .

"Hypovanadate." As the Co salt. (Piccini and Giorgis.)

**Potassium fluoxyvanadate**,  $7\text{KF}$ ,  $3\text{VOF}_3$ .Very sl. sol. in  $\text{H}_2\text{O}$  and  $\text{MF} + \text{Aq}$ . Easily sol. in dil. acids. (Petersen, J. pr. (2) 40. 199.) $2\text{KF}$ ,  $\text{VOF}_3$ . As above. (Petersen.) $2\text{KF}$ ,  $2\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . (Ditte, C. R. 105. 1067.) $2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ . As above. $2\text{KF}$ ,  $4\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ . As above. $4\text{KF}$ ,  $\text{V}_2\text{O}_5$ . Less sol. than  $4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and  $+3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . $4\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ , and  $+6\text{H}_2\text{O}$ . Less sol. than  $2\text{KF}$ ,  $3\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ . $8\text{KF}$ ,  $\text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ , and  $+3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .**Potassium trifluoxyvanadate**,  $2\text{KF}$ ,  $\text{VOF}_3$ .

Ppt. (Petersen, J. pr. (2) 40. 272.)

 $6\text{KF}$ ,  $\text{V}_2\text{O}_5$ ,  $2\text{VOF}_3 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in cold conc.  $\text{H}_2\text{SO}_4$ . (Baker, Chem. Soc. 33. 300.)Formula is  $3\text{KF}$ ,  $2\text{VO}_2\text{F}$ . (Piccini and Giorgis.)

See also Fluovanadate fluoxyvanadate, potassium.

**Potassium fluodioxyvanadate**,  $2\text{KF}$ ,  $\text{VO}_2\text{F}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Petersen, J. pr. (2) 40. 278.)

3KF, VO<sub>2</sub>F. As above. (Petersen.)  
 3KF, 2VO<sub>2</sub>F. Sol. in H<sub>2</sub>O; scarcely attacked by H<sub>2</sub>SO<sub>4</sub>. (Piccini and Giorgis.)

**Potassium hydrogen fluoxyvanadate**, 3KF, HF, 2VOF<sub>2</sub>.

Sol. in H<sub>2</sub>O. (Petersen.)

**Sodium fluoxyvanadate**, 8NaF, 3VOF<sub>2</sub> + 2H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Petersen, J. pr. (2) 40. 200.)  
 3NaF, VO<sub>2</sub>F, VOF<sub>2</sub> (?). Very easily decomp. (Piccini and Giorgis.)

2NaF, 2V<sub>2</sub>O<sub>5</sub> + 10H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Ditte, C. R. 108. 270.)

4NaF, V<sub>2</sub>O<sub>5</sub>. As above.

4NaF, 3V<sub>2</sub>O<sub>5</sub> + 18H<sub>2</sub>O. As above.

6NaF, V<sub>2</sub>O<sub>5</sub> + 5H<sub>2</sub>O. As above.

8NaF, V<sub>2</sub>O<sub>5</sub> + 3H<sub>2</sub>O. (As above.)

**Thallous fluoxyvanadate**, 2TlF, VOF<sub>2</sub>.

Somewhat sol. in cold H<sub>2</sub>O without decomp. Sol. in boiling H<sub>2</sub>O with exception of a black residue, which is easily sol. in dil. H<sub>2</sub>SO<sub>4</sub>. (Ephraim, B. 1909, 42. 4460.)

3TlF, 2VO<sub>2</sub>F. Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>O containing H<sub>2</sub>SO<sub>4</sub>. (Ephraim and Heymann, B. 1909, 42. 4459.)

**Zinc fluoxyvanadate**, ZnF<sub>2</sub>, ZnO, 2VOF<sub>2</sub> + 14H<sub>2</sub>O.

Decomp. on air; sol. in H<sub>2</sub>O. (Baker, Chem. Soc. 33. 388.)

True composition is represented by the formula ZnF<sub>2</sub>, VO<sub>2</sub>F + 7H<sub>2</sub>O. (Petersen.)

ZnF<sub>2</sub>, VO<sub>2</sub>F + 7H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Piccini and Giorgis.)

ZnF<sub>2</sub>, VOF<sub>2</sub> + 7H<sub>2</sub>O. "Hypovanadate." Sol. in cold H<sub>2</sub>O, but decomp. by boiling; sol. in dil. HF + Aq. (Piccini and Giorgis.)

### Fluozirconic acid.

**Ammonium fluozirconate**, (NH<sub>4</sub>)<sub>2</sub>ZrF<sub>6</sub>.

Sol. in H<sub>2</sub>O.

3NH<sub>4</sub>F, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O. (Marignac.)

**Cadmium fluozirconate**, 2CdF<sub>2</sub>, ZrF<sub>4</sub> + 6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; can be recrystallised therefrom. (Marignac, A. ch. (3) 60. 257.)

CdZrF<sub>6</sub> + 6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)

**Cesium fluozirconate**, CsF, ZrF<sub>4</sub> + H<sub>2</sub>O.

Sol. in H<sub>2</sub>O without decomp. (Wells, Z. anorg. 1895, 10. 434.)

2CsF, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells, Z. anorg. 1895, 10. 434.)

2CsF, 3ZrF<sub>4</sub> + 2H<sub>2</sub>O. Only al. sol. in H<sub>2</sub>O. (Wells, Z. anorg. 1895, 10. 434.)

**Cupric fluozirconate**, 2CuF<sub>2</sub>, ZrF<sub>4</sub> + 12H<sub>2</sub>O.

Easily sol. in cold H<sub>2</sub>O. (Marignac, A. ch. (3) 60. 296.)

3CuF<sub>2</sub>, 2ZrF<sub>4</sub> + 16H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)

**Lithium fluozirconate**, 2LiF, ZrF<sub>4</sub>.

Ppt. (Wells, Am. J. Sci. 1897, (4) 3. 468.)

4LiF, ZrF<sub>4</sub> + 1/2 H<sub>2</sub>O. Sol. in H<sub>2</sub>O with decomp. (Wells, Am. J. Sci. 1897, (4) 3. 469.)

**Magnesium fluozirconate**, MgZrF<sub>6</sub> + 5H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac.)

**Manganous fluozirconate**, MnZrF<sub>6</sub> + 5H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac, J. pr. 83. 202.)

**Nickel fluozirconate**, 2NiF<sub>2</sub>, ZrF<sub>4</sub> + 12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac, A. ch. (3) 60. 291.)

NiZrF<sub>6</sub> + 6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac.)

**Nickel potassium fluozirconate**, K<sub>2</sub>ZrF<sub>6</sub>,

NiZrF<sub>6</sub> + 8H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac.)

**Potassium fluozirconate**, KF, ZrF<sub>4</sub> + H<sub>2</sub>O.

Much more sol. in hot, than cold H<sub>2</sub>O. (Marignac.)

2KF, ZrF<sub>4</sub> = K<sub>2</sub>ZrF<sub>6</sub>. 100 pts. H<sub>2</sub>O dissolve at 2°, 0.781 pt.; at 15°, 1.41 pts.; at 19°, 1.69 pts.; at 100°, 25.0 pts. K<sub>2</sub>ZrF<sub>6</sub>. (Marignac.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 829.)

3KF, ZrF<sub>4</sub>.

**Sodium fluozirconate**, 5NaF, ZrF<sub>4</sub>.

100 pts. H<sub>2</sub>O dissolve 0.387 pt. at 18°, and 1.67 pts. at 100°. (Marignac.)

2NaF, ZrF<sub>4</sub>. (Wells, Am. J. Sci. 1897, (4) 3. 469.)

5NaF, 2ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O with decomp. (Wells.)

**Tellurium fluozirconate**, TeF<sub>4</sub>, ZrF<sub>4</sub>.

Sol. in H<sub>2</sub>O without decomp. (Wells, Am. J. Sci. 1897, (4) 3. 470.)

+H<sub>2</sub>O. Sol. in H<sub>2</sub>O without decomp. (Wells.)

3TeF<sub>4</sub>, ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells.)

5TeF<sub>4</sub>, 3ZrF<sub>4</sub>. Sol. in H<sub>2</sub>O without decomp. (Wells.)

**Zinc fluozirconate**, ZnZrF<sub>6</sub> + 6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Marignac.)

2ZnF<sub>2</sub>, ZrF<sub>4</sub> + 12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Marignac, A. ch. (3) 60. 257.)

### Fulminating gold.

See Auroamidoimide.

### Fulminating platinum.

See Fulminoplatinum.

**Fulminating silver.**

See Silver nitride.

**Fulminoplatinum compounds.**

See—

*Dichlorofulminoplatinum.*

*Trichlorofulminoplatinum.*

*Tetrachlorofulminoplatinum.*

*Chloroxyfulminoplatinum.*

**Fuscoscobaltic chloride,  $\text{Co}(\text{NH}_3)_4(\text{OH})\text{Cl}_2 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl} + \text{Aq}$ ; decomp. by boiling  $\text{H}_2\text{O}$ ; pptd. from aqueous solution by alcohol. (Freymy, C. R. 32. 501.)

— nitrate,  $\text{Co}(\text{NH}_3)_4(\text{OH})(\text{NO}_3)_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Properties as the chloride. (Freymy.)

— sulphate,  $\text{Co}(\text{NH}_3)_4(\text{OH})\text{SO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Freymy, C. R. 32. 501.)

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ , or  $\text{H}_2\text{SO}_4$ , from which it is precipitated by  $\text{H}_2\text{O}$ . (Vortmann, N. 6. 412.)

**Fusible white precipitate.**

See *Mercuridiammonium chloride*.

**Gadolinium, Gd.**

(Marignac, C. R. 102. 92.)

**Gadolinium bromide,  $\text{GdBr}_3 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{HBr}$ . (Benedicks, Z. anorg. 1900, 22. 403.)

**Gadolinium chloride,  $\text{GdCl}_3 + 6\text{H}_2\text{O}$ .**

Somewhat deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Benedicks.)

**Gadolinium platinum chloride.**

See *Chloroplatinate, gadolinium*.

**Gadolinium fluoride,  $\text{GdF}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in hot  $\text{HF}$ . (Popovici, B. 1908, 41. 635.)

**Gadolinium hydroxide,  $\text{Gd}(\text{OH})_3$ .**

Ppt. (Benedicks, Z. anorg. 1900, 22. 402.)

**Gadolinium oxide,  $\text{Gd}_2\text{O}_3$ .**

Sol. in acids. (de Boisbaudran, C. R. 111. 394.)

Somewhat hygroscopic; easily sol. in acids. (Benedicks.)

**Gallium, Ga.**

Not decomp. by  $\text{H}_2\text{O}$ ; easily sol. in cold  $\text{HCl} + \text{Aq}$ . Slowly sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . Not attacked by conc.  $\text{HNO}_3$  free from

$\text{N}_2\text{O}_5$ , below  $40-50^\circ$ , and only slowly in presence of  $\text{N}_2\text{O}_5$ . (Dupré, C. R. 86. 720.)

Easily sol. in cold or warm  $\text{KOH} + \text{Aq}$ . (de Boisbaudran, A. ch. (5) 10. 100.)

**Gallium bromide,  $\text{GaBr}_3$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Gallium dichloride,  $\text{GaCl}_3$ .**

Deliquescent, and decomp. by  $\text{H}_2\text{O}$ . (Nilsson and Petersen, C. R. 107. 527.)

**Gallium chloride,  $\text{GaCl}_3$ .**

Deliquescent, and very sol. in little  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ , with formation of basic salt, which is slowly sol. in dil.  $\text{HCl} + \text{Aq}$ .

**Gallium hydroxide.**

Sol. in acids; sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , less easily in  $\text{NH}_4\text{OH} + \text{Aq}$ , even in presence of ammonium salts.

**Gallium iodide,  $\text{GaI}_3$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (de Boisbaudran and Jungfleisch, C. R. 86. 578.)

**Gallium sesquioxide,  $\text{Ga}_2\text{O}_3$  (?).**

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Dupré.)

Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Gallium oxide,  $\text{Ga}_2\text{O}_3$ .**

Sol. in acids.

**Germanium, Ge.**

Insol. in  $\text{HCl} + \text{Aq}$ . Easily sol. in aqua regia. Decomp. by  $\text{HNO}_3 + \text{Aq}$  to oxide. Conc.  $\text{H}_2\text{SO}_4$  decomp. to sulphate. Insol. in boiling  $\text{KOH} + \text{Aq}$ . (Winkler, J. pr. (2) 34. 177; 36. 177.)

**Germanium tetrabromide,  $\text{GeBr}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Winkler.)

**Germanium dichloride,  $\text{GeCl}_2$ .**

Decompl by  $\text{H}_2\text{O}$ . (Winkler.)

**Germanium tetrachloride,  $\text{GeCl}_4$ .**

Sinks in  $\text{H}_2\text{O}$ , and is gradually decomp. thereby. (Winkler, J. pr. 34. 177.)

Insol. in and not attacked by hot conc.  $\text{H}_2\text{SO}_4$ . (Friedrich, W. A. B. 102, 2b. 540.)

**Germanium chloroform,  $\text{GeHCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Winkler.)

**Germanium tetrafluoride,  $\text{GeF}_4$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .  $+ 3\text{H}_2\text{O}$ . Deliquescent. Melts in its crystal  $\text{H}_2\text{O}$  when warmed. (Winkler.)

**Germanium potassium fluoride.***See Fluogermanate, potassium.***Germanium hydride,  $\text{GeH}_4$ .**Sl. sol. in hot  $\text{HCl}$ . Sol. in  $\text{NaOCl} + \text{Aq.}$  (Voegelen, Z. anorg. 1902, 30. 327.)**Germanium tetraiodide,  $\text{GeI}_4$ .**Deliquescent, and sol. in  $\text{H}_2\text{O}$  with decomp. (Winkler.)**Germanium monoxide,  $\text{GeO}$ .**Not appreciably sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Easily sol. in  $\text{HCl} + \text{Aq.}$  Insol. in alkalis. (Winkler, J. pr. (2) 34. 177.)Somewhat sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  even when hot and conc. (van Bemmelen, R. t. c. 6. 206.)**Germanium dioxide,  $\text{GeO}_2$ .**Not very difficultly sol. in  $\text{H}_2\text{O}$ .Sol. in 247.1 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ ; in 93.3 pts. at  $100^\circ$ . (Winkler.)Easily sol. in alkali carbonates or hydrates  $+ \text{Aq.}$ ; sl. sol. in acids.**Germanium oxychloride,  $\text{GeOCl}_2$ .**Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Winkler, J. pr. (2) 36. 177.)**Germanium monosulphide,  $\text{GeS}$ .**Sol. in 402.9 pts.  $\text{H}_2\text{O}$ . Sol. in conc. hot  $\text{HCl} + \text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  Sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  when precipitated. Insol. in  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  if crystalline. Also exists in a colloidal state. (Winkler.)**Germanium disulphide,  $\text{GeS}_2$ .**Sol. in 221.9 pts.  $\text{H}_2\text{O}$ . Easily sol. in  $\text{KOH} + \text{Aq.}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  Insol. in acids. Exists also in a colloidal state. (Winkler.)**Glass.**

Numerous and extensive researches have been made on the action of  $\text{H}_2\text{O}$  and various solutions on glass. The older work has a certain historical interest, but only a brief statement of some of the more important results can be given here. For a very thorough résumé of the work before the year 1861, Storer's Dictionary, p. 555, should be consulted.

All glass is more or less attacked by  $\text{H}_2\text{O}$ , the more easily the greater the amount of alkali present, the finer it is powdered, and the higher the temperature.

Glass, as that of a flask, is decomposed to a considerable extent by several days' boiling with  $\text{H}_2\text{O}$ , a portion of the fixed alkali being dissolved, but when powdered glass is rubbed with distilled  $\text{H}_2\text{O}$  in a mortar, the  $\text{H}_2\text{O}$  remains pure and exhibits no alkalinity. (Scheele.)

Glass of alembics is partially dissolved by long boiling with  $\text{H}_2\text{O}$ . (Lavoisier.)

$\text{H}_2\text{O}$  extracts potash or soda from glass together with

a portion of the silica, the decomposition taking place the more easily in proportion as the glass is richer in alkalis, more minutely divided, or the temperature of the water higher. (Bischof, Kastn. Arch. 1. 443.)

Powdered crown glass and some varieties of window glass render cold  $\text{H}_2\text{O}$  alkaline when in contact therewith. (Dumas.)

100 pts. finely divided flint glass lose 7 pts. potash when boiled one week with  $\text{H}_2\text{O}$ . (Griffiths, Q. J. Sci. 20. 258.)

Retorts of ordinary or flint glass are partially dissolved by  $\text{H}_2\text{O}$  when it is evaporated therein. (Chevreul, 1811.)

Finely powdered plate-glass (Faraday, Pogg. 18. 569), and Thuringian potash glass (Ludwig, Arch. Pharm. 91. 47) reddened moistened turmeric paper.

The alkaline reaction disappears by continued washing, but reappears when the glass is freshly rubbed. (Griffiths.)

Cold  $\text{H}_2\text{O}$  takes up  $\text{SiO}_2$  as well as alkali from glass powder. (Fuchs.)

Powdered lead glass gives up appreciable amounts of PbO to weakly acidified  $\text{H}_2\text{O}$ . (Pelouze.)

When powdered white glass, containing 12.4%  $\text{Na}_2\text{O}$ , 15.5%  $\text{CaO}$ , and 72.1%  $\text{SiO}_2$ , is treated repeatedly with  $\text{H}_2\text{O}$ , more than 3% of the glass is dissolved, and the undissolved part gives up 1.5%  $\text{CaO}$  to  $\text{HCl} + \text{Aq.}$  with effervescence. A glass containing more alkali, t. e. 16.3%  $\text{Na}_2\text{O}$ , 6.4%  $\text{CaO}$ , 77.3%  $\text{SiO}_2$ , lost with the same treatment 18.2%, and the residue gave up 2%  $\text{CaO}$  to  $\text{HCl} + \text{Aq.}$  (Pelouze, C. R. 43. 117.)

In the above case the fineness of the glass has an influence as well as its composition. When the same sample of glass was boiled 1 hour with  $\text{H}_2\text{O}$ , amounts were dissolved in the proportion 1 : 4 : 28, according as the glass was in form of a coarse, fine, or very fine powder. Glass of the composition of the above samples, as given by Pelouze, lost 10 and 32% respectively.

If powdered glass is boiled with  $\text{H}_2\text{O}$  and  $\text{CO}_2$  conducted into the solution, it is absorbed; if boiled with  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$  is dissolved. (Pelouze.)

Glass tubes are converted into a white crystalline mass by heating with  $\text{H}_2\text{O}$  several months to  $75$ – $150^\circ$ ; lead glass and Bohemian glass most easily, English crown glass least. A little  $\text{H}_2\text{O}$  attacks glass more than much  $\text{H}_2\text{O}$ .

The action of  $\text{H}_2\text{O}$  is greatly increased by finely pulverising the glass.

$\text{H}_2\text{O}$  dissolved 10% of a glass containing 12%  $\text{Na}_2\text{O}$ , 15.5%  $\text{CaO}$ , and 72.5%  $\text{SiO}_2$ , and 32% of another glass containing 16.3%  $\text{Na}_2\text{O}$ , 6.4%  $\text{CaO}$ , and 77.3%  $\text{SiO}_2$ . (Vogel, B. A. Munchen, 1867. 437.)

Action of  $\text{H}_2\text{O}$  on a glass containing 74%  $\text{SiO}_2$ , 8.8%  $\text{CaO}$ , 14%  $\text{Na}_2\text{O}$ , 0.6%  $\text{K}_2\text{O}$ , with traces of  $\text{Al}_2\text{O}_3$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{MnO}$ , and  $\text{MgO}$ .

By boiling with  $\text{H}_2\text{O}$  a decrease of 3.9 mg. was observed for the first hour, which soon became constant at 2.2 mg. per hour. The action was then proportional to the time, and also to the surface in contact with the liquid, but independent of the amount of liquid evaporating.

The action decreases rapidly with the temperature, so that at  $90$ – $100^\circ$  only  $\frac{1}{4}$  as much glass is dissolved as by boiling  $\text{H}_2\text{O}$ . (Emmerling, A. 180. 257.)

When steam condenses in tubes of Na glass, they are so strongly attacked that the  $\text{H}_2\text{O}$  has an alkaline reaction, but tubes of hard or Bohemian K glass are not so strongly attacked. (Tollens, B. 9. 1540.)

The effect of  $\text{H}_2\text{O}$  is so great as to impart a distinctly alkaline reaction to water condensing in a tube of ordinary glass. By condensing water in long tubes of various kinds of glass the following results were obtained.



I. Easily fusible Thuringian glass. Surface exposed = 324 sq. cm.

After 2 hours, 62.0 mg. KOH were dissolved.

After 3 hours more, 36.0 mg. KOH were dissolved.

After 3 hours more, 33.2 mg. KOH were dissolved.

After 3 hours more, 20.8 mg. KOH were dissolved.

After 3 hours more, 20.8 mg. KOH were dissolved.

Or, in 14 hours, 172.8 mg. KOH were dissolved.

II. Less easily fusible Thuringian glass. Surface exposed = 499 sq. cm.

After 3 hours, 19.2 mg. KOH were dissolved.

After 3 hours more, 15.2 mg. KOH were dissolved.

After 3 hours more, 12.4 mg. KOH were dissolved.

After 3 hours more, 11.2 mg. KOH were dissolved.

Or, after 12 hours, 58.0 mg. KOH were dissolved.

III. Combustion tubing of very difficultly fusible Bohemian glass. Surface exposed = 1130 sq. cm.

After 3 hours 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

After 3 hours more 4.16 mg. KOH were dissolved.

Or, after 12 hours, 16.64 mg. KOH were dissolved.

IV. Easily fusible Bohemian glass. Surface exposed = 1394 sq. cm.

After 3 hours, 7.88 mg. KOH were dissolved.

After 3 hours more, 8.56 mg. KOH were dissolved.

After 3 hours more, 1.97 mg. KOH were dissolved.

Or, after 9 hours, 24.32 mg. KOH were dissolved. (Kreusler and Hensold, B. 17. 34.)

From the above the following table has been calculated.

50 ccm. H<sub>2</sub>O dissolves from a surface of 1000 sq. m. in 1 hour:—

96.0 mg. from easily fusible Thuringian glass.

12.8 mg. from less fusible Thuringian glass.

1.2 mg. from combustion tube of Bohemian glass.

2.0 mg. from harder tube of Bohemian glass.

(Kreusler and Hensold, B. 17. 34.)

100 ccm. H<sub>2</sub>O dissolves so much glass from a flask every 2 seconds when in contact therewith that 0.1 ccm.  $\frac{1}{2}$  normal oxalic acid is neutralised thereby. (Bohlig, Z. anal. 23. 518.)

Action of H<sub>2</sub>O on various kinds of Na glass. 1 g. of finely powdered glass was boiled 10–15 minutes in a silver dish with 100 ccm. H<sub>2</sub>O, and the per cent of Na<sub>2</sub>O (or K<sub>2</sub>O) in the solution was determined.

	% Na <sub>2</sub> O (K <sub>2</sub> O)
Orthoclase feldspar . . . . .	0.17
Glass of a Bohemian combustion tube . . . . .	0.56
“ flask (German manuf.) . . . . .	0.69
“ champagne bottle . . . . .	1.7
Natrolite . . . . .	1.32
Glass of a wine bottle (Hungarian) . . . . .	2.22
Glass which was attacked by H <sub>2</sub> O under pressure . . . . .	3.7
Lead glass . . . . .	3.8
Glass that broke easily . . . . .	4.8
Glass tubing that became rough when fused . . . . .	6.1
Glass tubing that became opaque by fusing . . . . .	14.35
Solid water glass . . . . .	26.97

(Wartha, Z. anal. 24. 220.)

The relative ease by which various kinds of glass are attacked by H<sub>2</sub>O is shown by the following table. The glass was powdered and heated on a water bath with exclusion of atmospheric CO<sub>2</sub>.

Potassium water glass . . . . .	291
Sodium water glass . . . . .	196
Yellow glass rich in alkali . . . . .	34
Thuringian glass . . . . .	19
Ditto from Tittel and Co. . . . .	8
Window glass . . . . .	8
Lead glass from Jena . . . . .	6
Bohemian glass from Kavalier . . . . .	2.4
Lead crystal glass . . . . .	1.4
Thermometer glass, 16IV, from Jena . . . . .	1.0
Zinc glass, 362, from Jena . . . . .	0.8
Lead glass, 434, from Jena . . . . .	0.6
Lead glass, 483, from Jena . . . . .	0.2
Heaviest lead silicate, from Jena. . . . .	0.0

(Mylius, C. C. 1888. 1313.)

Solubility of various kinds of glass in H<sub>2</sub>O.

The amounts dissolved from various kinds of glass by heating 5 hours with H<sub>2</sub>O were as follows.

Yellow glass rich in alkali (13% K <sub>2</sub> O, 15% Na <sub>2</sub> O) . . . . .	249 mg.
Poor Thuringian glass (6.6% K <sub>2</sub> O, 16.5% Na <sub>2</sub> O) . . . . .	91.4 “
Glass from Tittel and Co. (7.1% K <sub>2</sub> O, 14.3% Na <sub>2</sub> O) . . . . .	30.4 “
Bottle glass from Schilling (4.2% K <sub>2</sub> O, 11.9% Na <sub>2</sub> O) . . . . .	13.0 “
Bohemian glass from Kavalier (13.3% K <sub>2</sub> O, 11.4% Na <sub>2</sub> O) . . . . .	10.1 “
Rhenish window glass (13.5% Na <sub>2</sub> O) . . . . .	8.4 “
Lead crystal glass from Ehrenfeld (12.1% K <sub>2</sub> O) . . . . .	8.5 “
Green bottle glass (1.3% K <sub>2</sub> O, 9.5% Na <sub>2</sub> O) . . . . .	6.5 “

Solubility of various kinds of glass in  $H_2O$ —*Continued.*

Thermometer glass 16III from Jena (14.0% $Na_2O$ , 7% $ZnO$ )	6.4 mg.
Lead glass, No. 483, from Jena (47% $PbO$ , 7.3% $K_2O$ )	3.3 "
Lead silicate	0.6 "

(Mylius and Forster, B. 22. 1100.)

By calculation from the electrical conductivity of the solutions formed, various data were obtained by Kohlrausch (B. 24. 3565), which showed that different varieties of glass were attacked in very different degree by cold  $H_2O$ , and, moreover, the amount dissolved was proportionately much greater during the first few minutes of treatment with  $H_2O$  than afterwards, and, furthermore, the rate of decrease was much faster for good glass than poor. Increase of temperature increased the rate of solubility to a very great degree, the increase for  $1^\circ C$ . being about 17%. In 7 hours at  $80^\circ$  half as much was dissolved as in 6 months at  $18^\circ$ . Extensive tables are given. (Kohlrausch, B. 24. 3651.) See also Kohlrausch (W. Ann. 44. 577).

A very extensive research on the action of  $H_2O$  on glass, with a historical review of the work previously done on the subject, has been published by Mylius and Forster. (Z. anal. 31. 241.) The general results may be summed up as follows:—

1. The solution of glass in  $H_2O$  is caused by a decomposition, by which free alkali is formed.

2. The silicic acid of the glass is brought into solution by a secondary reaction of the free alkali in the solution.

3. The constituents of the solution change according to the conditions of the digestion.

4. The amount of alkali going into solution from a given surface under certain conditions is a measure for the resistance of a glass under those conditions.

5. The rate of attack of glass surfaces by cold  $H_2O$  decreases rapidly with the length of time of digestion, and finally approaches a constant value.

6. The solubility increases very rapidly with increase of temperature.

7. The ratio of the solubility of several kinds of glass is dependent on the temperature.

8. From glasses which show the same ease of attack unequal amounts of substance may be dissolved.

9. The solubility of a glass is influenced by the condition of the surface from "weathering" by prolonged exposure to the  $CO_2$  and  $H_2O$  of the air.

10. The poorer a glass is the less will its solubility decrease by prolonged treatment with  $H_2O$ .

11. A good glass is essentially less easily

attacked after having been previously treated with  $H_2O$ .

12. After treatment with  $H_2O$ , glass surfaces have the property of fixing alkali from the solutions formed, and giving it up again by a subsequent treatment with  $H_2O$ .

13. Potassium glass is much more sol. than sodium glass (contrary to previous researches), but the difference decreases as the glass becomes richer in  $CaO$ .

14. In glass flasks which are to be only slightly attacked by cold or hot  $H_2O$ , the  $CaO$ , alkalis, and  $SiO_2$  must stand in a fixed relation to each other.

15. Of the more common varieties of glass, lead flint glass is least sol. in  $H_2O$ , but its surface is corroded, and it is easily decomp. by acids.

(Mylius and Forster, Z. anal. 31. 241.)

Bottle glass containing much  $Al_2O_3$  is easily attacked by acids.

From powdered flint glass, boiling  $HCl + Aq$  extracts  $K$ , but no  $Pb$ . (Griffiths.)

Bottles of flint glass with  $(NH_4)_2CO_3 + Aq$  became so fragile that on shaking pieces of glass were detached. (Griffiths.)

All glass is decomp. by  $HF$ .

Conc.  $H_3PO_4$  also attacks all glass.

Glass containing small amounts of  $SiO_2$  are attacked by  $H_2SO_4$ ; poorer glass by boiling  $HCl$ ,  $HNO_3$ , and aqua regia. (Berselius.)

Conc.  $HNO_3$  does not act on flint glass at  $145-150^\circ$ . (Sorby, C. R. 50. 990.)

Glass of ordinary chemical apparatus gives up traces of metals to  $HCl$  and  $HNO_3 + Aq$ , but hard Bohemian glass consisting of 75%  $SiO_2$ , 15%  $K_2O$ , 10%  $CaO$ , resists the action of warm conc. acids; also an easily fusible  $Na K$  glass with 77 %  $SiO_2$ , 7.7%  $K_2O$ , 5%  $Na_2O$ , 10.3%  $CaO$ , is not easily attacked. (Stas.)

$KOH$ , and  $NaOH + Aq$  dissolve  $SiO_2$  from glass the more easily the hotter and the more conc. the solutions are. (Müller.)  $NH_4OH$ , and  $(NH_4)_2CO_3 + Aq$  attack many kinds of glass, especially flint glass.  $CaO, H_2$  attacks glass appreciably at  $45^\circ$  and lower; still more strongly on boiling. (Lamy, A. ch. (5) 14. 155.)

The action of various solvents on the glass mentioned on page 359 in Emmerling's experiments is as follows:

The action of  $HCl + Aq$  containing 0.2 to 3%  $HCl$  is practically null, but is increased either by dilution or concentration. A very small quantity (0.02%)  $HCl$  added to  $H_2O$  almost wholly prevents its action on glass. With  $HCl + Aq$  (11%  $HCl$ ) a decrease of 4.2 mg. was noticed in the first hour, and only 3-4 mg. afterwards. The same is the case for  $HNO_3 + Aq$  in still greater degree, 0.008%  $HNO_3$  sufficing to nearly counteract the solvent action of  $H_2O$ .

$H_2SO_4 + Aq$  has about double the solvent effect possessed by  $H_2O$ .

Oxalic and acetic acids both diminish the solvent action of  $H_2O$ .

The addition of even traces (0.04%) of

$\text{Na}_2\text{CO}_3$  increases the solvent action, and this is further rapidly increased by an increase in the amount of  $\text{Na}_2\text{CO}_3$ .  $\text{Na}_2\text{CO}_3 + \text{Aq}$  containing 1%  $\text{Na}_2\text{CO}_3$  dissolves about 10 times as much as pure  $\text{H}_2\text{O}$ , i. e. about 35 mg. per hour.

The above is also the case with  $\text{KOH} + \text{Aq}$ , but in even greater degree.  $\text{KOH} + \text{Aq}$  containing 0.025%  $\text{KOH}$  dissolved three times as much as pure  $\text{H}_2\text{O}$ .

$(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  has about the same action as  $\text{H}_2\text{O}$ .

With  $\text{NH}_4\text{OH} + \text{Aq}$  (9%  $\text{NH}_4$ ) 7 mg. decrease for the first hour, and 3 mg. afterwards was noticed. The concentration of the  $\text{NH}_4\text{OH} + \text{Aq}$  was apparently without effect.

The addition of  $\text{NH}_4\text{Cl}$  decreases the solvent action of  $\text{H}_2\text{O}$  proportionately to the amount added, but with new flasks large amounts are dissolved.

With  $\text{NH}_4\text{Cl} + \text{Aq}$  (7%  $\text{NH}_4\text{Cl}$ ) 4.2 mg. were dissolved in the first hour, and the amount dissolved gradually decreased to null after 24 hours on account of the liberation of  $\text{HCl}$  by the decomp. of  $\text{NH}_4\text{Cl}$ .

$\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{KNO}_3$ , and  $\text{Na}_2\text{SO}_4$  show a similar behaviour to that of  $\text{NH}_4\text{Cl}$ .

$\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing 0.4%  $\text{Na}_2\text{HPO}_4$

has six times the solvent action of pure  $\text{H}_2\text{O}$ , but the action is not increased by further concentration.

In general, those salts the acids of which form insol. Ca salts, as  $\text{Na}_2\text{CO}_3$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{Na}_2\text{HPO}_4$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ , increase the solvent action of  $\text{H}_2\text{O}$ , and this effect is greater the more concentrated the solution.  $\text{KCl}$ ,  $\text{KNO}_3$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{CaCl}_2$  decrease the effect, and the stronger the solution the less is the action.

All Na glass with approximately the above composition has the same power of resistance against  $\text{H}_2\text{O}$ ; Bohemian K glass shows a greater resistance, especially against acids. (Emmerling, A. 150. 257.)

Action of various reagents on hard Bohemian glass. 100 ccm. substance dissolved mg. glass in 6 days at  $100^\circ$ .

$\text{H}_2\text{O}$	10.0
$\text{H}_2\text{S} + \text{Aq}$	8.7
Dil. $(\text{NH}_4)_2\text{S} + \text{Aq}$	52.5
Conc. $(\text{NH}_4)_2\text{S} + \text{Aq}$	47.2
Conc. $\text{NH}_4\text{OH} + \text{Aq}$	42.5
Dil. $\text{NH}_4\text{OH} + \text{Aq}$	7.7
$\text{NH}_4\text{SH} + \text{Aq}$	51.2

(Cowper, Chem. Soc. 41. 254.)

Action of various solutions on glass of different composition. (The figures denote decrease in weight in mg. of a 100 ccm. flask.)

	Time	1	2	3	4	5	6	7	8	9	10
$\text{H}_2\text{O}$	5 hrs.	62	31	29	17	13	9	7	7	5	4
$\text{H}_2\text{SO}_4 + \text{Aq}$ (25% $\text{H}_2\text{SO}_4$ )	3 "	..	43	35	8	7	6	5	5	5	3
$\text{HCl} + \text{Aq}$ (12% $\text{HCl}$ )	3 "	..	85	..	27	4	2	1	1	0	0
$\text{NH}_4\text{OH} + \text{Aq}$ (10% $\text{NH}_4$ )	3 "	..	..	62	11	8	7	7	6	5	5
$\text{Na}_2\text{HPO}_4 + \text{Aq}$ (12% $\text{Na}_2\text{HPO}_4$ )	3 "	..	..	81	64	40	35	34	30	15	12
$\text{Na}_2\text{CO}_3 + \text{Aq}$ (2% $\text{Na}_2\text{CO}_3$ )	3 "	233	160	130	124	50	45	42	42	26	25

Composition of above varieties of glass.

	1	2	3	4	5	6	7	8	9	10
$\text{SiO}_2$	76.22	74.09	76.39	68.56	74.48	74.69	66.75	74.12	77.07	74.40
$\text{Al}_2\text{O}_3$	..	0.40	0.50	1.85	0.50	0.45	1.31	0.50	0.30	0.70
$\text{CaO}$	4.27	5.85	5.50	7.60	7.15	7.85	13.37	8.55	8.10	8.85
$\text{K}_2\text{O}$	..	7.32	4.94	2.24	6.64	8.64	05.50	4.86	3.75	4.40
$\text{Na}_2\text{O}$	19.51	12.34	12.67	19.75	11.23	8.37	3.07	11.97	10.78	11.65

It is seen that glass which resists the attack of  $\text{H}_2\text{O}$  also resists acids and alkalis, and that the relative resistance of all varieties to any of the solutions is the same. Therefore the action of  $\text{H}_2\text{O}$  may be accepted as a criterion for judging of the resistance of a glass to all solvents. Glass No. 10, in which the molecular ratio of  $\text{SiO}_2 : \text{CaO} : \text{K}_2\text{O} (\text{Na}_2\text{O})$  is 8:1:1.5, is recommended as best suited for chemical uses. (Weber and Sauer, B. 25. 70.)

Mylius and Förster (B. 25. 97) recommend a glass in which the molecular ratio of  $\text{SiO}_2 : \text{CaO} : \text{K}_2\text{O} (\text{Na}_2\text{O})$  is 7.2:1:1.1 as the best suited for chemical apparatus.

In an exhaustive research on the action of aqueous solutions on glass, which cannot be given in full on account of its great length, the following conclusions are reached:—

1. Solutions of caustic alkalis act on glass much more strongly than  $\text{H}_2\text{O}$ , dissolving all the constituents of the glass—that is, the glass as such. Very dilute solutions form an exception.

2. Of the caustic alkalis,  $\text{NaOH} + \text{Aq}$  has the strongest action, then come  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$ , and  $\text{BaO} \cdot \text{H}_2\text{O} + \text{Aq}$  in the order named.

3. Increase in temperature increases the

strength of the attack of alkalis very considerably.

4. At high temperatures, the ease with which glass is attacked increases at first rapidly with the concentration of the alkali, but afterwards more slowly.

5. At ordinary temperatures very concentrated alkali solutions have less action on glass than dil. solutions.

6. Solutions of pure alkalis, if not too conc., act less on glass than when contaminated with small amounts of  $\text{SiO}_2$ .

7. Alkali carbonates + Aq. attack glass much more than  $\text{H}_2\text{O}$ , even when they are very dilute. The action corresponds less to that of the caustic alkalis than to that of other salts. With equivalent concentration,  $\text{Na}_2\text{CO}_3$  + Aq. has a stronger action than  $\text{K}_2\text{CO}_3$  + Aq.

8. The action of salt solutions on glass is a compound one, depending both on the concentration and the kind of salt dissolved, and is made up of the action of the  $\text{H}_2\text{O}$  and the salt in solution.

9. Each kind of attack is differently influenced by the composition of the glass.

10. Solutions of those salts, the acids of which form insol. Ca salts, have a stronger action than  $\text{H}_2\text{O}$ , and the action increases with the concentration.

11. Solutions of those salts, the acids of which form sol. Ca salts, have less action than  $\text{H}_2\text{O}$ , and the action decreases with the concentration. (Förster, B. 25. 2494.)

Data on this subject published since the first edition of this work have not been considered.

### Glucinic acid.

#### Potassium glucinate, $\text{K}_2\text{GluO}_2$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and acids. (Kriess and Morah, B. 23. 733.)

#### Glucinum (Beryllium), Gl.

Not attacked by hot or cold  $\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{HNO}_3$  + Aq. (Wöhler, Pogg. 18. 577.)

Sol. only in boiling conc.  $\text{HNO}_3$  + Aq. (Debray, A. ch. (3) 44. 5.)

Sol. in dil.  $\text{HCl}$  + Aq. dil. and conc.  $\text{H}_2\text{SO}_4$  + Aq. and  $\text{KOH}$  + Aq. but insol. in  $\text{NH}_4\text{OH}$  + Aq. (Wöhler, Debray.)

Sol. in hot  $\text{HCl}$ , hot conc.  $\text{HNO}_3$ , and hot conc.  $\text{H}_2\text{SO}_4$ . (Lebeau, A. ch. 1899, (7), 16. 474.)

#### Glucinum azoimide, $\text{GluN}_2$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2), 58. 292.)

#### Glucinum borocarbide, $3\text{Gl}_2\text{C}$ , $\text{B}_2\text{C}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in mineral acids especially  $\text{HNO}_3$ . (Lebeau, A. ch. 1899, (7) 16. 481.)

$\text{C}_2\text{B}_2\text{Gl}_4$ . Stable in air.

Easily sol. in mineral acids, conc. and dil. (Lebeau, C. R. 1898, 126. 1349.)

#### Glucinum bromide, $\text{GlBr}_2$ .

Sol. in  $\text{H}_2\text{O}$  with evolution of much heat. (Wöhler.)

Sol. in abs. alcohol. (Lebeau, A. ch. 1899, (7) 16. 484.)

#### Glucinum carbide, $\text{Gl}_2\text{C}$ .

Decomp. by  $\text{H}_2\text{O}$ . Slowly attacked by cold or hot conc.  $\text{HCl}$  and  $\text{HNO}_3$ . Gradually but completely sol. in dil. acids. (Lebeau, A. ch. 1899, (7), 16. 476.)

$\text{GlC}_2$ . Not easily decomp. by strong acids. Easily sol. with decomp. in dil. acids. (Lebeau, C. R. 1895, 121. 497.)

#### Glucinum chloride, $\text{GlCl}_2$ .

Anhydrous. Fumes and deliquesces in air. Sol. in  $\text{H}_2\text{O}$  with hissing and evolution of much heat. Easily sol. in alcohol.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Sol. in alcohol and ether. Sl. sol. in  $\text{C}_2\text{H}_5$ ,  $\text{CHCl}_3$ ,  $\text{Cl}_4$  and  $\text{CS}_2$ . (Lebeau, A. ch. 1899, (7) 16. 493.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+  $4\text{H}_2\text{O}$ . Very hygroscopic. Easily sol. in  $\text{H}_2\text{O}$  and in alcohol. (Mieleitner, Z. anorg. 1913, 60. 73.)

#### Glucinum chloride ammonia, $\text{GlCl}_2 \cdot 4\text{NH}_3$ .

(Mieleitner, Z. anorg. 1913, 80. 73.)

#### Glucinum chloride iodine trichloride,

$2\text{ICl}_3 \cdot \text{GlCl}_2 + 8\text{H}_2\text{O}$ .

Hygroscopic. (Weinland, Z. anorg. 1902, 30. 140.)

#### Glucinum ferric chloride, $\text{GlCl}_3 \cdot \text{FeCl}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Neumann, A. 244. 329.)

#### Glucinum mercuric chloride, $\text{GlCl}_2 \cdot 3\text{HgCl}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Atterberg, B. 6. 1288.)

#### Glucinum thallic chloride, $3\text{GlCl}_3 \cdot 2\text{TlCl}_3$ .

Cryst. from  $\text{HCl}$  solution. (Neumann, A. 244. 348.)

#### Glucinum stannic chloride.

See Chlorostannate, glucinum.

**Glucinum fluoride, basic,  $2\text{GIO}$ ,  $5\text{GIF}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Lebeau, A. ch. 1899, (7) 16. 484.)

**Glucinum fluoride,  $\text{GIF}_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Insol. in anhydrous HF. Sol. in alcohol. (Lebeau, C. R. 1898, 126. 1421.)

Sol. in  $\text{H}_2\text{O}$  in all proportions. Somewhat sol. in abs. alcohol. Easily sol. in 90% alcohol, also in a mixture of alcohol and ether. Insol. in anhydrous HF. (Lebeau, A. ch. 1899, (7) 16. 484.)

**Glucinum potassium fluoride,  $\text{GIF}_2$ , KF.**

Sl. sol. in  $\text{H}_2\text{O}$ . (Awdejew.) Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{GIF}_2$ , 2KF. Sol. in about 50 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , and 19 pts. boiling  $\text{H}_2\text{O}$ . (Marignac.)

**Glucinum sodium fluoride,  $\text{GIF}_2$ ,  $2\text{NaF}$ .**

Sol. in 34 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ , and 68 pts. at  $18^\circ$ . (Marignac.)

**Glucinum hydroxide,  $\text{GIO}_2\text{H}_2$ .**

Easily sol. in acids. Sol. in  $\text{H}_2\text{SO}_4$  + Aq. Sol. in  $\text{CO}_2$  + Aq; 100 ccm. sat.  $\text{CO}_2$  + Aq dissolve 0.0185 g.  $\text{GIO}$ . (Sestini, Gazz. ch. it. 20. 313.)

Also sol. in KOH, NaOH,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3$  + Aq, especially when freshly precipitated; also in  $\text{Na}_2\text{CO}_3$ , or  $\text{K}_2\text{CO}_3$  + Aq. (Debray.)

Insol. in  $\text{NH}_4\text{OH}$  + Aq containing  $\text{NH}_4\text{Cl}$  + Aq.

Very sl. sol. in  $\text{Li}_2\text{CO}_3$  + Aq. (Gmelin.)

Sol. in  $\text{H}_2\text{SO}_4$  + Aq. (Berthier.)

Sol. in  $\text{BaO}_2\text{H}_2$  + Aq, from which it is pptd. by  $\text{NH}_4$  salts, but not by boiling. Sol. in boiling  $\text{NH}_4\text{Cl}$  + Aq when freshly pptd.

Sol. in  $\text{NH}_4\text{F}$  + Aq. (Helmholtz, Z. anorg. 3. 130.)

**Solubility of  $\text{GIO}_2\text{H}_2$  in NaOH + Aq.**

G. Na in 20 ccm.	G. Gl. in 20 ccm.
0.3358	0.0358
0.6717	0.0682
0.8725	0.1175
1.7346	0.2847

(Rubenbauer, Z. anorg. 1902, 30. 334.)

When glucinum hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less glucinum hydroxide according to the concentration. (Rubenbauer.)

**Solubility of freshly pptd.  $\text{GIO}_2\text{H}_2$  in NaOH + Aq at room temperature.**

millimols Na per l.	G. $\text{GIO}$ dissolved in 1 l.
649	3.6
540	2.92
540	2.53
483	1.69
383	1.64
388	1.53
386	1.45
390	1.24

In the first two cases the values were obtained by adding to  $\text{GICl}_2$  + Aq at  $0^\circ$ , ice cold  $\text{NH}_4\text{OH}$  and treating the ppt. with NaOH + Aq. In the remaining cases by dissolving basic  $\text{GICl}_2$  in HCl and pouring into NaOH + Aq. (Haber, Z. anorg. 1904, 33. 386.)

**Solubility of  $\text{GIO}_2\text{H}_2$ , which is one week old, in NaOH + Aq at  $t^\circ$ .**

NaOH	$t^\circ$	G. $\text{GIO}$ in 1 l.
$\frac{1}{2}$ -N	$20-23^\circ$	0.060
1-N	$20-23^\circ$	0.170
2-N	$20-23^\circ$	0.570
$\frac{1}{2}$ -N	$50-53^\circ$	0.080
1-N	$50-53^\circ$	0.230
2-N	$50-53^\circ$	0.900
$\frac{1}{2}$ -N	$100^\circ$	0.080
1-N	$100^\circ$	0.290
2-N	$100^\circ$	1.020

(Haber.)

**Solubility of  $\text{GIO}_2\text{H}_2$  in NaOH + Aq at  $25^\circ$ .**

G. mols.	
Na	Gl.
0.268	0.0330
0.318	0.0492
0.446	0.0841
0.526	0.089
0.563	0.101
0.801	0.143
0.854	0.202

(Wood, Chem. Soc. 1910, 97. 884.)

Insol. in  $\text{NH}_4\text{OH}$  + Aq and in alkyl amines. (Rens, B. 1903, 36. 2753.)

Sol. in  $\text{GISO}_4$  + Aq. (Parsons, J. phys. Chem. 1907, 11. 658.)

A form insol. in acids and alkalies can be obtained by sufficiently long heating in boiling  $\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3$  + Aq,  $\text{NH}_4\text{OH}$  + Aq, or solutions of NaOH or KOH so dil. that the  $\text{GIO}_2\text{H}_2$  is either insol. or very sl. sol. therein. (van Oordt, C. C. 1906, I. 108.)

100 ccm. of glycerine + Aq containing about 60% by vol. of glycerine dissolve 0.1 g.  $\text{GIO}$ . (Müller, Z. anorg. 1905, 43. 322.)

Contains  $\frac{1}{2}\text{H}_2\text{O}$  (Schaffgotsch);  $\frac{4}{5}\text{H}_2\text{O}$  (Atterberg).

Solubility of  $\text{GlO}_2\text{H}_2$ , which has been boiled with alkali, in various solvents.

Alkali used	Time	Solvent	Solubility
10-N NaOH	2½ hrs.	0.106-N NaOH 0.39-N NaOH 0.97-N NaOH 2.0-N NaOH 2.0-N NaOH	1 mol. $\text{GlO}_2\text{H}_2$ : 331 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 183 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 91.8 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 49 mole NaOH 1 mol. $\text{GlO}_2\text{H}_2$ : 49 mole NaOH
NaOH NaOH	Long time 2 hrs.	10-N $\text{K}_2\text{CO}_3$ Dil. HCl Hot conc. HCl Dil. acetic acid	Insol. Sl. sol. Slowly sol. Almost insol.
KOH	Till flocculent ppt. appeared	1-N KOH  1-N NaOH Warm dil. HCl	Insol. " Sol.
½-N $\text{Na}_2\text{CO}_3$	3 hrs.	1-N NaOH Dil. HCl	Easily sol. "
{ ½-N $\text{Na}_2\text{CO}_3$ for then 1/10-N $\text{Na}_2\text{CO}_3$ for	3 hrs. and 4 hrs.	1-N NaOH Dil. HCl	Sl. sol. Slowly sol.
½-N $\text{K}_2\text{CO}_3$ 10-N $\text{K}_2\text{CO}_3$	6 hrs. Short time	10-N $\text{K}_2\text{CO}_3$ 1-N NaOH Cold 10-N $\text{K}_2\text{CO}_3$	Insol. Easily sol. Very slowly sol.
$\text{NH}_4\text{OH}$	5 hrs.	½-N NaOH	Very sl. sol.

(Haber.)

**Glucinum iodide,  $\text{Gli}_2$ .**Sol. in  $\text{H}_2\text{O}$  with evolution of much heat. (Wöhler.)Decomp. in moist air and by  $\text{H}_2\text{O}$ .

Sol. in abs. alcohol. Insol. in most neutral organic solvents, as benzene, toluene, etc. (Lebeau, C. R. 1898, 126. 1273.)

Insol. in  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_4$ , and oil of turpentine. Easily sol. in  $\text{CS}_2$ . Sol. in anhydrous alcohols without evolution of heat. (Lebeau, A. ch. 1899, (7) 16. 490.)**Glucinum iodide ammonia,  $2\text{Gli}_2, 3\text{NH}_3$ .**

Ppt. (Lebeau, A. ch. 1899, (7) 16. 492.)

**Glucinum oxide,  $\text{GlO}$ .***Crystalline.* Insol. in acids except conc.  $\text{H}_2\text{SO}_4$ . (Ebelmen, C. R. 32. 710.)*Amorphous.* Absolutely insol. in  $\text{H}_2\text{O}$ . The higher the temp. to which the substance has been heated the more insol. is it in acids. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in conc.  $\text{NH}_4\text{Cl} + \text{Aq}$ , or KOH, and  $\text{NaOH} + \text{Aq}$ . (Rose.)When obtained by ignition of  $\text{GlSO}_4$ , it is very slowly but completely sol. in HCl, and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Rose.)Insol. in hydracids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Lebeau, C. R. 1896, 123. 819.)Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898, 20. 828.)**Glucinum peroxide basic,  $2\text{GlO}_2, 3\text{GlO}$ .** $+8\frac{1}{2}\text{H}_2\text{O}$ . (Komarovski, Chem. Soc. 1913, 104 (2) 707.)**Glucinum oxybromides.**Sol. in  $\text{H}_2\text{O}$  if three or less equivalents of base are present to one of acid; insol. if more of the base is present. (Ordway, Am. J. Sci. (2) 26. 207.)**Glucinum oxychloride,  $\text{Gl}_2\text{OCl}_2 = \text{GlO}, \text{GlCl}_2$ .**Insol. in  $\text{H}_2\text{O}$ . $3\text{GlCl}_2, 2\text{GlO} + 2\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ . (Atterberg.) $\text{GlCl}_2, 3\text{GlO} + 3\text{H}_2\text{O}$  (?). Sol. in  $\text{H}_2\text{O}$ , but solution soon becomes cloudy and deposits a fine ppt. By boiling the solution it is decomp. into above salt, and  $\text{GlCl}_2, 12\text{GlO}_2\text{H}_2 + 10\text{H}_2\text{O}$ , which is insol. in  $\text{H}_2\text{O}$ ; decomp. into  $\text{GlO}_2\text{H}_2$  by washing. Sol. in acids. (Atterberg.)**Glucinum oxyfluoride,  $5\text{GlF}_2, 2\text{GlO}$ .**Readily sol. in  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1898, 126. 1419.)**Glucinum phosphide.**Decomp. by  $\text{H}_2\text{O}$ . (Wöhler.)**Glucinum selenide.**Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Glucinum sulphide.**

Slowly sol. without decomp. in  $H_2O$ , but easily decomp. by acids. (Wöhler.)

**Gold, Au.**

Gold which has been pptd. from  $AuCl_3 + Aq$  by  $FeSO_4$  is al. sol. in  $HCl$ . (Awerkiew, Z. anorg. 1909, 61. 10.)

Not attacked by  $H_2O$ . Insol. in  $HNO_3$  or  $HCl + Aq$ . Easily sol. in aqua regia or any mixture evolving  $Cl$  or  $Br$ . Sol. in selenic acid, or antimonie acid +  $Aq$ ; less easily in arsenic acid +  $Aq$ . Sol. in mixtures of  $HCl$  and nitrates, or  $HNO_3$  and chlorides; also in  $(NaCl + KNO_3 + K_2Al_2(SO_4)_6) + Aq$  (?). Insol. in  $H_2SO_4$ , except in presence of  $KMnO_4$ ,  $HNO_3$ , or  $HIO_3$ . Sol. in a solution of  $I$  in ether in direct sunlight.

Sol. in solutions of ferric, and cupric salts.

Sol. in  $HCl + Aq$  containing  $H_2CrO_4$ ,  $H_2MnO_4$ ,  $H_2SeO_4$ ,  $H_2AsO_4$ , or  $FeCl_3$ . (Wurtz.)

Attacked by fuming  $HCl$  (sp. gr. 1.178) at ord. temp. in direct light, especially in the presence of a trace of  $MnCl_2$ , but not attacked in the dark even in the presence of this salt. (Berthelot, C. R. 1904, 138. 1298.)

100 ccm. hot conc.  $HCl$  dissolve 0.008 g. yellow Au powder in 4 hours. (Hanriot and Raoult, C. R. 1912, 155. 1086.)

Upon boiling 25 and 50 cc.  $HCl + Aq$  (sp. gr. 1.178), dil. to 125 cc. with 250 mg. sheet Au  $\frac{1}{8}$  in. square, 0.009 in. thick, weighing 250 mg. for several hours, there was no loss of weight of Au. (McCaughy, J. Am. Chem. Soc. 1909, 31. 1263.)

From 5 g. finely divided ordinary yellow gold; 100 cc.  $HNO_3$  of 22° B. dissolve 0.002 g. in 2 hrs.

100 cc.  $HNO_3$  of 32° B. dissolve 0.0119 g. in 2 hrs.

100 cc.  $HNO_3$  of 36° B. dissolve 0.028 g. in 2 hrs.

100 cc.  $HNO_3$  monohydrate dissolve 0.076 g. in 2 hrs. (Hanriot and Raoult, C. R. 1912, 155. 1085.)

From 5 g. brown gold:

100 ccm.  $HNO_3$  of 22° Baume dissolve 0.006 g. in 2 hrs.

100 ccm.  $HNO_3$  of 32° Baume dissolve 0.039 g. in 2 hrs.

100 ccm.  $HNO_3$  of 36° Baume dissolve 0.078 g. in 2 hrs.

100 ccm.  $HNO_3$  monohydrate dissolve 1.540 g. in 2 hrs. (Hanriot and Raoult.)

Sl. sol. in boiling  $HNO_3$  (sp. gr. = 1.42). The solution deposits Au by standing several days. (Dewey, J. Am. Chem. Soc. 1910, 32. 320.)

Best composition of aqua regia for dissolving Au is 200 cc.  $HCl$  (sp. gr. 1.1946) 45 cc.  $HNO_3$  (sp. gr. 1.4) and 245 cc.  $H_2O$ . 1 pt. Au is sol. in 4.3 pts. of such a mixture. (Priwoznik, C. C. 1910, II. 1743.)

Sol. in 1 pt.  $HNO_3 + 4$  pts.  $HCl$  as representing the most economical mixture. (Priwoznik, Chem. Soc. 1911, 100. (2), 484.)

Easily sol. in nitrosulphonic acid from sulphuric acid manufacture, when mixed with equal parts conc.  $HCl + Aq$ . (Bornträger, Rep. anal. Ch. 1887. 741.)

Sol. in hot conc.  $H_2SO_4$  in the presence of  $MnO_2$ ,  $Mn_2O_3$ ,  $Mn_3O_4$ ,  $PbO$ ,  $Pb_2O_3$ ,  $Pb_3O_4$ ,  $CrO_3$ ,  $CrO_2$  and  $Ni_2O_3$ . Solution also takes place slowly in the cold. Sol. in hot  $H_2SO_4 + KMnO_4$ . Slowly sol. in cold, more rapidly in hot  $H_2SO_4 + HNO_3$ . (Lenher, J. Am. Chem. Soc. 1904, 26. 550.)

Sol. in a hot solution of crystalline telluric acid in  $H_2SO_4$  or  $H_3PO_4$ .

Sol. in hot  $H_3PO_4$  in the presence of  $MnO_2$ ,  $Mn_2O_3$ ,  $Mn_3O_4$ , the higher oxides of lead,  $CrO_3$ , chromium tetroxide and nickelic oxide. Solution takes place more slowly in the cold. Sol. in hot  $H_3PO_4$  in the presence of  $KMnO_4$ . Slowly sol. in a cold, more rapidly sol. in a hot mixture of  $H_3PO_4$  and  $HNO_3$ .

Sol. in hot arsenic acid in the presence of  $MnO_2$ ,  $Mn_2O_3$  and  $Mn_3O_4$ . (Lenher, J. Am. Chem. Soc. 1904, 26. 550.)

Gold leaf is not attacked by cold conc.  $H_2SeO_4$ , when completely free from halogens, but is dissolved by conc.  $H_2SeO_4$  at 300°. (Lenher, J. Am. Chem. Soc. 1902, 24. 354.)

Solubility of thin sheet Au in  $HCl$  solution of iron alum.

Time, hours	Mg. Au dissolved			
	1 g. Fe 25 cc. HCl	1 g. Fe 50 cc. HCl	2 g. Fe 25 cc. HCl	2 g. Fe 50 cc. HCl

Temp. 38–43°.

	1 g. Fe 25 cc. HCl	1 g. Fe 50 cc. HCl	2 g. Fe 25 cc. HCl	2 g. Fe 50 cc. HCl
16	1.00	1.30	1.08	1.47
22	1.12	1.55	1.20	1.81
40	1.52	2.15	1.82	2.75
46	1.71	2.34	2.02	2.95
64	1.96	3.10	2.60	3.79
72	2.12	3.30	2.83	4.05
89	2.32	3.65	3.22	4.65
100	2.40	3.76	3.38	4.81
113	2.45	3.95	3.51	5.12
124	2.60	4.09	3.63	5.39
161	2.78	4.36	3.95	5.96
185	2.90	4.49	4.11	6.22

Temp. 98–100°.

	1 g. Fe 25 cc. HCl	1 g. Fe 50 cc. HCl	2 g. Fe 25 cc. HCl	2 g. Fe 50 cc. HCl
1	1.13	0.78	1.15	1.27
2	1.99	1.74	2.56	2.86
4	3.46	3.31	4.55	5.06
16	10.09	11.37	13.15	15.56
20	12.20	13.72	15.59	19.41
24	14.37	16.49	17.96	23.29
36	17.38	23.27	22.07	31.73
42	18.79	26.30	24.62	35.29
54	20.94	31.39	29.49	42.11
59½	21.64	33.12	30.64	44.43

The solution contained the given amounts of Fe as iron alum, the sp. gr. of the HCl was 1.178, and the solutions diluted to 125 cc. (McCaughy, J. Am. Chem. Soc. 1909, 31, 1263.)

The solvent action of ferric salt occurs even in presence of a ferrous salt, but decreases with increase of concentration of ferrous salt. (McCaughy.)

Solubility of thin sheet Au in HCl solution of  $\text{CuCl}_2$ .

Time, hours	Mg. Au dissolved			
	1 g. Cu 25 cc. HCl	1 g. Cu 50 cc. HCl	2 g. Cu 25 cc. HCl	2 g. Cu 50 cc. HCl
Temp. 38-43°.				
19	0.03	0.26	0.05	0.39
25	0.09	0.36	0.05	0.54
43	0.10	0.54	0.14	0.94
49½	0.12	0.61	0.15	1.07
66½	0.11	0.76	0.17	1.40
78	0.14	0.87	0.22	1.58
91	0.14	0.92	0.24	1.75
102	0.16	1.02	0.27	1.90
139	0.18	1.34	0.32	2.45
163	0.23	1.60	0.39	2.84

Temp. 98-100°.

1	0.15	0.34	0.17	0.46
4	0.55	1.23	0.55	1.35
16	1.34	5.00	2.12	8.80
20	1.63	6.5?	2.78	11.86
26	2.17	9.13	3.59	15.70
38	3.13	13.98	5.07	23.14
43	3.61	16.54	5.77	26.62
48	4.07	19.26	6.26	30.80
60	4.82	26.37	7.47	39.09

Conditions the same as above for HCl + iron alum. (McCaughy.)

Finely powdered gold is sol. in conc HCl in the presence of alcohol, etc.

0.0302 g. Au. is sol. in 100 cc. HCl + 100 cc.  $\text{CH}_3\text{OH}$ .

0.0230 g. Au. is sol. in 100 cc. HCl + 100 cc.  $\text{CHCl}_3$ .

0.0066 g. Au. is sol. in 100 cc. HCl + 100 cc.  $\text{C}_2\text{H}_5\text{OH}$ .

0.0190 g. Au. is sol. in 100 cc. HCl + 100 cc.  $\text{C}_2\text{H}_{11}\text{OH}$ .

0.0125 g. Au. is sol. in 100 cc. HCl + 50 cc.  $\text{CCl}_3\text{CH}(\text{OH})_2$ .

(Awerkiew, C. C. 1908, II. 1566.)

Solubility of Au which has been pptd. from  $\text{AuCl}_3 + \text{Aq}$  by various precipitants in HCl + formaldehyde.

HCHO (40%) ccm.	HCl (1.19) ccm.	Au dissolved g.	Au used was pptd. from $\text{AuCl}_3 + \text{Aq}$ by
150	150	0.0007	$\text{FeSO}_4$
100	100	0.0006	"
125	25	0.0008	"
100	200	0.0009	sugar
150	150	0.0003	oxalic acid
250	250	0.0002	"
500	500	0.0008	$\text{FeSO}_4$
100	500	0	oxalic acid
100	200	0.0004	"
100	200	0	"
150	300	0.0006	sugar
250	125	0.001	"
150	75	0.0013	$\text{FeSO}_4$
100	200	0.0008	"
100	200	0.0006	HCHO
100	100	0.0005	"
180	540	0	
360	720	0.001	$\text{FeSO}_4$
360	720	0.0019	sugar
209	400	0.0013	$\text{FeSO}_4$

In the last four cases the solubility was determined at the ordinary temp.; in the first sixteen the gold was boiled with the mixture of HCl and HCHO.

(Awerkiew, Z. anorg. 1909, 61. 3.)

Solubility of Au in boiling HCl + paraformaldehyde.

$(\text{CH}_2\text{O})_x$ g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from $\text{AuCl}_3 + \text{Aq}$ by
5	25	0.0005	$\text{FeSO}_4$
5	25	0.0004	oxalic acid
25	125	0.006	sugar
20	400	0.0024	$\text{CHOH}$
20	400	0.0034	$\text{CH}_2\text{OH}$
20	400	0.003	"
20	400	0.0065	sugar
20	400	0.0044	formic acid
20	400	0.0005	"
40	400	0.001	$\text{CH}_2\text{OH}$
20	300	0.0024	$\text{FeSO}_4$
20	300	0.003	"
10	200	0.0008	$\text{CH}_2\text{OH}$
10	200	0.0006	oxalic acid
60	120	0.0015	$\text{FeSO}_4$

(Awerkiew.)



## Solubility of Au in boiling HCl+methyl alcohol.

C <sub>2</sub> H <sub>5</sub> OH (99%) ccm.	HCl (1.19) ccm.	Dissolved Au g.	Au used was pptd. from AuCl <sub>3</sub> +Aq. by
100	100	0.0302	FeSO <sub>4</sub>
150	150	0.0043	oxalic acid
150	150	0.028	sugar
25	25	0.001	CH <sub>3</sub> OH
50	50	0.0002	oxalic acid
50	50	0.0005	CH <sub>3</sub> OH
50	50	0.0002	oxalic acid
50	50	0.0015	FeSO <sub>4</sub>
50	50	0.002	"
100	100	0.0009	oxalic acid
500	500	0.0128	FeSO <sub>4</sub>
1000	1000	0.0281	"
50	100	0.0084	"
100	200	0.0006	"
100	300	0	"
75	25	0.005	HCOH
90	30	0.005	"
75	25	0.0014	"
80	20	0.0005	"
100	50	0.0018	FeSO <sub>4</sub>
100	50	0.0008	CH <sub>3</sub> OH
50	200	0.001	"

(Awerkiew.)

## Solubility of Au in boiling HCl+ethyl alcohol.

C <sub>2</sub> H <sub>5</sub> OH (95%) ccm.	HCl (1.19) ccm.	Dissolved Au g.	Au used was pptd. from AuCl <sub>3</sub> +Aq. by
25	50	0.0006	FeSO <sub>4</sub>
100	200	0.0111	"
200	400	0.0017	"
150	50	0.0003	sugar
100	300	0.0004	"
100	100	0.0015	"
200	200	0.0055	C <sub>2</sub> H <sub>5</sub> OH
250	250	0.0021	sugar
300	300	0.0197	FeSO <sub>4</sub>
1000	1000	0.007	CH <sub>3</sub> OH
150	150	0.008	"

(Awerkiew.)

## Solubility of Au in boiling HCl+amyl alcohol.

C <sub>5</sub> H <sub>11</sub> OH g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from AuCl <sub>3</sub> +Aq. by
100	100	0.019	FeSO <sub>4</sub>
100	200	0.0048	"
150	150	0.0024	sugar
100	100	0.0027	"
150	50	0.0032	"
300	100	0.0023	FeSO <sub>4</sub>
200	200	0.0067	C <sub>5</sub> H <sub>11</sub> OH
500	500	0.028	FeSO <sub>4</sub>

(Awerkiew.)

## Solubility of Au in boiling HCl+phenol.

C <sub>6</sub> H <sub>5</sub> OH g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from AuCl <sub>3</sub> +Aq. by
10+25	100	0.001	C <sub>6</sub> H <sub>5</sub> OH
10	40	0.0004	oxalic acid
20	50	0.0003	"
25	100	0.0005	FeSO <sub>4</sub>
25	150	0	HCOH
50	200	0.0005	"
25	250	0.0005	FeSO <sub>4</sub>
25	250	0.0012	"

(Awerkiew.)

## Solubility of Au in boiling HCl+chloroform.

CHCl <sub>3</sub> g.	HCl (1.19) g.	Dissolved Au g.	Au used was pptd. from AuCl <sub>3</sub> +Aq. by
50	100	0.0009	FeSO <sub>4</sub>
100	100	0.023	"
100	100	0.0017	"
150	50	0.0012	"
200	400	0.0024	sugar
250	250	0.002	"
300	300	0.0106	"

(Awerkiew.)

Colloidal gold is sol. in dil. alkalis. (Paal, B. 1902, 35, 2236.)

Rather quickly sol. in 10-15% solution I in KI+Aq.

Very slowly sol. in 5% solution of I in KI+Aq.

Scarcely sol. in more dil. solution of I in KI+Aq.

Easily sol. in 10% NH<sub>4</sub>I+I. Less easily sol. in 5% NH<sub>4</sub>I+I. (Döring.)

Sol. in cold Na<sub>2</sub>S+Aq when Na<sub>2</sub>S is present in proportion of 843 pts. Na<sub>2</sub>S to 1 pt. Au. (Becker, Sill. Am. J. (3) 33, 199.)

In finely divided state Au is sol. in boiling KCN+Aq. Not attacked by boiling HgCl<sub>2</sub>+Aq. (Vogel, J. pr. 20, 366.)

Solubility of Au (disks) in KCN+Aq with (A) oxygen passed through solution, and (B) agitated with oxygen.

% KCN	g. Au dissolved in 24 hours	
	A	B
1	0.00845	0.0187
5	0.01355	0.0472
20	0.0115	0.0314
50	0.00505	0.108

(MacLaurin, Chem. Soc. 1893, 63, 729.)

The solution of Au in KCN+Aq is essentially hastened by sunlight. (Caldecott, Proc. Chem. Soc. 1904, 20, 199.)

The presence of oxygen is necessary for the solution of Au in KCN+Aq. The rate of solution of Au in KCN+Aq varies with the strength of the solution, being small for conc. solutions, increasing as the solution becomes more dilute, reaching a maximum at 0.25% KCN, and then again diminishing. (MacLaurin, Chem. Soc. 1895, 67. 211.)

Solubility of Au (strips) in dil. KCN+Aq.

% KCN	Mg. Au dissolved in 24 hours
0	0.010
0.0005	0.043-0.07
0.001	0.10-0.23
0.0016	0.16
0.002	0.44
0.00325	1.77
0.004	4.29
0.008	48.43
0.016	74.96
0.0325	150.54
0.065	168.12

(Christy, Elektrochem. Z. 1901, 7. 205.)

Finely divided metallic gold is completely sol. at the ord. temp. in solutions of potassium ferrocyanide. Solution takes place very slowly even when the potassium ferrocyanide solution is boiling. (Beutel, Z. anorg. 1912, 78. 158.)

Sol. in  $\text{RbCl}_4$ +Aq. (Erdmann, Arch. Pharm. 1894, 232. 30.)

Not attacked by  $\text{FeCl}_3$ +Aq when air is excluded but very energetically attacked in presence of HCl and oxygen. (McIlhiney, Am. J. Sci., 1896, (4), 2. 293.)

Not attacked by several days heating with  $\text{SOCl}_2$  at  $150^\circ$ . At  $200^\circ$  there is sl. action in 10 days. (North, J. Am. Chem. Soc. 1912, 34. 892.)

$\text{SO}_2\text{Cl}_2$  in excess dissolves pulverulent Au by several hours heating at  $160^\circ$ . (North, Bull. Soc. (4), 9. 647.)

Sol. in  $\text{PCl}_5$ . (Baudrimont, A. ch. (4) 2. 416.)

Easily sol. in acid solutions of thiocarbamide especially in presence of suitable oxidising compounds. (Moir, Chem. Soc. 1906, 89. 1345.)

#### Gold arsenide, $\text{AuAs}$ .

$\text{H}_2\text{O}$  or alcohol slowly extracts As;  $\text{HNO}_3$ +Aq converts into Au and  $\text{H}_2\text{AsO}_4$ . Sol. in aqua regia. Not attacked by cold, decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Tivoli, C. C. 1887. 778; J. B. 1887. 610.)

#### Gold bismuthide, $\text{AuBi}$ .

Min. *Maldonite*. Sol. in aqua regia.

#### Aurous bromide, $\text{AuBr}$ .

Insol. in  $\text{H}_2\text{O}$ . (Thomsen, C. C. 1860. 606.)

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ .

Sol. in  $\text{NH}_4\text{OH}$ +Aq. with decomp.

Decomp. by HBr and KBr+Aq. Sol. in KCN+Aq without decomp. Slowly decomp. by alcohol, ether, acetone and moist  $\text{CHCl}_3$ . (Lengfeld, Am. Ch. J. 1901, 26. 325.)

#### Gold (auroauric) bromide, $\text{Au}_2\text{Br}_4$ .

Not deliquescent.  $\text{H}_2\text{O}$  or ether dissolves out  $\text{AuBr}_3$ . (Thomsen, C. C. 1860. 606.)

Does not exist. (Krüss, B. 20. 640.)

Existence is maintained by Petersen. (J. pr. (2) 46. 334.)

#### Auric bromide, $\text{AuBr}_3$ .

Not deliquescent. Slowly sol. in  $\text{H}_2\text{O}$ , more readily in ether.

Can be recryst. from  $\text{AsBr}_3$ ,  $\text{SbBr}_3$ ,  $\text{TiBr}_3$  or  $\text{SnBr}_3$ . (Lindet, Bull. Soc. 1886, (2) 45. 149.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

#### Aurous phosphorus tribromide, $\text{AuBr}$ , $\text{PBr}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lindet, J. pr. (2) 32. 494.)

#### Auric phosphorus pentabromide, $\text{AuBr}_3$ , $\text{PBr}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lindet.)

#### Aurous bromide phosphorus trichloride, $\text{AuBr}$ , $\text{PCl}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Lindet.)

#### Auric praseodymium bromide,

$\text{PrBr}_3$ ,  $\text{AuBr}_3$ + $10\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sol. in conc HBr. (Von Schule, Z. anorg. 1898, 18. 355.)

#### Aurous bromide ammonia,

$\text{AuBr}$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$  and dil. HCl.

Sol. in aqua regia. (Meyer, C. R. 1906, 143. 281.)

#### Gold carbide, $\text{Au}_2\text{C}_3$ .

Ppt. Decomp. by boiling  $\text{H}_2\text{O}$  without evolution of  $\text{C}_2\text{H}_2$ . Decomp. by HCl with evolution of  $\text{C}_2\text{H}_2$ . (Mathews, J. Am. Chem. Soc. 1900, 22. 110.)

#### Aurous chloride, $\text{AuCl}$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby into Au and  $\text{AuCl}_3$ . (Thomsen, J. pr. (2) 13. 341.)

Insol. in  $\text{H}_2\text{O}$  and dil.  $\text{HNO}_3$ .

Decomp. by conc.  $\text{HNO}_3$  to Au and  $\text{AuCl}_3$ .

Sol. in HCl, HBr and in sol. of alkali chloride and bromides, with decomp.

Decomp. by alcohol, ether and acetone. (Lengfeld, Am. Ch. J. 1901, 26. 324.)

**Gold (auric) chloride,  $\text{AuCl}_3$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . Sol. in 1.47 pts.  $\text{H}_2\text{O}$ . (Abl.) Sol. in conc.  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq without decomp.

$\text{AsCl}_3$  dissolves about 22% at  $160^\circ$  and 2.5% at  $15^\circ$ . Solubility in  $\text{SbCl}_3$  is about the same. Much less sol. in  $\text{SnCl}_4$  or  $\text{TiCl}_4$ ,  $\text{SnCl}_4$  dissolving 4% at  $160^\circ$  and hardly a trace at  $0^\circ$ . Very sl. sol. in hot or cold  $\text{SiCl}_4$ . (Lindet, Bull. Soc. (2) 45. 149.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin and Kraus, Am. Ch. J. 1898, 20. 829.)

Sol. in alcohol with gradual decomp. (Gmelin.) Sol. in ether with decomp. in light or on long standing. Ether extracts  $\text{AuCl}_3$  from  $\text{AuCl}_3$ +Aq (Proust). Sol. in volatile oils with gradual decomp.

Sol. in ether. (Mylius, Z. anorg. 1911, 70. 207.)

Very sol. in ether. (Willstätter, B. 1903, 36. 1830.)

Completely sol. in ether. (Frank, C. C. 1913, II. 541.)

Insol. in or decomp. by alcohol, ether,  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ , oil of turpentine, pentane, hexane,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl nitrate, nitrobenzol, ethyl acetate, ethyl propionate and pyridine. (Lenher, J. Am. Chem. Soc. 1903, 25. 1138.)

+ $2\text{H}_2\text{O}$ . (Thomsen.)

**Auroauric chloride,  $\text{Au}_2\text{Cl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{AuCl}_3$  and  $\text{AuCl}$ . (Thomsen, J. pr. (2) 13. 357.)

Does not exist. (Krüss and Schmidt, J. pr. (2) 38. 77.)

Existence is maintained by Christensen. (J. pr. (2) 46. 328.)

**Auric chloride with  $\text{MCl}$ .**

See Chloraurate,  $\text{M}$ .

**Auric nitrosyl chloride,  $\text{AuCl}_2$ ,  $\text{NOCl}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Sudborough, Chem. Soc. 59. 662.)

**Aurous phosphorus trichloride,  $\text{AuCl}$ ,  $\text{PCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in about 100 pts.  $\text{PCl}_3$  at  $15^\circ$ , and about 8 pts. at  $120^\circ$ . Sol. in  $\text{AsCl}_3$ . (Lindet, C. R. 101. 1492.)

**Auric phosphorus pentachloride,  $\text{AuCl}_3$ ,  $\text{PCl}_5$ .**

Decomp. by  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{PCl}_5$ . Sol. in  $\text{AsCl}_3$ . (Lindet.)

**Aurous potassium chloride,  $\text{AuCl}$ ,  $\text{KCl}$ .**

Decomp. by  $\text{H}_2\text{O}$  or  $\text{HCl}$ +Aq into  $\text{KCl}$ ,  $\text{KAuCl}_4$ , and  $\text{Au}$ . (Berzelius.)

**Auric potassium chloride.**

See Chloraurate, potassium.

**Auric selenium chloride,  $\text{AuCl}_3$ ,  $\text{SeCl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{AsCl}_3$ . (Lindet, C. R. 101. 1492.)

**Gold (aurous) sodium chloride,  $\text{AuCl}$ ,  $\text{NaCl}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Meillet, J. Pharm. 3. 447.)

Formula is  $4\text{NaCl}$ ,  $\text{AuCl}$ ,  $\text{AuCl}_3$ . (Jörgensen.)

**Auric sodium chloride.**

See Chloraurate, sodium.

**Auric sulphur chloride,  $\text{AuCl}_3$ ,  $\text{SCl}_2$ .**

Easily decomp. by  $\text{H}_2\text{O}$ . (Lindet, C. R. 101. 1492.)

**Aurous chloride ammonia,  $\text{AuCl}$ ,  $\text{NH}_3$ .**

Ppt. Unstable. (Diemer, J. Am. Chem. Soc. 1913, 35. 554.)

$\text{AuCl}$ ,  $3\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$  and dil. acids.

Sol. in aqua regia. Sol. in conc.  $\text{H}_2\text{SO}_4$  with decomp. (Meyer, C. R. 1906, 143. 282.)

$\text{AuCl}$ ,  $12\text{NH}_3$ . (Meyer.)

**Auric fluoride,  $\text{AuF}_3$ .**

Very unstable.

Is incapable of existence not only in presence of  $\text{H}_2\text{O}$  but under the ordinary conditions met with in the laboratory and in nature. (Lenher, J. Am. Chem. Soc. 1903, 25. 1138.)

**Auric hydroxide,  $\text{AuO}_2\text{H}_3$ .**

Nearly insol. in most acids. Easily sol. in very conc.  $\text{HNO}_3$ +Aq (Proust), from which all  $\text{AuO}_2\text{H}_3$  is separated by dilution (Fremy). Extremely al. sol. in fuming  $\text{HNO}_3$ . Sol. in dil.  $\text{HNO}_3$ +Aq when pure (Krüss, A. 237. 281). Not attacked by  $\text{H}_3\text{PO}_4$ . Insol. in  $\text{HF}$ . Sol. in  $\text{HCl}$ , or  $\text{HBr}$ +Aq (Fremy).

Sol. in  $\text{H}_2\text{SeO}_4$ +Aq. (Mitscherlich.)

Sl. sol. in conc.  $\text{H}_2\text{SO}_4$ ; somewhat sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq. (Rose.)

Nearly insol. in cold  $\text{KOH}$ +Aq, but dissolved on boiling. Insol. in  $\text{NH}_4\text{OH}$ +Aq or alkali carbonates + Aq (Rose). Sl. sol. in boiling  $\text{CaCl}_2$ +Aq,  $\text{NaCl}$ +Aq,  $\text{BaCl}_2$ +Aq (Pelletier). Sol. in  $\text{NH}_4\text{CN}$ , and  $\text{KCN}$ +Aq (Himly).

Sl. sol. in  $\text{KCl}$ , or  $\text{NaCl}$ +Aq. (Pelletier.)

Sol. in  $\text{K}_4\text{Fe}(\text{CN})_6$ +Aq at ord. temp. rapidly on boiling. (Beutel, Z. anorg. 1912, 78. 154.)

$\text{AuO}$ ,  $\text{OH}=\text{Au}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ . (Krüss.)

**Auroauric hydroxide,  $\text{Au}_2\text{O}_3(\text{OH})_2=3\text{Au}_2\text{O}_3+2\text{H}_2\text{O}$ .**

Insol. in boiling conc.  $\text{KOH}$ +Aq. Decomp. by conc.  $\text{HCl}$  or  $\text{HNO}_3$ +Aq into  $\text{Au}$  and  $\text{Au}_2\text{O}_3$ , which dissolves. (Schöttlander, A. 217. 336.)

**Aurous iodide,  $\text{AuI}$ .**

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3$ +Aq, with separation of  $\text{Au}$ . Decomp. immediately by ether, more slowly by alcohol.

Partially sol. in KI,  $\text{FeI}_3$ , or  $\text{HI} + \text{Aq}$  (Pelletier). Sl. attacked by  $\text{NH}_4\text{OH}$ , or  $\text{NaCl} + \text{Aq}$  at  $35^\circ$  (Fordos). Instantly decomp. by  $\text{KOH} + \text{Aq}$ .

**Gold (auric) iodide,  $\text{AuI}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in alkali iodides, and  $\text{HI} + \text{Aq}$ . Decomp. on air or by alkalis. (Johnston, Phil. Mag. J. 9. 286.)

**Aurous iodide ammonia,  $\text{AuI}, \text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  or dil. acids. (Meyer, C. R. 1906, 143. 281.)

Sol. in aqua regia.

$\text{AuI}, 6\text{NH}_3$ . (Meyer.)

**Aurous oxide,  $\text{Au}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. Decomp. by boiling with  $\text{HCl} + \text{Aq}$  into Au and  $\text{AuCl}_3$ .  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  do not attack. Sol. in cold aqua regia. Sol. in  $\text{HI} + \text{Aq}$ . Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when freshly precipitated. (Berzelius.)

According to Krüss (A. 237. 281) all hitherto prepared  $\text{Au}_2\text{O}$  is impure. Pure  $\text{Au}_2\text{O}$  is sol. in cold  $\text{H}_2\text{O}$  when freshly precipitated, from which hydroxide is precipitated by boiling. Partly sol. in  $\text{HCl}$ , or  $\text{HBr} + \text{Aq}$ . Sol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  when freshly precipitated. Not affected by any other acid or solvent. (Krüss.)

The so-called solution of  $\text{Au}_2\text{O}$  in  $\text{H}_2\text{O}$  is in reality a colloidal suspension. (Vanino, B. 1905, 38. 462.)

**Auric oxide,  $\text{Au}_2\text{O}_3$ .**

See Auric hydroxide.

**Auroauric oxide,  $\text{Au}_2\text{O}_2$ .**

Sol. in cold  $\text{HCl} + \text{Aq}$ ; forms insol. comp. with HF. (Prat, C. R. 70. 842.)

Obtained pure by Krüss (A. 237. 296.)

**Gold phosphide,  $\text{Au}_3\text{P}_2$ .**

Not attacked by  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3$  forms  $\text{H}_3\text{PO}_4$ , and leaves undissolved Au. (Schrötter, J. B. 1849. 247.)

$\text{Au}_3\text{P}_2$ . Decomp. on air or with  $\text{H}_2\text{O}$ . (Cavassi, Gazz. ch. it. 15. 40.)

$\text{Au}_3\text{P}_2$ . Readily attacked by aqua regia or  $\text{Cl}_2 + \text{Aq}$ . (Granger, C. R. 1897, 124. 498.)

**Gold purple (mixture of Au and  $\text{SnO}_2$ ).**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in aqua regia.

$\text{HCl} + \text{Aq}$  dissolves all Sn and leaves Au. Boiling  $\text{HNO}_3 + \text{Aq}$  dissolves a little Sn.

Insol. in boiling  $\text{KOH} + \text{Aq}$  (Berzelius).  $\text{KOH} + \text{Aq}$  extracts excess of  $\text{SnO}_2$ , and the residue becomes sol. in  $\text{H}_2\text{O}$ , from which it is pptd. by  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Figuier, A. ch. (3) 11. 353.)

Sol., when still moist, in  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol. if it has been dried.

Obtained in colloidal state in aqueous solution containing 0.58 g. Au. and 5.41 g.  $\text{SnO}_2$

in a litre. This solution may be concentrated without coagulation. The solution is coagulated by dil.  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , more easily by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; also by  $\text{KCl}$ ,  $\text{HgCl}_2$ ,  $\text{FeSO}_4 + \text{Aq}$ , and many other salts. Not coagulated by alcohol, but easily when ether is added to the alcohol. (Schneider, Z. anorg. 5. 80.)

**Gold (auric) selenide,  $\text{Au}_2\text{Se}_3$ .**

$\text{HNO}_3 + \text{Aq}$  dissolves out Se. Sol. in aqua regia or alkali sulphides +  $\text{Aq}$ . (Uelsmann, J. B. 1860. 90.)

**Aurous sulphide,  $\text{Au}_2\text{S}$ .**

Easily sol. in  $\text{H}_2\text{O}$  when freshly prepared, but precipitated from aqueous solution by  $\text{HCl}$ ,  $\text{KCl}$ , or  $\text{NaCl} + \text{Aq}$ . When dried is insol. in  $\text{H}_2\text{O}$ .

Insol. in boiling dil. or conc.  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in aqua regia,  $\text{HCl} + \text{Aq}$  with  $\text{KClO}_3$ , etc. Slowly sol. in alkali monosulphides +  $\text{Aq}$ . Easily sol. in polysulphides +  $\text{Aq}$ .

Insol. in  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ . (Krüss, B. 20. 2369.)

Known also in colloidal state in aqueous solution containing 1.74 g.  $\text{Au}_2\text{S}$  per l. (Schneider, B. 24. 2241.)

**Auric sulphide,  $\text{Au}_2\text{S}_3$ .**

Insol. in  $\text{H}_2\text{O}$  and acids except aqua regia; sol. in alkali sulphides, or  $\text{KOH} + \text{Aq}$ . (Berzelius.)

Does not exist (Krüss, B. 22. 2369), but has since been made by Antony and Luchesi (Gazz. ch. it. 20. 601). Insol. in  $\text{HCl}$ , or dil.  $\text{HNO}_3 + \text{Aq}$ . Decomp. by conc.  $\text{HNO}_3$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  with separation of Au. Sl. decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $\text{KCN} + \text{Aq}$ ; decomp. by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sol. in cold  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$ ; decomp. on boiling. (Antony and Luchesi, Gazz. ch. it. 21, 2. 209.)

Insol. in ether. (Hofmann, B. 1904, 37. 246.)

**Auroauric sulphide,  $\text{Au}_2\text{S}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or acids except aqua regia. Sl. sol. in cold alkali monosulphides +  $\text{Aq}$ , but easily sol. on warming. Sol. in cold polysulphides +  $\text{Aq}$ , but less in ammonium polysulphide than the other alkali polysulphides.

Not attacked by cold, but easily sol. in hot  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{KCN} + \text{Aq}$ . (Hoffmann and Krüss, B. 20. 2704.)

Obtained also in colloidal state in aqueous solution containing 0.8 g. per l. (Schneider.)

Insol. in  $\text{Na}_2\text{S} + \text{Aq}$  sat. with S. (Ditte, A. ch. 1907, (8) 12. 273.)

**Aurous potassium sulphide,  $\text{Au}_2\text{S}, 3\text{K}_2\text{S}$ .**

(Antony and Luchesi, Gazz. ch. it. 1896, 26. (2) 350.)

$\text{Au}_2\text{S}$ ,  $4\text{K}_2\text{S}+12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 1895, 120. 322.)

Gold silver sulphide,  $\text{Ag}_2\text{AuS}_2$ .

Ppt. (Lucchesi, Gazz. ch. it. 1896, 26. 350-53.)

Aurous sodium sulphide,  $\text{NaAuS}+4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Yorke, Chem. Soc. Q. J. 1. 236.)

$+5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 1895, 120. 321.)

$\text{Na}_2\text{AuS}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Lucchesi, Gazz. ch. it. 1896, 26. 350-53.)

$\text{Au}_2\text{S}$ ,  $2\text{Na}_2\text{S}+20\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 1895, 120. 321.)

Gold telluride.

Ppt. (Berzelius, Pogg. 8. 178.)

Gold silver telluride,  $\text{Au}_2\text{Te}_2$ ,  $\text{Ag}_2\text{Te}$ .

Min. *Sylvanite*. Sol. in  $\text{HNO}_3$ +Aq with separation of Au, in aqua regia with separation of AgCl.

$3\text{Ag}_2\text{Te}$ ,  $\text{Au}_2\text{Te}$ . Min. *Petsile*.

Hartshorn, salts of.

See Carbonate carbamate, ammonium hydrogen.

Helium, He.

Coefficient of absorption for  $\text{H}_2\text{O}$  at  $18.2^\circ=0.0073$ . (Ramsay, Z. phys. Ch. 1906, 55. 347.)

Absorption of helium by  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm. pressure.

$t^\circ$	Coefficient of absorption
0	0.01500
0.5	0.01487
5	0.01460
10	0.01442
15	0.01396
20	0.01386
25	0.01371
30	0.01362
35	0.01360
40	0.01387
45	0.01403
50	0.01404

(Estreicher, Z. phys. Ch. 1899, 31. 184.)

Absorption by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption
0	0.0134
10	0.0100
20	0.0138
30	0.0161
40	0.0191
50	0.0226

(Antropoff, Roy. Soc. Proc. 1910, 83. A 480.)

Completely insol. in benzene and in alcohol (Ramsay, Chem. Soc. 1895, 67. 684.)

Hexamine chromium compounds.

See Luteochromium compounds.

Hexamine cobaltic compounds,

$\text{Co}_2(\text{NH}_3)_4\text{X}_6$ .

See Dichrocoaltic compounds.

$\text{Co}(\text{NH}_3)_4\text{X}_3$ .

See Luteocobaltic compounds.

Hexamine iridium chloride,  $\text{Ir}_2(\text{NH}_3)_4\text{Cl}_6$ .

See Iridotriamine chloride.

Hexathionic acid,  $\text{H}_2\text{S}_6\text{O}_4$ .

Known only in aqueous solution, which decomposes rapidly, even in presence of free sulphuric acid. (Debus, A. 244. 76.)

Potassium hexathionate,  $\text{K}_2\text{S}_6\text{O}_4$ .

Sol. in  $\text{H}_2\text{O}$ , with rapid decomp. Not obtained in pure state. (Debus, A. 244. 76.)

Holmium, Ho.

Holmium oxide,  $\text{Ho}_2\text{O}_3$ .

(Cleve, C. R. 89. 478; 91. 328.)

Consists of at least two elements. (Lecoq de Boisbaudran, C. R. 102. 1005.)

Consists of seven elements. (Krüss and Nilson.)

See *quihydraurylamine*,  $(\text{AuOH})_2\text{N}$ ,  $\text{NH}_2=\text{Au}_2\text{N}_2+3\text{H}_2\text{O}$ .

Decomp. by boiling with  $\text{H}_2\text{O}$ . (Raschig, A. 235. 341.)

Hydrazidophosphoric acid.

Barium hydrazidophosphate,

$\text{OP}(\text{N}_2\text{H}_2)_2\text{O}_2\text{Ba}$ .

(Ephraim, B. 1911, 44. 3420.)

Lead hydrazidophosphate,  $\text{OP}(\text{N}_2\text{H}_2)_2\text{O}_2\text{Pb}$ .

Easily sol. in  $\text{HNO}_3$ . (Ephraim.)

Potassium hydrazidophosphate,

$\text{OP}(\text{N}_2\text{H}_2)_2(\text{OK})_2$ . (Ephraim.)

Sodium hydrazidophosphate,

$\text{OP}(\text{N}_2\text{H}_2)_2(\text{ONa})_2$ .

Can be cryst. from dil. alcohol. (Ephraim.)

Hydrazine,  $\text{N}_2\text{H}_4=\text{NH}_2-\text{NH}_2$ .

Very sol. in  $\text{H}_2\text{O}$ . (Curtius, B. 20. 1632.)

Very hygroscopic; decomp. by  $\text{H}_2\text{O}$ ; solvent for sulphur, KCl, KBr,  $\text{KNO}_3$ . (de Bruyn, R. t. c. 1894, 13. 433-40; Chem. Soc. 1895, 68 (2) 347.)

Mixes in all proportions with alcohols; al. sol. in organic solvents. (Lobry de Bruyn, Chem. Soc. 1897, 72 (2) 22.)

**Hydrazine amidosulphonate,**  
 $N_2H_4, HSO_3, NH_2$ .

Very sol. in  $H_2O$ . (Sabanejeff, Z. anorg. 1899, 20, 22.)

**Hydrazine azoimide,  $N_2H_4, HN_3$ .**

Deliquescent. Easily sol. in  $H_2O$ . Sl. sol. in alcohol, and can be crystallised therefrom. (Curtius, B. 24. 2344.)

**Hydrazine borate,  $(N_2H_4)_2(B_2O_3)_2$ .**

Sol. in  $H_2O$ . (Dschawachow, C. C. 1902, I. 1394.)

$(N_2H_4)_2(H_2B_2O_7)_2$ . Sol. in  $H_2O$ . (Dschawachow, C. C. 1902, I. 1394.)

+5 $H_2O$ . Sol. in  $H_2O$ . (Dschawachow, C. C. 1902, I. 1394.)

+10 $H_2O$ . Ppt. (Dschawachow, C. C. 1902, I. 1394.)

**Hydrazine cuprous bromide chloride,**

$N_2H_4Cl, N_2H_4Br, 3CuBr$ .

(Ranfaldi, Real. Ac. Linc. 1906 (5) 15, II, 95.)

**Hydrazine mercuric bromide,**

$HgBr_2, 2(N_2H_4, HBr) + H_2O$ .

Very sol. in  $H_2O$ , sol. in alcohol and acetone. Sl. sol. in acetic ether.

Insol. in ethyl ether. (Ferratini, C. A. 1912. 1612.)

**Hydrazine zinc bromide,  $2N_2H_4HBr, ZnBr_2 + H_2O$ .**

Very sol. in  $H_2O$ ; sol. in alcohol and acetone. (Ferratini, C. A. 1912. 1612.)

**Hydrazine carbonate.**

Very deliquescent, but only sl. sol. in  $H_2O$ . Sl. sol. in alcohol. (Curtius and Jay, J. pr. 1889, (2) 39. 41.)

**Hydrazine zinc carbonate hydrazine,**

$Zn(CO_3, NH, NH_3)_2, 2N_2H_4$ .

Easily sol. in  $H_2O$ . (Ebeler and Schott, J. pr. 1909, (2) 79, 72.)

**Hydrazine chlorate,  $N_2H_4, HClO_3$ .**

Very sol. in  $H_2O$ ; sl. sol. in alcohol. Insol. in ether,  $CHCl_3$  and benzol. (Salvadori, Gazz. ch. it. 1907, 37, (2) 32.)

**Hydrazine dichlorate,  $N_2H_4, 2HClO_3$ .**

Ppt. Decomp. in aq. solution. (Turrentine, J. Am. Chem. Soc. 1915, 37. 1123.)

**Hydrazine cupric chloride,  $N_2H_4Cl, CuCl_2 + \frac{1}{2}H_2O$ .**

Decomp. by  $H_2O$ . (Ranfaldi, Real. Ac. Linc. 1906, (5) 15, II. 95.)

+2 $H_2O$ . Decomp. by  $H_2O$ . (Ranfaldi.)

**Hydrazine mercuric chloride,  $N_2H_4Cl, HgCl_2$ .**  
(Hoffmann and Marburg, A. 1899, 305. 221.)**Hydrazine dithionate,  $N_2H_4, H_2S_2O_6$ .**

Sol. in  $H_2O$ ; decomp. on standing in aq. solution. (Sabanejeff, Z. anorg. 1899, 20, 21.)

$2N_2H_4, H_2S_2O_6$ . Sol. in  $H_2O$ . (Sabanejeff.)

**Hydrazine fluosilicate,  $N_2H_4, H_2SiF_6$ .**

Easily sol. in  $H_2O$ .

Difficultly sol. in ethyl and methyl alcohol. (Ebeler, J. pr. 1910, (2) 81. 552.)

**Hydrazine fluotitanate,  $(N_2H_4)_2, H_2TiF_6 + 2H_2O$ .**

Ppt. Sol. in  $H_2O$ . (Ebeler, J. p. r. 1910, (2) 81. 555.)

**Hydrazine monohydrobromide,  $N_2H_4, HBr$ .**

Very easily sol. in  $H_2O$  or hot alcohol. (Curtius and Schultz, J. pr. (2) 42. 537.)

**Hydrazine dihydrobromide,  $N_2H_4, 2HBr$ .**

Easily sol. in  $H_2O$ . Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) 42. 535.)

**Hydrazine monohydrochloride,  $N_2H_4, HCl$ .**

Extremely sol. in  $H_2O$ . Sl. sol. in boiling absolute alcohol. (Curtius and Jay, J. pr. (2) 39. 38.)

**Hydrazine dihydrochloride,  $N_2H_4, 2HCl$ .**

Easily sol. in cold  $H_2O$ ; sl. sol. in hot alcohol. (Curtius, l. c.)

Sol. in 2.67 pts.  $H_2O$  at 23°. Sp. gr. of sat. solution at 20°/4° = 1.4226. (Schiff, Z. phys. Ch. 1896, 21. 292.)

Sp. gr. of aqueous solution at 20°.

% salt	Sp. gr.
25	1.1183
20	1.0923
15	1.0675
10	1.0436
5	1.0206

(Schiff, Z. phys. Ch. 1896, 21. 292.)

Nearly insol. in hot absolute alcohol. (Curtius and Jay, J. pr. (2) 39. 37.)

**Hydrazine dihydrofluoride,  $N_2H_4, 2HF$ .**

Easily sol. in  $H_2O$ . Nearly insol. in alcohol. (Curtius and Schulz, J. pr. (2) 42. 533.)

**Hydrazine monohydroiodide,  $N_2H_4, HI$ .**

Easily sol. in  $H_2O$ . (Curtius and Schulz.)

**Hydrazine dihydroiodide,  $N_2H_4, 2HI$ .**

Very deliquescent. Easily sol. in  $H_2O$ . Sl. sol. in alcohol. (Curtius and Schulz, J. pr. (2) 42. 536.)

**Trihydrazine dihydroiodide**,  $3\text{N}_2\text{H}_4 \cdot 2\text{HI}$ .

Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Curtius and Schulz, J. pr. (2) 42. 540.)

**Hydrazine hydroxide**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{O}$ .

Miscible with  $\text{H}_2\text{O}$  or alcohol, but not with ether, chloroform, or benzene. (Curtius and Schulz, J. pr. (2) 42. 530.)

**Hydrazine hypophosphate**,  $\text{N}_2\text{H}_4 \cdot \text{H}_4\text{P}_2\text{O}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . 1.5 pts. dissolve in 100 pts.  $\text{H}_2\text{O}$ . (Sabanejeff, Z. anorg. 1898, 17. 490.)

**Hydrazine hypophosphate ammonia**,  
 $\text{N}_2\text{H}_4 \cdot \text{H}_4\text{P}_2\text{O}_6 \cdot \text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Sabanejeff, Z. anorg. 1899, 20. 23.)

**Hydrazine mercuric iodide**,  
 $2\text{N}_2\text{H}_4 \cdot \text{HgI}_2 \cdot \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , alcohol, acetone, acetic ether.

Insol. in ether. Excess of  $\text{H}_2\text{O}$  decomp. (Ferratini, Gazz. ch. it. 1912, 42. (1), 172.)

**Hydrazine zinc iodide**,  
 $\text{ZnI}_2 \cdot 2\text{N}_2\text{H}_4 \cdot \text{HI} + \frac{1}{2}\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sol. in alcohol and acetone. (Ferratini, C. A. 1912. 1612.)

**Hydrazine nitrate**,  $\text{N}_2\text{H}_4 \cdot \text{HNO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in abs. alcohol. (Sabanejeff, Z. anorg. 1899, 20. 24.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{N}_2\text{H}_4 \cdot \text{HNO}_3$ per 100 g.	
	Sat. solution	$\text{H}_2\text{O}$
10	63.63	174.9
15	68.47	217.2
20	72.70	266.3
25	76.61	327.5
30	80.09	402.2
35	83.06	490.3
40	85.86	607.2
45	88.06	737.6
50	91.18	1034.
55	93.58	1458.
60	95.51	2127.

(Sommer, Z. anorg. 1914, 86. 85.)

$\text{N}_2\text{H}_4 \cdot 2\text{HNO}_3$ . Very unstable.

Sol. in  $\text{H}_2\text{O}$  but solution cannot be concentrated beyond 30% without decomp.

Decomp. by abs. alcohol.

Very sol. in hydrazine hydroxide + Aq. (Sabanejeff, Z. anorg. 1898, 20. 25.)

**Hydrazine nitrite**,  $\text{N}_2\text{H}_4 \cdot \text{HNO}_2$ .

Very sol. in  $\text{H}_2\text{O}$ . IPptd. by ether from solution in alcohol; insol. in ether.

Very hygroscopic. (Sommer, Z. anorg. 1913, 83. 125.)

**Hydrazine perchlorate**,  $\text{N}_2\text{H}_4 \cdot \text{HClO}_4 + 2\text{H}_2\text{O}$ .

Sol. in 1.48 pts.  $\text{H}_2\text{O}$  at  $30^\circ$  and 34 pts. alcohol; crystallises from boiling absolute alcohol. (Salvadori, Ch. Z. 31. 680.)

+  $3\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{N}_2\text{H}_4 \cdot \text{HClO}_4$	Sp. gr.
18	41.72	1.264
35	66.9	1.391

(Carlson, Dissert. 1910.)

**Hydrazine diperchlorate**,  $\text{N}_2\text{H}_4 \cdot 2\text{HClO}_4 + 2\text{H}_2\text{O}$ .

Efflorescent.

Deliquescent.

102 pts. salt sol. in 100 pts.  $\text{H}_2\text{O}$  at  $29^\circ$ .

2.8 pts. salt sol. in 100 pts. alcohol.

1.0 pt. " " " 100 " ether.

(Turrentine, J. Am. Chem. Soc. 1915, 37. 1123.)

**Hydrazine phosphate**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{PO}_4$ .

Very sol. in  $\text{H}_2\text{O}$ . (Sabanejeff, Z. anorg. 1898, 17. 488.)

$\text{N}_2\text{H}_4 \cdot 2\text{H}_2\text{PO}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Sabanejeff.)

**Hydrazine phosphite**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{PO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Sabanejeff, Z. anorg. 1898, 17. 468.)

**Hydrazine hydrogen phosphite**,  
 $\text{N}_2\text{H}_4 \cdot 2\text{H}_2\text{PO}_3$ .

Less sol. in  $\text{H}_2\text{O}$  than the normal salt. (Sabanejeff.)

**Hydrazine selenate**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{SeO}_4$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Rimini, C. C. 1907, I. 86.)

**Hydrazine zinc selenate**,  
 $(\text{N}_2\text{H}_4)_2\text{SeO}_4 \cdot \text{ZnSeO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$  but more sol. than Cu salt. (Rimini and Malagnini, Gazz. ch. it. 1907, 37. (1), 265.)

**Hydrazine sulphocyanide**,  $\text{N}_2\text{H}_4 \cdot \text{HSCN}$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Curtius and Herdenreich, J. pr. 1895, [2] 62. 488.)

**Hydrazine sulphate**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{SO}_4$ .

Sol. with difficulty in cold, easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Curtius, l. c.)

100 pts.  $\text{H}_2\text{O}$  dissolve 3.055 pts. salt at  $22^\circ$ . (Curtius and Jay, J. pr. (2) 39. 39.)

$2\text{N}_2\text{H}_4 \cdot \text{H}_2\text{SO}_4$ . Very deliquescent, and

sol. in  $H_2O$ . Insol. in alcohol. (Curtius, J. pr. (2) 44. 101.)

**Hydrazine sulphite**,  $(N_2H_4)_2H_2SO_3$ .  
(Sabanejeff, Z. anorg. 1899, 20, 24.)

**Hydrazine pyrosulphite**,  $2N_2H_4 \cdot H_2S_2O_5$ .  
Sol. in  $H_2O$  with decomp.; insol. in alcohol. (Sabanejeff, Z. anorg. 1899, 20, 23.)

**Hydrazine thiosulphate**,  $(N_2H_4)_2H_2S_2O_4$ .  
Ppt. (Not pure.) (Ferratini, Gazz. ch. it. 1912, 42. (1) 138.)

**Hydrazine lead thiosulphate**,  
 $PbS_2O_5 \cdot 2(N_2H_4)_2H_2S_2O_4 + H_2O$ .  
Insol. in  $H_2O$  and alcohol.  
Sol. in  $HCl + Aq$  and in  $HNO_3 + Aq$ . (Ferratini, C. A. 1912. 1612.)

**Hydrazine silver thiosulphate**,  
 $Ag_2S_2O_5 \cdot (N_2H_4)_2H_2S_2O_4$ .  
Insol. in  $H_2O$ ; sol. in  $NH_4OH + Aq$  and in  $HNO_3$ . (Ferratini.)

**Hydrazine sulphinic acid**.

**Barium hydrazine disulphinate**,  
 $Ba_2N_2(SO_3)_2$ .  
Insol. in  $H_2O$ ; sol. in acids. (Ephraim, B. 1911, 44. 390.)

**Hydrazinesulphonic acid**,  $N_2H_5SO_3OH$ .  
Sol. in about 24 pts.  $H_2O$  at ord. temp. Decomp. by mineral acids; nearly insol. in alcohol and other organic solvents. (Traube, B. 1914, 47. 941.)

**Ammonium hydrazinesulphonate**,  
 $(N_2H_5SO_3)NH_4$ .  
Deliquescent; decomp. by acids. (Traube.)

**Barium hydrazinesulphonate**,  
 $(N_2H_5SO_3)_2Ba + 2H_2O$ .  
Sol. in  $H_2O$ ; pptd. by alcohol; decomp. by acids. (Traube.)

**Calcium hydrazinesulphonate**,  
 $(N_2H_5SO_3)_2Ca + H_2O$ .  
Sol. in  $H_2O$ . Decomp. by acids. Insol. in alcohol. (Traube.)

**Potassium hydrazinesulphonate**,  $N_2H_5SO_3K$ .  
Decomp. by acids. (Traube.)

**Silver hydrazinesulphonate**,  $N_2H_5SO_3Ag$ .  
(Traube.)

**Sodium hydrazinesulphonate**,  
 $N_2H_5SO_3Na + H_2O$ .  
Decomp. by acids. (Traube.)

**Strontium hydrazinesulphonate**,  
 $(N_2H_5SO_3)_2Sr + 2H_2O$ .

Sol. in  $H_2O$ . Decomp. by acids. Insol. in alcohol. (Traube.)

**Hydriodic acid**,  $HI$ .  
See Iodhydric acid.

**Hydrobromic acid**,  $HBr$ .  
See Bromhydric acid.

**Hydrochloric acid**,  $HCl$ .  
See Chlorhydric acid.

**Hydrofluorboric acid**,  $HBF_4$ .  
See Fluoborhydric acid.

**Hydrofluoric acid**,  $HF$ .  
See Fluorhydric acid.

**Hydrogen**,  $H_2$ .  
Sl. absorbed by  $H_2O$ .

Sol. in 150 pts.  $H_2O$ ; 1 vol.  $H_2O$  absorbs 0.016 vol.  $H$ . Recently boiled  $H_2O$  absorbs 1.53%  $H$ . (Henry, 1903.)  
100 vols.  $H_2O$  at  $18^\circ$  absorb 4.6 vols.  $H$ . (de Saussure, 1814.)

1 vol.  $H_2O$  absorbs 0.0193 vol.  $H$  at 760 mm. and all temperatures between  $0^\circ$  and  $23.6^\circ$ . (Bunsen.)

Later work does not confirm the above statement.

Absorption of  $H$  by  $H_2O$  at  $t$  and 760 mm.  
 $\beta$  = coefficient of absorption;  $\beta_1$  = "solubility" (see under Oxygen).

$t^\circ$	$\beta$	$\beta_1$
0	0.02153	0.02140
1	0.02134	0.02120
2	0.02115	0.02100
3	0.02097	0.02081
4	0.02079	0.02062
5	0.02061	0.02043
6	0.02044	0.02025
7	0.02027	0.02207
8	0.02010	0.01989
9	0.01994	0.01971
10	0.01978	0.01954
11	0.01962	0.01937
12	0.01947	0.01920
13	0.01932	0.01904
14	0.01918	0.01888
15	0.01903	0.01872
16	0.01889	0.01856
17	0.01876	0.01840
18	0.01863	0.01825
19	0.01850	0.01810
20	0.01837	0.01795
21	0.01825	0.01781
22	0.01813	0.01767
23	0.01802	0.01753
24	0.01791	0.01739
25	0.01780	0.01725
26	0.01770	0.01712

(Timofejeff, Z. phys. Ch. 6. 147.)



Absorption of H by  $H_2O$  at  $t^\circ$  and 760 mm.  
 $\beta$  = coefficient of absorption.

$t^\circ$	$\beta$	$t^\circ$	$\beta$	$t^\circ$	$\beta$
0	0.0203	16	0.0182	32	0.0161
1	0.0202	17	0.0180	33	0.0160
2	0.0200	18	0.0179	34	0.0159
3	0.0199	19	0.0178	35	0.0157
4	0.0198	20	0.0177	36	0.0156
5	0.0196	21	0.0175	37	0.0155
6	0.0195	22	0.0174	38	0.0154
7	0.0194	23	0.0172	39	0.0153
8	0.0192	24	0.0171	40	0.0152
9	0.0191	25	0.0170	41	0.0151
10	0.0190	26	0.0168	42	0.0150
11	0.0189	27	0.0167	43	0.0149
12	0.0187	28	0.0166	44	0.0148
13	0.0186	29	0.0164	45	0.0147
14	0.0184	30	0.0163	46	0.0146
15	0.0183	31	0.0162	47	0.0144
				48	0.0143
				49	0.0142
				50	0.0141
				51	0.0139
				52	0.0136
				53	0.0134
				54	0.0131
				55	0.0128
				56	0.0125
				57	0.0122
				58	0.0118
				59	0.0115
				60	0.0110
				61	0.0106
				62	0.0101
				63	0.0096
				64	0.0091
				65	0.0085
				66	0.0079
				67	0.0072
				68	0.0065
				69	0.0057
				70	0.0049
				71	0.0040
				72	0.0031
				73	0.0021
				74	0.0011
				75	0.0000

(Bohr and Bock, W. Ann. 44. 318.)

Absorption of hydrogen by  $H_2O$  at  $t^\circ$  and 760 mm. pressure.  $\beta$  = coefficient of absorption.  $\beta_1$  = "solubility" (see under Oxygen).

$t^\circ$	$\beta$	$\beta_1$
0	0.02148	0.02135
1	0.02126	0.02112
2	0.02105	0.02090
3	0.02084	0.02068
4	0.02064	0.02047
5	0.02044	0.02026
6	0.02025	0.02006
7	0.02007	0.01987
8	0.01989	0.01968
9	0.01972	0.01950
10	0.01955	0.01932
11	0.01940	0.01915
12	0.01925	0.01899
13	0.01911	0.01883
14	0.01897	0.01867
15	0.01883	0.01851
16	0.01869	0.01836
17	0.01856	0.01821
18	0.01844	0.01706
19	0.01831	0.01792
20	0.01819	0.01777
21	0.01805	0.01761
22	0.01792	0.01746
23	0.01779	0.01730
24	0.01766	0.01715
25	0.01754	0.01700
26	0.01742	0.01685
27	0.01731	0.01670
28	0.01720	0.01656
29	0.01709	0.01642
30	0.01699	0.01630
31	0.01692	0.01618
32	0.01685	0.01606
33	0.01679	0.01596
34	0.01672	0.01585
35	0.01666	0.01574

Absorption of hydrogen by  $H_2O$  at  $t^\circ$  and 760 mm. pressure.—Continued.

$t^\circ$	$\beta$	$\beta_1$
36	0.01661	0.01564
37	0.01657	0.01554
38	0.01652	0.01544
39	0.01648	0.01535
40	0.01644	0.01525
41	0.01640	0.01515
42	0.01635	0.01504
43	0.01631	0.01493
44	0.01627	0.01482
45	0.01624	0.01475
46	0.01620	0.01460
47	0.01617	0.01449
48	0.01614	0.01437
49	0.01611	0.01425
50	0.01608	0.01413
51	0.01606	0.01392
52	0.01605	0.01369
53	0.01603	0.01343
54	0.01602	0.01316
55	0.01600	0.01287
56	0.01600	0.01256
57	0.01600	0.01223
58	0.01600	0.01188
59	0.01600	0.01150
60	0.01600	0.01109
61	0.01600	0.01065
62	0.01600	0.01017
63	0.01600	0.00966
64	0.01600	0.00912
65	0.01600	0.00853
66	0.01600	0.00790
67	0.01600	0.00723
68	0.01600	0.00652
69	0.01600	0.00575
70	0.01600	0.00494
71	0.01600	0.00407
72	0.01600	0.00315
73	0.01600	0.00216
74	0.01600	0.00111
75	0.01600	0.0000

(Winkler, B. 24. 99.)

Critical  $t$ ,  $-232^\circ$ . (Natanson, Z. phys. Ch. 1895, 17. 43-48.)

Coefficient of absorption for  $H_2O$  = 0.01750 at  $25^\circ$ ; 0.01905 at  $20^\circ$ ; 0.02059 at  $15^\circ$ ; 0.02213 at  $10^\circ$ ; 0.02366 at  $5^\circ$ . (Braun, Z. phys. Ch. 1900, 33. 734.)

Solubility in  $H_2O$  at  $25^\circ$  = 0.01926. (Geffcken, Z. phys. Ch. 1904, 49. 267.)

Coefficient of absorption for  $H_2O$  = 0.01810 at  $20.11^\circ$ . (Hüfner, Z. phys. Ch. 1907, 57. 623.)

Solubility in  $H_2O$  at  $25^\circ$  = 0.01962. (Drucker and Moles, Z. phys. Ch. 1910, 75. 417.)

Coefficient of absorption for  $H_2O$  at  $15^\circ$  = 0.01892; at  $20^\circ$  = 0.01829. (Müller, Z. phys. Ch. 1912, 81. 493.)

Solubility of hydrogen in water at 25°.  
S = Solubility calculated according to formula, for which see original article.  
P = Pressure.

P	S	P	S
756	0.0199	1095	0.0195
757	0.0198	1097	0.0197
850	0.0200	1244	0.0202
877	0.0193	1252	0.0196
986	0.0194	1380	0.0196
992	0.0198	1393	0.0198

(Findlay, Chem. Soc. 1912, 101. 1465.)

Absorption by H<sub>2</sub>O at different pressures.

P = Hg-pressure in metres.

λ = coefficient of solubility.

Table I. Volume of the absorbing liquid = 32.32 ccm. T = 19.5°.

P	λ	P	λ
0.9010	0.01798	3.3926	0.01789
0.9967	0.01796	4.1405	0.01776
1.0809	0.01799	4.6629	0.01761
1.2133	0.01800	5.4705	0.01748
1.3711	0.01794	5.9580	0.01725
1.5448	0.01791	6.6507	0.01706
1.8002	0.01793	7.4548	0.01674
2.5208	0.01793	7.8783	0.01652
2.9971	0.01795	8.2439	0.01632

Table II. Volume of the absorbing liquid = 32.007 ccm. T = 23°.

P	λ	P	λ
1.1154	0.01736	4.6220	0.01716
1.3758	0.01739	5.1130	0.01702
1.7416	0.01733	5.9702	0.01687
2.1712	0.01731	7.1920	0.01649
2.8724	0.01734	7.4493	0.01631
3.4115	0.01732	7.8696	0.01618
4.0229	0.01728	8.1913	0.01603

(Cassuto, Phys. Zeit. 1904, 5. 235.)

Absorption of H<sub>2</sub> by acids + Aq.

M = content in gram-equivalents per liter.

S = solubility. (See under Oxygen.)

Absorption of H<sub>2</sub> by HNO<sub>3</sub> + Aq.

M	S 25°
0.741	0.01851
0.753	0.01868
1.22	0.01812
1.45	0.01782
2.09	0.01739
2.96	0.01690
3.18	0.01667
3.22	0.01633
4.13	0.01611
4.23	0.01589

(Geffcken, Z. phys. Ch. 1904, 49. 267.)

Absorption of H<sub>2</sub> by HCl + Aq.

M	S 25°
0.426	0.01875
0.432	0.01868
1.063	0.01789
1.602	0.01732
1.802	0.01699
1.928	0.01688
2.338	0.01652
2.438	0.01627
2.836	0.01606

(Geffcken.)

Absorption of H<sub>2</sub> by  $\frac{H_2SO_4}{2}$  + Aq.

M	S 25°
0.527	0.01869
0.562	0.01838
0.985	0.01780
1.122	0.01768
1.866	0.01642
1.905	0.01632
2.605	0.01575
3.045	0.01496
3.174	0.01456
3.962	0.01422
3.989	0.01402

(Geffcken.)

Solubility of H<sub>2</sub> in H<sub>2</sub>SO<sub>4</sub> + Aq at 20°.

% H <sub>2</sub> SO <sub>4</sub>	λ 20°
0	0.0208
35.82	0.00954
61.62	0.00708
95.6	0.01097

(Christoff, Z. phys. Ch. 1906, 55. 627.)

Solubility of H<sub>2</sub> in colloidal ferric hydroxide solution is practically the same as its solubility in pure H<sub>2</sub>O.

Solubility of H<sub>2</sub> in a solution containing 18.11 g. Fe(OH)<sub>3</sub> per liter at 25° = 0.3085.

Solubility of H<sub>2</sub> in a solution containing 18.309 g. Fe(OH)<sub>3</sub> per liter at 25° = 0.3083.

(Geffcken, Z. phys. Ch. 1904, 49. 299.)

Absorption of H<sub>2</sub> by bases + Aq.

M = content in gram-equivalents per liter.

S = solubility. (See under Oxygen.)

Absorption of H<sub>2</sub> by KOH + Aq.

M	S 25°
0.536	0.01658
0.715	0.01539
1.059	0.01378
1.056	0.01389
1.490	0.01195

(Geffcken, Z. phys. Ch. 1904, 49. 267.)

Absorption of  $H_2$  by  $NaOH + Aq.$ 

M	S 25°
0.543	0.01632
0.571	0.01608
0.692	0.01442
0.974	0.01409
1.059	0.01372
1.137	0.01348
1.850	0.01018
3.400	0.00648
3.430	0.00639
4.687	0.00483

(Geffken.)

Solubility of  $H_2$  in salts + Aq at 15°.

Salt	% Salt	Coefficient of absorption
$H_2O$	0.00	0.01883
$CaCl_2$	3.47	0.01619
	6.10	0.01450
	11.33	0.01138
	17.52	0.00839
	26.34	0.00519
$MgSO_4$	4.94	0.01501
	10.19	0.01159
	23.76	0.00499
$LiCl$	3.48	0.01619
	7.34	0.01370
	14.63	0.0099
$K_2CO_3$	2.82	0.01628
	8.83	0.01183
	16.47	0.00761
	24.13	0.00462
	41.81	0.00160
$KCl$	3.83	0.01667
	7.48	0.01489
	12.13	0.01279
	19.21	0.01012
	22.92	0.00892
$KNO_3$	4.73	0.01683
	8.44	0.01559
	16.59	0.01311
	21.46	0.01180
$NaNO_3$	5.57	0.01603
	11.16	0.01370
	19.77	0.01052
	37.43	0.00578
$Na_2CO_3$	2.15	0.01639
	8.64	0.01385
	11.53	0.00839
$Na_2SO_4$	4.58	0.01519
	8.42	0.0154
	16.69	0.00775

(Gordon, Z. phys. Ch. 1895, 18. 14.)

## Absorption by salts + Aq.

Salt	t°	Sp. gr. salt + Aq. at t°/4°	% Salt	t°	Absorption-coefficient at t°	Absorption-coefficient at 15° (Calculated)
$KCl$	15°	1.1565	22.92	18.62	0.00869	0.00892
		1.1294	19.21	18.82	0.00865	0.01012
		1.0794	12.13	18.71	0.01246	0.01279
		1.0480	7.48	19.00	0.01447	0.01489
		1.0240	3.83	19.23	0.01618	0.01667
$KNO_3$	15°	1.1460	21.46	17.81	0.01157	0.01180
		1.1101	16.59	17.27	0.01290	0.01311
		1.0936	14.26	16.81	0.01373	0.01391
		1.0539	8.44	17.58	0.01531	0.01559
		1.0295	4.73	17.82	0.01650	0.01683
$K_2CO_3$	15°	1.4395	41.81	13.17	0.00162	0.00160
		1.3112	30.99	12.77	0.00290	0.00285
		1.2353	24.13	12.62	0.00470	0.00462
		1.1558	16.47	12.51	0.00775	0.00761
		1.0807	8.83	11.32	0.01216	0.01183
$NaCl$	15°	1.0405	4.53	12.29	0.01532	0.01501
		1.0248	2.82	11.23	0.01675	0.01628
		1.1817	23.84	13.48	0.00602	0.00595
		1.1088	14.78	13.17	0.00938	0.00925
		1.0807	11.09	13.80	0.01140	0.1130
$NaNO_3$	15°	1.0315	4.47	13.56	0.01565	0.01548
		1.2963	37.43	17.37	0.00568	0.00578
		1.2099	27.95	17.36	0.00797	0.00810
		1.1417	19.77	17.40	0.01034	0.01052
		1.0765	11.16	17.65	0.01345	0.01370
$Na_2CO_3$	15°	1.0367	5.57	17.80	0.01572	0.01603
		1.1213	11.53	13.07	0.00851	0.00839
		1.0835	8.02	12.08	0.01106	0.01082
		1.0457	4.64	11.61	0.01420	0.01385
		1.0217	2.15	11.94	0.01677	0.01639
$Na_2SO_4$	18°	1.1608	16.69	18.41	0.00757	0.00775
	15°	1.0768	8.42	18.57	0.01223	0.01254
		1.0412	4.58	18.51	0.01482	0.01519
$LiCl$	15°	1.0843	14.63	12.77	0.01006	0.00990
		1.0416	7.34	12.40	0.01396	0.01370
		1.0192	3.48	10.47	0.01676	0.01619
$MgSO_4$	15°	1.2679	23.76	18.26	0.00487	0.00499
		1.1805	16.64	17.55	0.00783	0.00797
		1.1064	10.19	17.30	0.01140	0.01159
		1.0503	4.97	17.10	0.01479	0.01501
$ZnSO_4$	18°	1.3265	26.51	18.56	0.00590	0.00605
		1.1961	17.23	18.22	0.00940	0.00961
		1.1394	12.73	17.95	0.01181	0.01175
		1.0602	6.03	17.79	0.01496	0.01525
$CaCl_2$	15°	1.2470	26.34	17.68	0.00510	0.00519
		1.2150	23.83	17.84	0.00600	0.00619
		1.1568	17.52	18.09	0.00821	0.00839
		1.0981	11.33	18.40	0.01112	0.01138
		1.0513	6.10	18.04	0.01419	0.01450
		1.0285	3.47	18.62	0.01579	0.01619
$AlCl_3$	15°	1.2647	32.30	17.14	0.00825	0.00833
		1.1589	20.75	17.28	0.00860	0.00874
		1.0914	12.46	17.30	0.01190	0.01210
		1.0488	6.88	17.46	0.01460	0.01486
$C_{12}H_{22}O_{11}$	17.5°	1.2184	47.65	13.80	0.00900	0.00892
		1.1286	30.08	14.19	0.01292	0.01284
		1.0672	16.67	14.16	0.01571	0.01581

(Steiner, W. Ann. 1894 (2), 52. 291.)

Solubility in salt solutions.  
C = concentration of the solution in terms of normal.

$\alpha$  = coefficient of absorption.

Absorption of hydrogen by  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at 20°.

P	C	$\alpha$
1.037	0.1308	0.01872
2.167	0.2765	0.01845
3.378	0.4363	0.01823
4.823	0.6333	0.01773
6.773	0.9069	0.01744
11.550	1.6308	0.01647

(Knopp, Z. phys. Ch. 1904, 48. 103.)

Absorption of hydrogen by  $\text{KNO}_3 + \text{Aq}$  at 20°.

P	C	$\alpha$
1.244	0.1245	0.01835
2.094	0.2114	0.01818
4.010	0.4127	0.01785
5.925	0.6225	0.01743
7.742	0.8293	0.01667
13.510	1.5436	0.01436

(Knopp.)

Absorption of hydrogen by  $\text{NaNO}_3 + \text{Aq}$  at 20°.

P	C	$\alpha$
1.041	0.1236	0.01839
2.192	0.2634	0.01774
4.405	0.5416	0.01694
6.702	0.8442	0.01518
12.637	1.7394	0.01300

(Knopp.)

Absorption of hydrogen by  $\text{KCl} + \text{Aq}$  at 20°.

P	C	$\alpha$
1.089	0.1475	0.01823
2.123	0.2907	0.01757
4.070	0.5687	0.01661
6.375	0.9127	0.01531
7.380	1.0682	0.01472
13.612	2.1222	0.01255

(Knopp.)

Absorption of  $\text{H}_2$  by  $\text{NaCl} + \text{Aq}$ .  
 $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Percent of NaCl in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
5.999	0.01383	0.01528	0.01640	0.01749	0.01839
5.506	0.01395	0.01532	0.01665	0.01769	0.01861
4.496	0.01429	0.01587	0.01714	0.01817	0.01920
3.798	0.01476	0.01623	0.01760	0.01876	0.01977
1.523	0.01603	0.01754	0.01896	0.02030	0.02155
1.250	0.01621	0.01771	0.01914	0.02052	0.02180

(Braun, Z. phys. Ch. 1900, 33. 735.)

Absorption of  $\text{H}$  by  $\text{BaCl}_2 + \text{Aq}$ .  
 $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Percent of BaCl <sub>2</sub> in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
7.002	0.01455	0.01591	0.01716	0.01838	0.01937
6.453	0.01474	0.01605	0.01734	0.01857	0.01957
3.800	0.01562	0.01700	0.01839	0.01971	0.02089
3.291	0.01570	0.01719	0.01847	0.01983	0.02110

(Braun.)

1 vol. alcohol at  $t^\circ$  and 760 mm. absorbs V vols.  $\text{H}$  gas reduced to 0° and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.06925	9	0.06799	18	0.06690
1	0.06910	10	0.06787	19	0.06679
2	0.06896	11	0.06774	20	0.06668
3	0.06881	12	0.06761	21	0.06657
4	0.06867	13	0.06749	22	0.06646
5	0.06853	14	0.06737	23	0.06636
6	0.06839	15	0.06725	24	0.06621
7	0.06826	16	0.06713	..	...
8	0.06813	17	0.06701	..	...

(Bunsen's Gasometry, p. 286.)

One vol. alcohol absorbs 0.06925—0.000148t + 0.000001 $t^2$  vols.  $\text{H}$  at  $t^\circ$ .  
(Bunsen.)

Solubility in alcohol + Aq at 20° and 760 mm.

Wt. % alcohol	Vol. $\text{H}_2$ absorbed	Wt. % alcohol	Vol. $\text{H}_2$ absorbed
0	1.93	28.57	1.04
9.09	1.43	33.33	1.17
16.67	1.29	50	2.02
23.08	1.17	66.67	2.55

(Lubarsch, W. Ann. 1889, (2) 37. 525.)

Absorption of hydrogen by alcohol.

$t^\circ$	Coeff. of absorption	$t^\circ$	Coeff. of absorption
0	0.0676	13.4	0.0705
6.2	0.0693	18.8	0.0740

(Timofejeff.)

Solubility of  $\text{H}_2$  in ethyl ether at  $t^\circ$ .

$t^\circ$	Solubility
0	0.1115
5	0.1150
10	0.1195
15	0.1257

(Christoff, Z. phys. Ch. 1912, 79. 459.)

Coefficient of absorption in petroleum = 0.0582 at 20°, and 0.0652 at 10° (Griewas and Walfisz, Z. phys. Ch. 1. 70.)

Absorption of hydrogen by chloralhydrate + Aq at 20°.

P	C	$\alpha$
4.911	0.310	0.01839
7.69	0.504	0.01802
14.56	1.030	0.01712
18.77	1.397	0.01653
29.50	2.530	0.01542
32.00	2.845	0.01518
38.42	3.770	0.01440
49.79	6.000	0.01353
60.12	9.120	0.01324
63.90	10.700	0.01307

(Knopp, Z. phys. Ch. 1904, 48. 103.)

Absorption of H<sub>2</sub> by chloralhydrate + Aq.  
t° = temp. of the solution.

P = % chloralhydrate in the solution.

$\beta t^\circ$  = coefficient of absorption at t°.

$\beta 15^\circ$  = coefficient of absorption at 15°.

t°	P	$\beta t^\circ$	$\beta 15^\circ$
15.0	10.0	0.01740	0.01740
16.4	16.1	0.01719	0.01737
15.8	33.35	0.01475	0.01484
15.0	39.4	0.01470	0.01470
15.6	51.0	0.01300	0.01306
16.2	60.8	0.01281	0.01230
15.5	70.7	0.01282	0.01287
15.0	79.0	0.01320	0.01320
$\beta 20^\circ$			
19.4	15.5	0.01732	0.01724
17.4	28.3	0.01569	0.01540
18.7	46.56	0.01388	0.01375
16.5	52.0	0.01314	0.01280
17.0	63.0	0.01270	0.01243
17.2	66.0	0.01285	0.01260
17.9	68.0	0.01286	0.01270
18.3	78.4	0.01398	0.01380

(Müller, Z. phys. Ch. 1912, 81. 499.)

Solubility of H<sub>2</sub> in glycerol + Aq.

t°	% glycerol	Coefficient of absorption
14	0	0.0193
	2.29	0.0189
	5.32	0.0186
	8.57	0.0182
	10.83	0.01815
	15.31	0.01765
21	0	0.0184
	2.29	0.0181
	5.68	0.0177
	6.46	0.0176
	10.40	0.0171
	18.20	0.0160

(Henkel, in Landolt-Börnstein, Tab. 4th Ed. 602.)

Absorption of H<sub>2</sub> by glycerine + Aq.

t° = temp. of the solution.

P = % glycerine in the solution.

$\beta t^\circ$  = coefficient of absorption at t°.

$\beta 15^\circ$  = coefficient of absorption at 15°.

t°	P	$\beta t^\circ$	$\beta 15^\circ$
14.5	14.9	0.01654	0.01647
13.0	22.8	0.01532	0.01510
13.8	38.0	0.01226	0.01216
14.5	43.5	0.01117	0.01110
13.7	49.15	0.01019	0.01010
14.9	51.5	0.01026	0.01025
12.3	68.0	0.00822	0.00806
18.0	90.7	0.00853	0.00870

(Müller, Z. phys. Ch. 1912, 81. 496.)

Solubility of H<sub>2</sub> in glycerine + Aq at 25°.

G = % by wt. glycerine in the solvent.

S = Solubility of H<sub>2</sub>.

P = corrected pressure at end of experiment in mm. Hg at 0°.

P	G	S
716.3	4.0	0.0186
736.1	10.5	0.0178
684.3	22.0	0.0154
709.9	49.8	0.0099
730.1	50.5	0.0097
672.2	52.6	0.0090
741.1	67.0	0.0067
708.0	80.0	0.0051
665.5	82.0	0.0051
662.3	88.0	0.0044
741.8	95.0	0.0034

(Drucker and Moles, Z. phys. 1910, 75. 417.)

Absorption of H<sub>2</sub> by glucose + Aq.

t° = temp. of the solution.

P = % glucose in the solution.

$\beta t^\circ$  = coefficient of absorption at t°.

$\beta 20^\circ$  = coefficient of absorption at 20°.

t°	P	$\beta t^\circ$	$\beta 20^\circ$
20.5	12.2	0.01595	0.01600
20.5	20.7	0.01445	0.01450
21.1	32.56	0.01243	0.01250
21.8	45.8	0.01000	0.01015
21.2	59.0	0.00775	0.00780

(Müller, Z. phys. Ch. 1912, 81. 494.)

Solubility in sugar + Aq at 15°.

% Sugar	Absorption Coefficient
16.67	0.01561
30.08	0.01284
47.65	0.00892

(Gordon, Z. phys. Ch. 1895, 18. 14.)

Absorption of  $H_2$  by sucrose + Aq.  
 $t^\circ$  = temp. of the solution in the absorption vessel.

$P$  = % sucrose in the solution.

$\beta_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .

$\beta_{15^\circ}$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	$P$	$\beta_{t^\circ}$	$\beta_{15^\circ}$
12.7		0.01862	0.01892
19.3		0.01840	0.01829
15.2	5.04	0.01723	0.01726
11.6	14.7	0.01547	0.01510
12	20.26	0.01500	0.01462
12.7	29.86	0.01290	0.01257
11.8	31.74	0.01220	0.01185
13.3	39.65	0.01047	0.01033
12.6	42.94	0.00956	0.00939

(Müller.)

Absorption of  $H_2$  by propionic acid + Aq.  
 $\alpha_{t^\circ}$  = coefficient of absorption at  $t^\circ$ .

Percent of propionic acid in the solution	$\alpha_{25^\circ}$	$\alpha_{20^\circ}$	$\alpha_{15^\circ}$	$\alpha_{10^\circ}$	$\alpha_5^\circ$
9.910	0.01802	0.01782	0.01908	0.02029	0.02129
9.763	0.01638	0.01788	0.01929	0.02042	0.02120
6.500	0.01690	0.01829	0.01925	0.02093	0.02181
5.267	0.01705	0.01842	0.01983	0.02117	0.02239
3.373	0.01706	0.01866	0.01987	0.02120	0.02221
2.634	0.01722	0.01876	0.2003	0.02142	0.02245

(Braun, Z. phys. Ch. 1900, 33. 735.)

Absorption of  $H_2$  by organic acids + Aq.  
 $M$  = content in gram-equivalents per liter.  
 $S$  = solubility.

Absorption of  $H_2$  by  $CH_3COOH$  + Aq.

$M$	$S_{25^\circ}$
0.517	0.01925
0.528	0.01923
1.160	0.01903
1.20	0.01895
1.963	0.01885
1.980	0.01882
3.178	0.01862
3.220	0.01858
4.157	0.01849

(Geffcken, Z. phys. Ch. 1904. 49. 267.)

Absorption of  $H_2$  by  $CH_3ClCOOH$  + Aq.

$M$	$S_{25^\circ}$
0.527	0.01905
0.990	0.01852
1.773	0.01783

(Geffcken.)

Absorption of  $H$  by organic substances + Aq at  $t^\circ$ .

$V$  = absorbed volume reduced to  $0^\circ$  and 760 mm.

$a$  = coefficient of absorption.

Substance	Grams in 1 liter	Vol. of solution used in ccm.	$t^\circ$	$V$ ccm.	$x$
Glucose	174	409.94	20.28°	5.48	0.01516
Glucose	80.8	"	20.16°	6.12	0.01649
Glucose	41.45	"	20.00°	6.36	0.01759
Urea	60	"	20.17°	6.26	0.01703
Acetamide	59	"	20.11°	6.51	0.01795
Alanine	89	"	20.08°	5.57	0.01555
Glycocoll	75	"	20.16°	5.67	0.01577

(Hüfner, Z. phys. Ch. 1907, 57. 623-4.)

Solubility in organic solvents.

Solvent	Solubility at $25^\circ C$	Solubility at $20^\circ C$	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0.01992	0.02000	-0.000016
Aniline	0.02849	0.03033	-0.000368
Amyl alcohol	0.03708	0.03533	+0.00035
Nitrobenzene	0.03708	0.03533	+0.00035
Carbon bisulphide	0.03753	0.03358	+0.00079
Glacial acetic	0.06330	0.06172	+0.000316
Benzene	0.07560	0.07071	+0.000978
Acetone	0.07641	0.07027	+0.001228
Amyl acetate	0.07738	0.07432	+0.00061
Xylene	0.08185	0.07834	+0.000702
Ethyl acetate	0.08516	0.07877	+0.001278
Toluene	0.08742	0.08384	+0.000716
Ethyl alcohol (99.8%)	0.08935	0.08620	+0.000618
Methyl alcohol	0.09449	0.09016	+0.000866
Isobutyl acetate	0.09758	0.09287	+0.000942
Chloroform	no constant value		
Carbon tetrachloride			

(Just, Z. phys. Ch. 1901, 37. 359.)

Extended investigations have been made by Findlay and Shen. (Chem. Soc. 1912, 101. 1465) on the effect of colloids on solubility of  $H_2$  in  $H_2O$ . See original article.

Hydrogen arsenide.

See Arsenic hydride.

Hydrogen peroxide,  $H_2O_2$ .

Miscible with  $H_2O$ . Not stable in conc. solution. Aqueous solution gives up its  $H_2O_2$  to ether. Etheral solution is more stable than an aqueous solution of the same strength, and may be distilled without decomp. Miscible with alcohol.

Very stable in aq. solution of various conc. if perfectly free from impurity such as compds. of heavy metals, etc. (Woffenstein, B. 1894, 27. 3307.)

Coefficient of distribution between ether and  $H_2O$  determined at  $3^\circ$ ,  $7^\circ$ , and  $17.5^\circ$  with varying quantities (1.7-5%) of  $H_2O_2$ . (Osipoff, C. C. 1903, II. 1265.)

As sol. in ether as in  $H_2O$ . A 50% solution in  $H_2O$  still contained about 25%  $H_2O$ , after

being shaken 6 times with large quantities of fresh ether.

Insol. in petroleum ether. (Brühl, B. 1895, 28. 2855.)

+H<sub>2</sub>O, and +2H<sub>2</sub>O. Does not solidify at -20°. (Wolffenstein, B. 1894, 27. 3311.)

**Hydrogen phosphide, gaseous (Phosphine), PH<sub>3</sub>.**

Very slightly absorbed by H<sub>2</sub>O.

Statements as to solubility in H<sub>2</sub>O vary considerably.

(a) *Difficultly inflammable gas*—

1 vol. H<sub>2</sub>O absorbs 0.1122 vol. PH<sub>3</sub>. (Dybrowsky, J. B. 1866. 735.)

1 vol. H<sub>2</sub>O absorbs 0.125 vol. PH<sub>3</sub>. (H. Davy.)

(b) *Easily inflammable gas*—

1 vol. H<sub>2</sub>O absorbs 0.018 vol. PH<sub>3</sub>. (Gengembre, Crell. Ann. 1. 450.)

1 vol. H<sub>2</sub>O absorbs 0.0214 vol. PH<sub>3</sub>. (Henry.)

1 vol. H<sub>2</sub>O absorbs 0.025 vol. PH<sub>3</sub>. (Davy.)

1 vol. H<sub>2</sub>O absorbs 0.125 vol. PH<sub>3</sub>. (Dalton, Ann. Phil. 11. 7.)

1 vol. H<sub>2</sub>O absorbs 0.255 vol. PH<sub>3</sub>. (Raymond, Scher. J. 5. 389.)

1 vol. H<sub>2</sub>O dissolves 0.26 vols. PH<sub>3</sub> at 17°. (Stock, Böttger and Lenger, B. 1909, 42. 2855.)

Sol. in conc. H<sub>2</sub>SO<sub>4</sub> without immediate decomp. (Buff, Pogg. 16. 363.)

1 vol. 50% H<sub>2</sub>SO<sub>4</sub> dissolves 0.05 vol. PH<sub>3</sub>. (S. B. and L.)

Absorbed by CuSO<sub>4</sub>+Aq and by Br. (Berthelot.)

Absorbed rapidly by Cu<sub>2</sub>Cl<sub>2</sub>+Aq with formation of Cu<sub>2</sub>Cl<sub>2</sub>, 2PH<sub>3</sub>, and Cu<sub>2</sub>Cl<sub>2</sub>, 4PH<sub>3</sub>. (Riban, C. R. 88. 581.)

1 vol. alcohol of 0.85 sp. gr. absorbs 0.5 vol.; 1 vol. ether absorbs 2 vols. (Graham.)

Sol. in volatile oils; 1 vol. oil of turpentine absorbs 3.25 vols. (Graham.)

Several varieties of blood absorb PH<sub>3</sub>.

**Hydrogen phosphide, liquid, P<sub>2</sub>H<sub>4</sub>.**

Insol. in H<sub>2</sub>O. Apparently sol. in alcohol and oil of turpentine, but solution is very quickly decomp. (Thénard, A. ch. (3) 145.)

**Hydrogen phosphide, solid, P<sub>4</sub>H<sub>6</sub>.**

Insol. in H<sub>2</sub>O and alcohol. (Leverrier, A. ch. 60. 174.)

Insol. in all liquids except liquid PH<sub>3</sub>. (Thénard, A. ch. (3) 14. 5.)

Instantly decomp. by HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Aq. Sol. with decomp. in alcoholic solution of KOH. (Thénard.)

Somewhat sol. in liquid phosphorus. (Buck, Dissert. 1904.)

P<sub>4</sub>H<sub>6</sub>. Insol. in all solvents. (Stock, Böttger and Lenger, B. 1909, 42. 2851.)

P<sub>2</sub>H<sub>4</sub>. Sol. in liquid hydrogen phosphide and molten P. There are no other solvents which appreciably dissolve it. Insol. in liquid PH<sub>3</sub>. (S. B. and L.)

**Hydrogen selenide, H<sub>2</sub>Se.**

More sol. in H<sub>2</sub>O than hydrogen sulphide. (Berzelius.)

Solubility coefficient of H<sub>2</sub>Se at t°.

t°	Sol. Coeff.
4	3.77 vols.
9.65	3.43
13.2	3.31
22.5	2.70

(Forcrand and Fonzes-Diacon, C. R. 1902, 134. 171.)

Sol. in cold COCl<sub>2</sub>. (Besson, C. R. 1869, 122. 140.)

**Hydrogen silicide.**

See Silicon hydride.

**Hydrogen sulphide, H<sub>2</sub>S.**

(a) *Liquid*. Dissolves S on warming, which separates on cooling.

(b) *Gas*.

1 vol. H<sub>2</sub>O absorbs 1.08 vols. H<sub>2</sub>S at 10°. (Henry, 1803.)

1 vol. H<sub>2</sub>O absorbs 2.53 vols. H<sub>2</sub>S at 15°. (de Saussure, Ann. Phil. 6. 340.)

1 vol. H<sub>2</sub>O absorbs 3 vols. H<sub>2</sub>S at 11°. (Gay-Lussac and Thénard.)

1 vol. H<sub>2</sub>O absorbs 3.66 vols. H<sub>2</sub>S at ord. temp. (Thompson.)

1 vol. H<sub>2</sub>O absorbs 2.5 vols. H<sub>2</sub>S at ord. temp. (Dalton.)

1 vol. H<sub>2</sub>O absorbs 4.3706–0.083687t+0.0005213t<sup>2</sup> vols. H<sub>2</sub>S at temperatures between 2 and 43.3°. (Bunsen and Schönfeld, A. 93. 26.)

At 0° and about 820 mm. pressure, 1 ccm. H<sub>2</sub>O absorbs 100 ccm. H<sub>2</sub>S, while only about 4 ccm. are absorbed at ord. pressure. (de Forcrand and Villard, C. R. 106. 1402.)

1 vol. H<sub>2</sub>O at 760 mm. pressure and t° absorbs V vols. H<sub>2</sub>S, reduced to 0° and 760 mm.

t°	V	t°	V	t°	V
0	4.3706	14	3.3012	28	2.4357
1	4.2874	15	3.2326	29	2.3819
2	4.2053	16	3.1651	30	2.3290
3	4.1243	17	3.0986	31	2.2771
4	4.0442	18	3.0331	32	2.2262
5	3.9652	19	2.9687	33	2.1764
6	3.8872	20	2.9053	34	2.1277
7	3.8103	21	2.8430	35	2.0799
8	3.7345	22	1.7817	36	2.0332
9	3.6596	23	2.7215	37	1.9876
10	3.5858	24	2.6623	38	1.9430
11	3.5132	25	2.6091	39	1.8994
12	3.4415	26	2.5470	40	1.8569
13	3.3708	27	2.4909	..	.....

(Schönfeld, A. 93. 26.)

Absorption coefficient of  $\text{H}_2\text{S}$  in  $\text{H}_2\text{O}$  at  $0^\circ = 4.6796$ . (Prytz and Holst, W. Ann. 1895, 54, 137.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.1004 mol.  $\text{H}_2\text{S}$  at  $25^\circ$  and 760 mm. (Pollitzer, Z. anorg. 1909, 64, 145.)

Absorption of hydrogen sulphide by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption
$0^\circ$	4.686
$10^\circ$	3.520
$20^\circ$	2.672

[Calc. fr. data of Fauser. (C. C. 1889, 1, 754.)]

(Winkler, Z. phys. Ch. 1906, 55, 350.)

Absorption of hydrogen sulphide by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption
0	4.621
10	3.362
20	2.554
30	2.014
40	1.642
50	1.376
60	1.176

(Winkler, Z. phys. Ch. 1906, 55, 350.)

Solubility of  $\text{H}_2\text{S}$  in  $\text{H}_2\text{O}$ .

Layer rich in $\text{H}_2\text{S}$	
$t^\circ$	Mols. $\text{H}_2\text{S}$ per 100 mols. $\text{H}_2\text{O}$
0	0.4
6	0.5
17	0.8
26	1.2
29.5	1.6

Layer rich in $\text{H}_2\text{O}$	
$t^\circ$	Mols. $\text{H}_2\text{S}$ per 100 mols. $\text{H}_2\text{O}$
29.4	96.3
28.5	96.9
26.9	97.3
26.3	97.5
23.8	98.1
23.3	98.1
22.9	98.2
17.2	98.8
13.7	99.1
11.4	99.25
5.3	99.5

(Scheffer, Proc. K. Ak. Amsterdam, 1911, 14, 198.)

Difficultly sol. in conc.  $\text{H}_2\text{SO}_4$  with decomp. Instantly decomp. by fuming  $\text{HNO}_3$ .

Solubility of  $\text{H}_2\text{S}$  in  $\text{HI} + \text{Aq}$  at  $25^\circ$  and 760 mm.

$\text{HI}$ Mol. per l.	$\text{H}_2\text{S}$ Mol. per l.
0.00	0.1004
1.01	0.111
1.51	0.113
1.93	0.125
2.65	0.130
2.64	0.138
3.42	0.142
4.38	0.163
5.005	0.165
5.695	0.181
6.935	0.197
* (9.21)	0.267

\* Not exact.

(Pollitzer, Z. anorg. 1909, 64, 145.)

Solubility in acids +  $\text{Aq}$ .

$l$  = value of  $\text{H}_2\text{S}$  dissolved in acid +  $\text{Aq}$  as determined by titration.

$l_0$  = value of  $\text{H}_2\text{S}$  dissolved in  $\text{H}_2\text{O}$  as determined by titration.

$t^\circ = 25^\circ$ .

Acid	$l/l_0$
$\frac{1}{2}\text{-N. HCl}$	0.975
$\frac{1}{2}\text{-N. H}_2\text{SO}_4$	0.905

(McLauchlan, Z. phys. Ch. 1903, 44, 615.)

Less sol. in  $\text{NaCl}$ , or  $\text{CaCl}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$ .

Sol. in  $\text{CdCl}_2 + \text{NH}_4\text{OH} + \text{Aq}$ . (Crobaugh, Z. anorg. 1894, 5, 321.)

Solubility in salts +  $\text{Aq}$ .

$l$  = value of  $\text{H}_2\text{S}$  dissolved in salt +  $\text{Aq}$  as determined by titration.

$l_0$  = value of  $\text{H}_2\text{S}$  dissolved in  $\text{H}_2\text{O}$  as determined by titration.

$t^\circ = 25^\circ$ .

Salt + $\text{Aq}$ .	$l/l_0$	Salt + $\text{Aq}$ .	$l/l_0$
$\frac{1}{2}\text{-N. Na}_2\text{SO}_4$	0.73	$\frac{1}{2}\text{-N. Na}_2\text{SO}_4$	0.855
$\frac{1}{2}\text{-N. K}_2\text{SO}_4$	0.78	$\frac{1}{2}\text{-N. K}_2\text{SO}_4$	0.890
$\frac{1}{2}\text{-N. (NH}_4\text{)}_2\text{SO}_4$	0.82	$\frac{1}{2}\text{-N. (NH}_4\text{)}_2\text{SO}_4$	0.91
$\text{N. NaCl}$	0.847	$\frac{1}{2}\text{-N. NaCl}$	0.930
$\text{N. KCl}$	0.853	$\text{N. NaBr}$	0.935
$\text{N. NH}_4\text{Cl}$	0.960	$\text{N. KBr}$	0.945
$\text{N. NaNO}_3$	0.893	$\text{N. NH}_4\text{Br}$	1.00
$\text{N. KNO}_3$	0.913	$\text{N. KI}$	0.98
$\text{N. NH}_4\text{NO}_3$	0.990		

(McLauchlan, Z. phys. Ch. 1903, 44, 615.)



Solubility of  $H_2S$  in  $NaSH + Aq.$   
(g. mol.  $H_2S$  dissolved in 1 l.)

$t^\circ$	0.05 g. mol. $NaSH$ per l.	0.1 g. mol. $NaSH$ per l.	0.2 g. mol. $NaSH$ per l.
15	...	0.132	0.129
25	...	0.104	0.1035
35	0.062	0.062	...
45	0.064	...	...

(Goldschmidt and Larsen, Z. phys. Ch. 1910, 71. 449.)

At  $18^\circ$  and ord. pressure, 100 vols. alcohol of 0.84 sp. gr. absorb 606 mols.  $H_2S$ . (de Saussure, 1814.)

1 vol. alcohol absorbs 17.891-0.65598t + 0.00661t<sup>2</sup> vols.  $H_2S$  between 0 and  $22^\circ$ . (Carius.)

1 vol. alcohol at  $t^\circ$  and 760 mm. absorbs V vols.  $H_2S$  reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	17.891	9	12.523	18	8.225
1	17.242	10	11.992	19	7.814
2	16.606	11	11.475	20	7.415
3	15.983	12	10.971	21	7.030
4	15.373	13	10.480	22	6.659
5	14.776	14	10.003	23	6.300
6	14.193	15	9.539	24	5.955
7	13.623	16	9.088	..	...
8	13.066	17	8.650	..	...

(Carius, A. 94. 140.)

Solubility in alcohol + Aq at  $25^\circ$ .

Molecules of $C_2H_5OH$ in 100 molecules $C_2H_5OH$ + $H_2O$	Molecules $H_2O$ in 100 molecules $C_2H_5OH + H_2O$	l/l <sub>0</sub>
0.00	100	1.00
1.60	98 (?)	0.96
5.18	94.82	0.933
9.25	90.75	0.91
23.60	76.40	1.28
47.75	52.25	1.95
* (100)	0	2.16)

\* Carius.

(McLauchlan.)

Sol. in methyl acetate (Marchand), ether (Higgins).

Insol. in caoutchouc.

Sol. in glycerine in less amount than in  $H_2O$ . If a certain vol. of  $H_2O$  dissolves 100 pts.  $H_2S$ , the same vol. of glycerine (1 pt. glycerine + 1 pt.  $H_2O$ ) dissolves only 60 pts.  $H_2S$ , but the solution is very stable. After standing a year there is no appreciable decomp. (Lapage, J. Pharm. (4) 5. 256.)

According to Lindo (C. N. 57. 173), the solution in glycerine is no more stable than that in  $H_2O$ .

Sol. in  $CS_2$ .

Solubility in organic substances + Aq.  
l = value of  $H_2S$  dissolved in organic substance + Aq as determined by titration.  
l<sub>0</sub> = value of  $H_2S$  dissolved in  $H_2O$  as determined by titration.  
 $t^\circ = 25^\circ$ .

Solution	l/l <sub>0</sub>
$N-NH_2C_2H_5O_2$	1.09
$N-C_2H_5O_2$	0.944
$3-N-C_2H_5O_2$	0.858
$N-(NH_2)_2CO$	1.02
pure $C_2H_5(OH)_2$	0.863

(McLauchlan, Z. phys. Ch. 1903, 44. 615.)

Solubility in acetic acid + Aq at  $25^\circ$ .

Molecules of $CH_3COOH$ in 100 molecules $CH_3COOH + H_2O$	Molecules of $H_2O$ in 100 molecules $CH_3COOH + H_2O$	l/l <sub>0</sub>
0	100	1.00
8.85	91.15	0.98
16.7	83.30	0.955
21.0	79	1.00
35.5	64.5	1.035
53.5	40.5	1.21
55.7	...	1.29
67.8	32.2	1.40
81.0	19.0	1.83
98.58	1.42	3.81

(McLauchlan.)

Hydrogen persulphide,  $H_2S_2$  or  $H_2S_4$ .

Decomp. by contact with  $H_2O$ , in which it is apparently insol. Sol. in ether with subsequent decomp. Sol. in  $CS_2$ . (Thénard, A. ch. 48. 79.)

$H_2S_2$ . Quickly decomp. by ether, acetic ether, ethyl, or amyl alcohol.  $H_2S$  has no action.

Conc.  $HCl$ , or  $HC_2H_3O_2 + Aq$  have no action. Sol. in a solution of S in  $CS_2$ , and in liquid hydrocarbons.

Chloroform dissolves without decomp.

(Sabatier, C. R. 100. 1346, 1585.)

Alkalies, and  $K_2S + Aq$  decomp. instantly.

Decomp. by  $H_2O$ , dil. and conc.  $HCl$ , conc.  $H_2SO_4$ , alkali and alcohol. Sol. in alcohol containing  $HCl$  but soon decomp. in this solution. Miscible in all proportions and without decomp. with benzene, ether and  $CS_2$ . (Bloch, B. 1906, 41. 1977.)

Formula is  $H_2S_4$ . (Rebs, A. 246. 356.)  
+  $7H_2O$ . Easily decomp. by heat. (de Forcrand and Villard, C. R. 106. 1402.)

Hydrogen trisulphide,  $H_2S_3$ .

Decomp. by  $H_2O$ , dil. and conc.  $HCl$ , conc.  $H_2SO_4$ , alkali and alcohol. Somewhat sol. in alcohol containing  $HCl$ , but slowly decomp. in this solution. Miscible with ether, benzene and  $CS_2$  and these solutions are relatively stable. (Bloch, B. 1906, 41. 1974.)

**Hydrogen telluride,  $H_2Te$ .**

Sl. sol. in  $H_2O$ . Decomp. in the air. (Erneyi, Z. anorg. 1900, 25. 313.)

**Hydrosulphuric acid,  $H_2S$ .**

See Hydrogen sulphide.

**Hydrosulphurous acid,  $H_2SO_3$ .**

See Hyposulphurous acid.

**Hydroxylamic acid.**
**Calcium hydroxylamate,  $Ca(OH)_2$ .**

Very explosive; decomp. by  $H_2O$ . (Ebler and Schott, J. pr. 1908, (2) 78. 323.)

**Zinc hydroxylamate  $Zn(OH)_2$ .**

Decomp. by  $H_2O$ . (Ebler and Schott.)

**Zinc hydroxylamate, hydroxylamine,  $Zn(H_2NO)_2, 3NH_3O$ .**

Very unstable.

Insol. in abs. alcohol. (Ebler and Schott.)

**Hydroxylamine,  $NH_2O = NH_2(OH)$ .**

Known only in solution.

Sol. in alcohol. (Lossen, J. pr. 96. 462.)

Prepared in free state by de Bruyn.

Very deliquescent, and sol. in  $H_2O$  and alcohol. Sl. sol. or insol. in  $CHCl_3$ ,  $C_6H_6$ , ether, or ethyl acetate.

Methyl alcohol at 5° dissolves 35%; ethyl alcohol at 15°, 15%; boiling dry ether, 1.2%; boiling ethyl acetate, 1.6%. (de Bruyn, R. t. c. 11. 18.)

**Hydroxylamine arsenate,  $AsO_4H_2(NH_2O)_2$ .**

Sl. sol. in cold  $H_2O$ ; sol. in hot  $H_2O$  from which it can be cryst. (Hofmann, A. 1899, 307. 331.)

**Hydroxylamine azoimide.**

See Azoimide, hydroxylamine.

**Hydroxylamine bromide,  $NH_2OH, HBr$ .**

Very sol. in  $H_2O$ ; insol. in ether by which it is pptd. from solution in alcohol. (Adams, Am. Ch. J. 1902, 28. 205.)

$2NH_2OH, HBr$ . Easily sol. in  $H_2O$ ; insol. in ether and ligroin. Sl. sol. in alcohol. (Adams.)

**Hydroxylamine mercuric bromide hydroxylamine,  $2NH_2OH, 2HBr, HgBr_2, 2NH_2OH$ .**

Decomp. by  $H_2O$  and methyl alcohol.

Readily decomp. by alkalis. (Adams.)

**Hydroxylamine calcium,  $HO.Ca.ONH_2$ .**

Partially decomp. by  $H_2O$  at ordinary temp. (Hofmann, Z. anorg. 1898, 16. 464.)

**Hydroxylamine chloride, basic,  $NH_2(OH)Cl, NH_2OH$ .**

Sol. in  $H_2O$ . Alcohol precipitates from aqueous solution. Insol. in ether. (Lossen.)  $2NH_2(OH)Cl, NH_2OH$ . Deliquescent; very sol. in  $H_2O$ , less in alcohol, and insol. in ether. (Lossen.)

**Hydroxylamine chloride,  $NH_2(OH)Cl$ .**

Not deliquescent. Very sol. in  $H_2O$  and hot ordinary alcohol. Sl. sol. in absolute alcohol. Insol. in ether. (Lossen.)

Sol. in 1.2 pts.  $H_2O$  at 17°. (Schiff, Z. phys. Ch. 1896, 21. 290.)

Sp. gr. of aqueous solution at 17°.

% salt	sp. gr.
40	1.1852
28	1.1260
20	1.0688
14	1.0616
10	1.0437
7	1.0303
5	1.0214
3.5	1.0147

(Schiff, Z. phys. Ch. 1896, 21. 290.)

100 pts. absolute methyl alcohol dissolve 16.4 pts. at 19.75°; 100 pts. absolute ethyl alcohol dissolve 4.43 pts. at 19.75°. (de Bruyn, Z. phys. Ch. 10. 783.)

Somewhat sol. in alcohol. (Adams, Am. Ch. J. 1902, 28. 204.)

**Hydroxylamine mercuric chloride,  $NH_2OH, HCl, HgCl_2$ .**

Very sol. in  $H_2O$  and alcohol. Less sol. in ether. (Adams, Am. Ch. J. 1902, 28. 213.)

$5(NH_2OH)_2, HCl, 2HgCl_2$ . Sol. in cold  $H_2O$ , alcohol and ether. More easily sol. in methyl alcohol. Sol. in  $HCl$ . The slightest trace of alkali causes decomp. (Adams.)

**Hexahydroxylamine cobaltic bromide,**

$[Co(NH_2OH)_6]Br_3$ .

(Werner, B. 1905, 38. 897.)

**Hexahydroxylamine cobaltic chloride,**

$[Co(NH_2OH)_6]Cl_3$ .

Very stable toward  $HCl$ . (Werner, B. 1905, 38. 895.)

**Hexahydroxylamine cobaltic nitrate,**

$[Co(NH_2OH)_6](NO_3)_3$ .

(Werner.)

**Hexahydroxylamine cobaltic sulphate,**

$[Co(NH_2OH)_6](SO_4)_3 + 2H_2O$ .

Easily sol. in  $H_2O$ . (Werner.)

**Hydroxylamine columbate,  $CbO_3N_2H_3$ .**

Explosive. Sl. sol. in  $H_2O$ . (Hofmann, Z. anorg. 1898, 16. 473.)

**Hydroxylamine dithionate,  $(\text{NH}_2\text{OH})_2, \text{H}_2\text{S}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ ; decomp. on heating the aq. solution. (Sabanejeff, *Z. anorg.* 1898, 17. 485.)

**Hydroxylamine fluosilicate,  $(\text{NH}_2\text{OH})_2, \text{H}_2\text{SiF}_6 + 2\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Nearly insol. in methyl and abs. ethyl alcohol. (Ebler, *J. pr.* 1908, (2), 78. 338.)

**Hydroxylamine fluotitanate,  $(\text{NH}_2\text{OH})_2, \text{H}_2\text{TiF}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in methyl alcohol. (Ebler, *J. pr.* 1908, (2) 78. 340.)

**Hydroxylamine hypophosphite,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{PO}_2$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Sabanejeff, *Z. anorg.* 1898, 17. 483.)

Sol. in  $\text{H}_2\text{O}$  and absolute alcohol. Insol. in ether. (Hofmann and Kohlschütter, *Z. anorg.* 1898, 16. 469.)

**Hydroxylamine potassium hypophosphite,  $(\text{H}_2\text{PO}_2)_2(\text{NH}_2\text{OH})_2\text{K}_2$ .**

Easily sol. in  $\text{H}_2\text{O}$ , decomp. on heating; sol. in hot abs. alcohol. (Hofmann and Kohlschütter, *Z. anorg.* 1898, 16. 468.)

**Hydroxylamine hypophosphate,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{P}_2\text{O}_6$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Sabanejeff, *Z. anorg.* 1898, 17. 489.)

**Hydroxylamine iodide,  $\text{NH}_2\text{OH}, \text{HI}$ .**

Hygroscopic; sol. in methyl alcohol. Very explosive. (Wolfenstein and Groll, *B.* 1901, 34. 2419.)

**Dihydroxylamine iodide,  $(\text{NH}_2\text{OH})_2, \text{HI}$ .**

Deliquescent. More sol. in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol than the tri compound. Is decomp. when recryst. from these solvents. Insol. in ether. (Dunstan, *Chem. Soc.* 1896, 69. 841.)

**Trihydroxylamine iodide,  $(\text{NH}_2\text{OH})_3, \text{HI}$ .**

Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol. Insol. in ether. (Dunstan.)

**Hydroxylamine nitrate,  $\text{NH}_2(\text{OH})\text{NO}_3$ .**

Very sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Lossen.)

**Hydroxylamine orthophosphate,  $(\text{NH}_2\text{OH})_2\text{PO}_4$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Lossen.)

Only al. sol. in  $\text{H}_2\text{O}$ . (Hofmann, *A.* 1899, 307. 330.)

Moderately sol. in  $\text{H}_2\text{O}$ . (Ross, *Chem. Soc.* 1906, 90, (2) 19.)

**Solubility in  $\text{H}_2\text{O}$ .**

1 g. of aqueous solution contains at:

0°	10°
0.012	0.015 g. hydroxylamine phosphate,
20°	30°
0.019	0.027 g. hydroxylamine phosphate,
40°	50°
0.040	0.065 g. hydroxylamine phosphate,
60°	70°
0.077	0.102 g. hydroxylamine phosphate,
80°	90°
0.133	0.168 g. hydroxylamine phosphate.

(Adams, *Am. Ch. J.* 1902, 28. 204.)

$(\text{NH}_2\text{OH})_2\text{H}_2\text{PO}_4$ . Hygroscopic. Aq. solution is decomp. on heating. (Sabanejeff, *B.* 1897, 30. 287.)

**Hydroxylamine phosphite,  $(\text{NH}_2\text{OH})_2\text{HPO}_2$ .**

Sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Hofmann and Kohlschütter, *Z. anorg.* 1898, 16. 467.)

$(\text{NH}_2\text{OH})_2\text{H}_2\text{PO}_2$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Sabanejeff, *Chem. Soc.* 1900, 78, (2), 14.)

**Hydroxylamine phosphite ammonia,  $(\text{NH}_2\text{OH})_2\text{H}_2\text{PO}_2, \text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Sabanejeff, *Chem. Soc.* 1900, 78, (2) 14.)

**Hydroxylamine sodium,  $\text{NaONH}_2$ .**

Very hygroscopic. (de Bruyn, *R. t. c.* 1892, 11. 18.)

**Hydroxylamine sulphate,  $(\text{NH}_2\text{OH})_2\text{SO}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Precipitated from concentrated aqueous solution by alcohol. (Lossen.)

Sol. in conc.  $\text{NH}_2\text{OH} + \text{Aq}$ . Insol. in alcohol and ether. (Preibisch, *J. pr.* 1873, (2) 7. 480.)

Not deliquescent. Sol. in  $\frac{3}{4}$  of its wt. of  $\text{H}_2\text{O}$  at 20°. (Divers and Haga, *Chem. Soc.* 1896, 69. 1665.)

1 g. of aqueous solution contains at:

-8°	0°	+10°
0.307	0.329	0.366 g. hydroxylamine sulphate,
20°	30°	40°
0.413	0.441	0.482 g. hydroxylamine sulphate,
50°	60°	90°
0.522	0.560	0.685 g. hydroxylamine sulphate.

(Adams, *Am. Ch. J.* 1902, 28. 203.)

Dry hydroxylamine sulphate is insol. in abs. and almost insol. in 95% alcohol. (Adams.)

For double salts, see under sulphuric acid.  $\text{NH}_2\text{OH}, \text{H}_2\text{SO}_4$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Divers, *Chem. Soc.* 1895, 67. 226.)

**Hydroxylamine tungstate,  $4\text{NH}_2\text{OH}, 3\text{WO}_3 + 3\text{H}_2\text{O}$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . (Allen and Gottschalk, *Am. Ch. J.* 1902, 27. 338.)

**Hydroxylamine uranate**,  $\text{UO}_4(\text{NH}_2\text{O})_2 + \text{H}_2\text{O}$ .

Decomp. by heat. (Hofmann, Z. anorg. 1897, 15. 78.)

**Hydroxylamine uranate ammonia**,

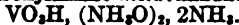


Decomp. by  $\text{H}_2\text{O}$ . (Hofmann, Z. anorg. 1897, 15. 79.)

**Hydroxylamine metavanadate**,  $\text{VO}_3\text{N}_2\text{H}_{11}$ .

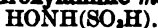
Decomp. by moisture. (Hofmann, Z. anorg. 1898, 16. 472.)

**Hydroxylamine metavanadate ammonia**,



Easily decomp. by  $\text{H}_2\text{O}$  and  $\text{HCl}$ . (Hofmann, Z. anorg. 1898, 16. 471.)

**Hydroxylamine monosulphonic acid**,

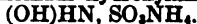


"Sulphazidic acid" of Fremy.

"Sulphhydroxylamic acid" of Claus.

Sol. in  $\text{H}_2\text{O}$ . Slowly decomp. on boiling. (Raschig, A. 241. 161.)

**Ammonium hydroxylamine monosulphonate**,



(Sabanéjeff, Z. anorg. 1898, 17. 491.)

**Monobarium** — — —,  $(\text{HONHSO}_3)_2\text{Ba} + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 55. 760.)

**Dibarium** — — —,  $\text{Ba}(\text{HONSO}_3)_2\text{Ba} + \text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Divers and Haga, Chem. Soc. 55. 760.)

**Potassium** — — —,  $\text{HONH}(\text{SO}_3\text{K})$ .

"Potassium sulphhydroxylamate" of Claus.

"Potassium sulphazidate" of Fremy.

Sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in hot  $\text{H}_2\text{O}$  without decomp. Insol. in alcohol. (Raschig, +  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 55. 760.)

**Hydroxylamine disulphonic acid**,



"Disulphhydroazotic acid" of Claus.

"Sulphazotic acid" of Fremy.

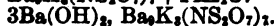
Not known in free state. (Raschig, A. 241. 161.)

**Barium hydroxylamine disulphonate**,



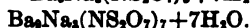
Practically insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Divers, Chem. Soc. 1894, 65. 559.)

**Barium potassium** — — —.



Above salts are all ppts. (Divers, Chem. Soc. 1894, 65. 561.)

**Barium sodium hydroxylamine disulphonate**,



Above salts are ppts. (Divers.)

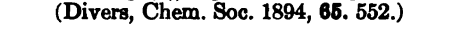
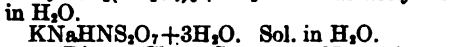
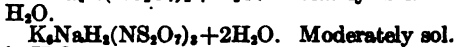
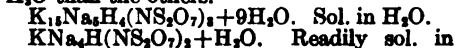
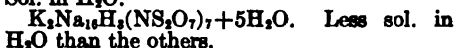
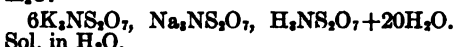
**Potassium** — — —,  $\text{HON}(\text{SO}_3\text{K})_2 + 2\text{H}_2\text{O}$ .

"Potassium disulphhydroxyazotate" of Claus (A. 158. 75). Insol. in cold  $\text{H}_2\text{O}$ .

Very unstable. Very difficultly sol. in  $\text{H}_2\text{O}$ , more easily in dil.  $\text{KOH} + \text{Aq}$ . (Raschig, A. 241. 161.)

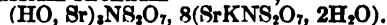
$\text{HON}(\text{SO}_3\text{K})_2, \text{KON}(\text{SO}_3\text{K})_2 + \text{H}_2\text{O}$ . True composition of potassium sulphazotate of Fremy. (Divers and Haga, Chem. Soc. 1900, 77. 432.)

**Potassium sodium** — — —.



(Divers, Chem. Soc. 1894, 65. 552.)

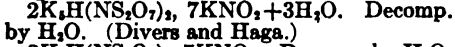
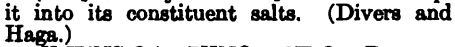
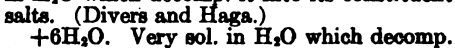
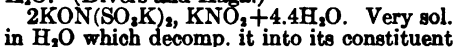
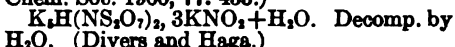
**Potassium strontium** — — —,



Ppt. (Divers.)

**Potassium hydroxylamine disulphonate nitrite**,  $\text{HON}(\text{SO}_3\text{K})_2, \text{KNO}_2$ .

Very sl. in  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1900, 77. 433.)



**Potassium hydroxylamine disulphonate sodium chloride**,  $5\text{K}_2\text{HNS}_2\text{O}_7, 8\text{NaCl} + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1894, 65. 551.)

**Sodium hydroxylamine disulphonate,**  
 $\text{HON}(\text{SO}_2\text{Na})_2$ .

Sol. in somewhat more than its own wt. of  $\text{H}_2\text{O}$  at  $14^\circ$ . (Divers, Chem. Soc. 1894, 65. 546.)

$\text{Na}_2\text{HNSO}_7$ ,  $2\text{Na}_2\text{NSO}_7 + 3\text{H}_2\text{O}$ . Sol. in less than 1.5 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ . (Divers.)

**Hydroxylamine isomonosulphonic acid,**  
 $\text{NH}_2$ , O,  $\text{SO}_2$ , OH.

Very hygroscopic. Sol. in water; sol. in alcohol. (Sommer, B. 1914, 47. 1226.)  
[Compare Raschig, A. 1887, 241. 161.]

**Hydroxylamine isodisulphonic acid.****Ammonium hydroxylamine isodisulphonate,**  
 $(\text{SO}_2\text{NH}_4)\text{ONH}(\text{SO}_2\text{NH}_4)$ .

3 pts. are sol. in 2 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . Apt to form supersat. solutions. (Haga, Chem. Soc. 1906, 89. 246.)

**Dipotassium — — —**,  $\text{K}_2\text{HSO}_7\text{N}$ .

Only sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in boiling  $\text{H}_2\text{O}$ . Decomp. by hot dil.  $\text{HCl}$ . (Raschig, B. 1906, 39. 246.)

6.44 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16.4^\circ$ .

7.18 " " " " 100 "  $\text{H}_2\text{O}$  "  $17.8^\circ$ .

8.05 " " " " 100 "  $\text{H}_2\text{O}$  "  $20^\circ$ .

(Haga, Chem. Soc. 1906, 39. 243.)

**Tripotassium — — —**,  $(\text{SO}_2\text{K})\text{ONK}(\text{SO}_2\text{K}) + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; ppt. by alcohol. (Haga.)

**Disodium — — —**,  $(\text{SO}_2\text{Na})\text{ONH}(\text{SO}_2\text{Na})$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol by which it is ppt. from aqueous solution. (Haga.)

**Trisodium — — —**,  $(\text{SO}_2\text{Na})\text{ONNa}(\text{SO}_2\text{Na}) + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; ppt. by alcohol. (Haga.)

$+ 3\text{H}_2\text{O}$ . Sol. in 1.3 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . Less

sol. in  $\text{NaOH} + \text{Aq.}$  (Divers, Chem. Soc. 1894, 65. 546.)

**Hydroxylamine trisulphonic acid.****Ammonium hydroxylamine trisulphonate,**  
 $2(\text{SO}_2\text{NH}_4)\text{ON}(\text{SO}_2\text{NH}_4)_2 + 3\text{H}_2\text{O}$ .

Sol. in 0.61 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Haga, Chem. Soc. 1904, 85. 84.)

**Potassium — — —**,  $2(\text{SO}_2\text{K})\text{ON}(\text{SO}_2\text{K})_2 + 3\text{H}_2\text{O}$ .

1 pt. is sol. in 25.37 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Haga.)

**Sodium — — —**,  $(\text{SO}_2\text{Na})\text{ON}(\text{SO}_2\text{Na})_2 + 2\text{H}_2\text{O}$ .

Sol. in 2.84 pts.  $\text{H}_2\text{O}$  at  $21.5^\circ$ .

**Dihydroxylamine sulphonic acid,**  
 $(\text{HO})_2\text{N}(\text{SO}_2\text{H})$ .

"Sulphazinous acid" of Fremy.

Known only in its salts. (Raschig, A. 241. 161.)

**Potassium dihydroxylamine sulphonate,**  
 $(\text{HO})_2\text{NSO}_2\text{K}$ .

Not obtained in pure state; forms basic salt  $\text{KO} \cdot \text{NSO}_2\text{K}$ , which is quite sol. in  $\text{H}_2\text{O}$ , and corresponds to "sulfasite de potasse" of Fremy (A. ch. (3) 15. 421).

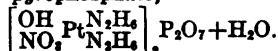
Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol and ether. (Fremy.)

**Hydroxylodoplatindiamine sulphate,**  
 $(\text{OH})\text{IPt}(\text{NH}_2)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Very sl. sol., even in boiling  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 312.)

**Hydroxylonitratoplatindiamine nitrate,**  
 $\text{OH} \cdot \text{Pt} \cdot \text{N}_2\text{H}_4\text{NO}_3$ ,  
 $\text{NO}_3 \cdot \text{Pt} \cdot \text{N}_2\text{H}_4\text{NO}_3$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Cleve.)

**— pyrophosphate,**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Hydroxyloplatinamine hydroxide,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_2\text{OH})_2$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids, even  $\text{HCl}$ . Not decomp. by boiling  $\text{KOH} + \text{Aq.}$  (Gerhardt, Compt. Chem. 1849. 490.)

**Hydroxyloplatinamine nitrate,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_2\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ ; not attacked by cold  $\text{HCl} + \text{Aq.}$  (Cleve.)

**— oxalate,  $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{C}_2\text{O}_4 + \text{H}_2\text{O}$ .**

Sol. in hot  $\text{H}_2\text{O}$ .

**— sulphate,  $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{SO}_4 + \text{HO}_2$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Hydroxyloplatindiamine bromide,**  
 $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{Br}_2$ .

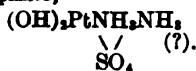
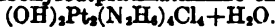
Sl. sol., even in boiling  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 320.)

**— chloride,  $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{Cl}_2$ .**

Sol. in 206 pts. cold, and 49 pts. boiling  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 316.)

**— chromate,  $(\text{OH})_2\text{Pt}(\text{NH}_2)_2\text{Cr}_2\text{O}_7$ .**

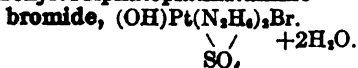
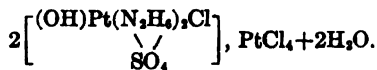
Very sl. sol. in cold or hot  $\text{H}_2\text{O}$ . (Carl-gren, Sv. V. A. F. 47. 319.)

**Hydroxyloplatin $\alpha$ diamine iodide,**  
(OH) $_2$ Pt(NH $_2$ ) $_4$ I $_2$ .Sl. sol. in hot or cold H $_2$ O. (Carlgren.)— **nitrate,** (OH) $_2$ Pt(NH $_2$ ) $_4$ (NO $_3$ ) $_2$ .Sl. sol. in cold, moderately sol. in hot H $_2$ O. (Gerhardt, A. 76. 315.)Sol. in 343 pts. cold, and 38 pts. boiling H $_2$ O. (Carlgren, Sv. V. A. F. 47. 318.)— **nitrite,** (OH) $_2$ Pt(NH $_2$ ) $_4$ (NO $_2$ ) $_2$ .Easily sol. in H $_2$ O. (Carlgren.)— **sulphate,** (OH) $_2$ Pt(NH $_2$ ) $_4$ SO $_4$ .Very sl. sol. in boiling H $_2$ O. (Cleva.)  
+4H $_2$ O. Efflorescent. (Carlgren, Sv. V. A. F. 47. 313.)**Hydroxyloplatin $\alpha$ monodiamine nitrate,**Very easily sol. in H $_2$ O. (Cleve.)**Hydroxyloplatin $\alpha$ semidiamine nitrate,**Easily sol. in H $_2$ O. (Cleve.)— **sulphate,**Sol. in hot H $_2$ O.**Hydroxyloplatin $\alpha$ diamine chloride,**Extremely sl. sol. in H $_2$ O.— **dichromate,** (OH) $_2$ Pt $_2$ (N $_2$ H $_4$ ) $_4$ (Cr $_2$ O $_7$ ) $_2$ .

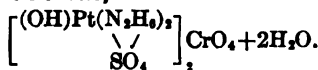
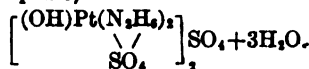
Ppt. (Cleve.)

— **nitrate,** (OH) $_2$ Pt $_2$ (N $_2$ H $_4$ ) $_4$ (NO $_3$ ) $_4$ .Very sl. sol. in cold, more easily in hot H $_2$ O. (Cleve.)— **phosphate,** (OH) $_2$ Pt $_2$ (N $_2$ H $_4$ ) $_4$ (PO $_4$ H) $_2$ .

Ppt.

— **sulphate,** (OH) $_2$ Pt $_2$ (N $_2$ H $_4$ ) $_4$ (SO $_4$ ) $_2$ +2H $_2$ O.Ppt. Nearly insol. in H $_2$ O.**Hydroxylosulphatoplatin $\alpha$ diamine**Easily sol. in H $_2$ O. (Cleve.)— **chloride,** (OH)Pt(N $_2$ H $_4$ ) $_2$ Cl $\begin{array}{c} \text{SO}_4 \\ \text{SO}_4 \end{array}$ +2H $_2$ O.Moderately sol. in cold, very sol. in hot H $_2$ O.**Hydroxylosulphatoplatin $\alpha$ diamine chloroplatinate,**

Ppt.

— **chromate,**Sl. sol. in H $_2$ O.— **dichromate,**  $\left[ \begin{array}{c} \text{(OH)Pt(N}_2\text{H}_4)_2 \\ \text{SO}_4 \end{array} \right]_2$ Cr $_2$ O $_7$ .Sl. sol. in H $_2$ O.— **nitrate,** (OH)Pt(N $_2$ H $_4$ ) $_2$ NO $_3$  $\begin{array}{c} \text{SO}_4 \\ \text{SO}_4 \end{array}$ Sol. in hot H $_2$ O.— **sulphate,**Sl. sol. in H $_2$ O. (Cleve.)**Hypoantimonic acid.****Calcium hypoantimonate** (?), Ca $_2$ Sb $_2$ O $_8$ .

Min. Romeite. Insol. in acids.

**Potassium hypoantimonate,** K $_2$ Sb $_2$ O $_8$ .Sol. in hot H $_2$ O. Sol. in 425 pts. boiling H $_2$ O (Brandes). Sol. in boiling KOH+aq (Berzelius).K $_2$ Sb $_2$ O $_8$ . Ppt.**Hypoboric acid.****Sodium hypoborate,** NaOBH $_2$ .

Deliquescent, decomp. in aq. solution at room temp. Decomp. by acids. Sl. sol. in alcohol with decomp. (Stock, B. 1914, 47. 821.)

**Hypobromous acid, HBrO.**

Known only in aqueous solution.

Solution containing 6.21 pts. Br as HBrO in 100 com. H $_2$ O decomposes at 30°. If dilute solution is distilled in vacuo, an acid containing 0.736 pt. Br as HBrO in 100 com. is obtained at first, but the distillate slowly grows weaker. Dil. solution, stable at ordinary temp., decomp. by heating over 60°. (Dancer A. 136. 237.)**Barium hypobromite.**

Known only in solution.

**Calcium hypobromite bromide.**

Deliquescent, and sol. in  $H_2O$  with partial decomp. (Berzelius.)

**Potassium hypobromite,  $KBrO$ .**

Known only in solution.

**Sodium hypobromite.**

Known only in solution.

**Strontium hypobromite.**

Known only in solution.

**Hypochlorous acid,  $HClO$ .**

Miscible with  $H_2O$ . Decomposes at  $0^\circ$  in the dark, more rapidly at higher temp. or in light. The stronger the solution the more rapid the decomposition. Moderately strong acid may be distilled without any considerable decomp., a stronger acid distilling over at first, and afterwards an acid weaker than the original acid. Very conc. or very dil. acids decomp. by distillation.

**Ammonium hypochlorite.**

Known only in aqueous solution, which decomposes at once.

**Barium hypochlorite.**

Known only in solution.

**Calcium hypochlorite,  $Ca(OCl)_2 + 4H_2O$ .**

Deliquescent, and sol. in  $H_2O$ . (Kinsagett, Chem. Soc. (2) 13. 404.)

**Calcium hypochlorite chloride, etc. (bleaching powder),  $Ca(OCl)_2$ ,  $CaCl_2$ ,  $Ca(OH)_2 + H_2O$ .**

Not deliquescent. Sol. in  $H_2O$ . Alcohol does not dissolve out  $CaCl_2$ . Sol. in 20 pts.  $H_2O$  with a slight residue.

Correct formula is  $CaOCl_2$  (Lunge and Schäppi; Kraut, A. 214. 354),  $Ca \overset{OCl}{OH}$  (Stahlschmidt, B. 8. 869),  $CaOCl$ ,  $Cl$  (Odling).

$CaCl_2$  is dissolved out by alcohol. Formula =  $2Ca \overset{OH}{OCl} CaCl + 2H_2O$ . (Dreyfuss, Bull. Soc. (2) 41. 600.)

**Didymium hypochlorite,  $Di(OCl)_2$ .**

Difficultly sol. in  $H_2O$ . Easily sol. in acids. (Frerichs and Smith, A. 191. 348.)

**Lanthanum hypochlorite,  $La(OCl)_2$ .**

Easily sol. in  $H_2O$ . (Frerichs and Smith.)

**Lithium hypochlorite,  $LiClO$ .**

Known only in solution. (Kraut, A. 1882, 214. 356.)

**Magnesium hypochlorite.**

Known only in solution.

**Potassium hypochlorite,  $KClO$ .**

Known only in solution.

**Silver hypochlorite,  $AgClO$ .**

Very sol. in  $H_2O$ , and decomp. very quickly. (Stas, Acad. R. de Belg. 35. 103.)

**Sodium hypochlorite,  $NaClO$ .**

Known only in solution.

**Hypoiodic acid,  $I_2O_4$ .**

See Iodine tetroxide.

**Hypoiodous acid,  $HOI$ .**

Known only in solution which decomp. on standing. (Taylor, C. N. 1897, 76. 97.)

**Calcium hypoiodite iodide,  $Ca(OI)_2$ ,  $CaI_2$ .**

Not very unstable. (Lunge and Shoch, B. 15. 1883.)

**Hyponitric acid,  $N_2O_4$ .**

See Nitrogen tetroxide.

**Hyponitrous acid,  $HNO$ , or better  $H_2N_2O_2$ .**

Known only in aqueous solution. Solution is quite stable. (van der Plaats, B. 10. 1507.)

Very deliquescent; sol. in  $H_2O$  and alcohol; sol. in ether, chloroform, benzene; sl. sol. in petroleum ether. (Hantzsch and Kaufmann, A. 1896, 292. 323.)

**Ammonium hyponitrite,  $(NH_4)_2N_2O_2$ .**

Sol. in  $H_2O$  and in alcohol. (Jackson, C. N. 1893, 68. 266.)

**Ammonium hydrogen hyponitrite,  $NH_4HN_2O_2$ .**

Easily sol. in  $H_2O$ . The solid salt slowly decomp. at ord. temp. into ammonia,  $H_2O$  and  $N_2O$ . (Hantzsch and Kaufmann, A. 1896, 292. 328.)

**Barium hyponitrite,  $BaN_2O_2$ .**

Nearly insol. in, but gradually decomp. by  $H_2O$ . Sol. in conc. acids with evolution of  $N_2O$ , but sol. in dil.  $HC_2H_3O_2 + Aq$  without decomp. (Zorn, B. 15. 1007.)

+  $4H_2O$ . Sl. sol. in  $H_2O$ ; insol. in alcohol and ether. (Kirschner, Z. anorg. 1898, 16. 424.)

+  $zH_2O$ . Efflorescent. (Maquenne, C. R. 108. 1303.)

**Barium hydrogen hyponitrite,  $BaH_2(N_2O_2)_2$ .**

Easily sol. in  $H_2O$ . (Zorn, B. 1882, 15. 1011.)

**Calcium hyponitrite,  $CaN_2O_2 + 4H_2O$ .**

Nearly insol. in  $H_2O$ ; easily sol. in dil. acids. (Maquenne, C. R. 108. 1303.)

Sl. sol. in  $H_2O$ ; insol. in alcohol. (Kirschner, Z. anorg. 1898, 16. 426.)

**Cupric hyponitrite, basic,  $\text{CuN}_2\text{O}_3$ ,  $\text{Cu}(\text{OH})_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; not decomp. by hot  $\text{H}_2\text{O}$ .  
Sol. in dil. acids and in ammonia. Decomp. by  $\text{NaOH}$ . (Divers, Chem. Soc. 1899, 75. 121.)  
Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kirschner, Z. anorg. 1898, 16. 430.)

**Cuprous hyponitrite,  $\text{Cu}_2\text{N}_2\text{O}_3 + 2\text{H}_2\text{O}$ .**

Ppt. (Kolotow, C. C. 1891, I. 1859.)  
Cannot be formed. (Divers, Chem. Soc. 1899, 75. 121.)

**Lead hyponitrite, basic,  $\text{PbN}_2\text{O}_3$ ,  $\text{PbO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids from which it may be pptd. by  $\text{NaOH} + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Kirschner, Z. anorg. 1898, 16. 430.)

**Lead hyponitrite,  $\text{PbN}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids from which it may be pptd. by  $\text{NaOH} + \text{Aq}$  or  $\text{NH}_3 + \text{Aq}$ . (Kirschner.)

**Mercuric hyponitrite, basic,  $3\text{HgO}$ ,  $\text{HgN}_2\text{O}_3 + 3\text{H}_2\text{O}$ .**

Ppt. Sl. sol. even in boiling dil.  $\text{HNO}_3$ . Scarcely sol. in conc., very sol. in warm dil.  $\text{HCl}$ . (Ray, Chem. Soc. 1897, 71. 349.)

**Mercurous hyponitrite,  $\text{Hg}_2\text{N}_2\text{O}_3$ .**

Sol. in dil.  $\text{HNO}_3$  with slow decomp. (Ray, Chem. Soc. 1907, 91. 1404.)

**Mercuric hyponitrite,  $\text{HgN}_2\text{O}_3$ .**

Sol. in  $\text{HCl}$ , and in  $\text{NaCl} + \text{Aq}$ .  
Sl. sol. in very dil. alkali. (Divers, Chem. Soc. 1899, 75. 119.)

**Potassium hyponitrite,  $\text{K}_2\text{N}_2\text{O}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (van der Plaats.)  
Stable when dry.  
Sol. in 90% alcohol, and al. sol. in abs. alcohol. (Divers, Chem. Soc. 1899, 75. 103.)

**Silver hyponitrite (nitrosyl silver),  $\text{Ag}_2\text{N}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .  
Decomp. by  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{S}$ , and boiling  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (van der Plaats.)  
Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Divers, C. N. 23. 206.)  
Sol. in dil.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ , and in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ ; decomp. by  $\text{HCl}$ . (Kirschner, Z. anorg. 1898, 16. 431.)

**Sodium hyponitrite,  $\text{Na}_2\text{N}_2\text{O}_3 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (van der Plaats.)

**Strontium hyponitrite,  $\text{SrN}_2\text{O}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Roederer, Bull. Soc. 1906, (3) 35. 715.)  
 $+ 5\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol.

in dil. acids. (Maquenne, C. R. 106. 1803.)

Sl. sol. in  $\text{H}_2\text{O}$ , insol. in alcohol. (Kirschner, Z. anorg. 1898, 16. 426.)

**Hypophosphomolybdic acid,  $\text{Mo}_3\text{O}_9$ ,  $7\text{H}_2\text{PO}_3 + 3\text{H}_2\text{O}$ .**

Very al. sol. in cold  $\text{H}_2\text{O}$ . Scarcely sol. in cold dil.  $\text{H}_2\text{SO}_4$ . Sol. in cold conc.  $\text{H}_2\text{SO}_4$ . Sol. in warm conc.  $\text{HCl}$ . Warm  $\text{HNO}_3$  oxidizes forming clear solution. (Mawrow, Z. anorg. 1901, 28. 164.)

**Ammonium hypophosphomolybdate,  $2(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{PO}_3$ ,  $8\text{MoO}_3 + 2\text{H}_2\text{O}$ .**

Not very sol. in cold  $\text{H}_2\text{O}$ , readily in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 402.)

**Hypophosphoric acid,  $\text{H}_4\text{P}_2\text{O}_6$ .**

Very deliquescent, and sol. in the least amount of  $\text{H}_2\text{O}$ . (Joly, C. R. 101. 1058.)

100 cc.  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , containing 4.1%  $\text{P}_2\text{O}_5$ , has sp. gr. = 1.036.

100 cc.  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ , containing 12.3%  $\text{P}_2\text{O}_5$ , has sp. gr. = 1.122.

(Salzer, A. 1878, 194. 28.)

$+ \text{H}_2\text{O}$ . (Sanger, A. 232. 14.)

Does not exist. (Joly.)

$+ 2\text{H}_2\text{O}$ . Appears to be the only stable hydrate between  $0^\circ$  and  $60^\circ$ .

Sanger's hydrate,  $\text{H}_4\text{P}_2\text{O}_6 + \text{H}_2\text{O}$ , and Joly's anhydride could not be obtained. (Rosenheim, B. 1906, 41. 2711.)

**Aluminum hypophosphate,  $\text{Al}_2(\text{P}_2\text{O}_6)_3 + 23\text{H}_2\text{O}$ .**

Easily sol. in mineral acids. Sol. in  $\text{Na}_2\text{P}_2\text{O}_6 + \text{Aq}$ . (Palm, Dissertation, Rostock, 1890.)

**Ammonium hypophosphate,  $(\text{NH}_4)_2\text{P}_2\text{O}_6 + \text{H}_2\text{O}$ .**

Sol. in 30 pts.  $\text{H}_2\text{O}$ . (Salzer, A. 194. 32.)

**Ammonium hydrogen hypophosphate,  $(\text{NH}_4)_2\text{H}_2\text{P}_2\text{O}_6$ .**

Sol. in 14 pts. cold, and 4 pts. boiling  $\text{H}_2\text{O}$ . (Salzer, A. 194. 32.)

**Ammonium trihydrogen hypophosphate,  $\text{NH}_4\text{H}_3\text{P}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Ammonium magnesium hypophosphate,  $(\text{NH}_4)_2\text{MgP}_2\text{O}_6 + 6\text{H}_2\text{O}$ .**

Precipitate. (Salzer, A. 232. 114.)

**Barium hypophosphate,  $\text{Ba}_2\text{P}_2\text{O}_6$ .**

Very slightly sol., but not wholly insol. in  $\text{H}_2\text{O}$ . Very slightly sol. in acetic acid, but more soluble in hydrochloric, and hypophosphoric acids. (Salzer, A. 194. 34.)

**Barium hydrogen hypophosphate,  $\text{BaH}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Soluble in about 1000 pts.  $\text{H}_2\text{O}$ . Solution decomposes by heating. (Salzer, A. 194. 34.)



**Bismuth hypophosphate**,  $\text{Bi}_4(\text{P}_2\text{O}_5)_3 + 8\frac{1}{2}\text{H}_2\text{O}$ .

Completely sol. in  $\text{HCl} + \text{Aq}$ , also in warm  $\text{HNO}_3 + \text{Aq}$ . Insol. in boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sl. sol. by long boiling with conc.  $\text{H}_2\text{SO}_4$ . (Palm, Rostock, 1890.)

**Cadmium hypophosphate**,  $\text{Cd}_3\text{P}_2\text{O}_8 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Draue, B. 21. 3403.)

**Cadmium potassium hydrogen hypophosphate**,  $\text{CdK}_2(\text{H}_2\text{P}_2\text{O}_6)_2 + 2\frac{1}{2}\text{H}_2\text{O}$ .

(Bausa, Z. anorg. 1894, 6. 147.)

**Cadmium sodium hypophosphate**,  $\text{CdNa}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Sol. in dil. acids. (Draue.)

**Calcium hypophosphate**,  $\text{Ca}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in  $\text{HCl} + \text{H}_2\text{O}_2$ ; easily sol. in  $\text{H}_2\text{P}_2\text{O}_6$ , or  $\text{HCl} + \text{Aq}$ . (Salzer, A. 194. 36.)

**Calcium hydrogen hypophosphate**,

$\text{CaH}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Sol. in 60 pts.  $\text{H}_2\text{O}$ . (Salzer, A. 232. 114.)

**Chromic hypophosphate**,  $\text{Cr}_4(\text{P}_2\text{O}_5)_3 + 34\text{H}_2\text{O}$ .

Sol. in  $\text{HCl} + \text{Aq}$  on sl. warming, also in  $\text{HNO}_3 + \text{Aq}$ . Not completely sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but completely sol. in conc.  $\text{H}_2\text{SO}_4$ . (Palm, Dissertation, Rostock, 1890.)

**Cobaltous hypophosphate**,  $\text{Co}_3\text{P}_2\text{O}_8 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Draue, B. 21. 3403.)

**Cobaltous potassium hypophosphate**,

$\text{CoK}_2\text{P}_2\text{O}_6 + 5\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 156.)

**Cobaltous potassium hydrogen hypophosphate**,  $\text{CoH}_2\text{P}_2\text{O}_6, 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

**Cobaltous sodium hypophosphate**,  $\text{CoNa}_2\text{P}_2\text{O}_6 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Sol. in dil. acids. (Draue, B. 21. 3403.)

**Cupric hypophosphate**,  $\text{Cu}_3\text{P}_2\text{O}_8 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Draue, B. 21. 3403.)

Ppt. (Bausa, Z. anorg. 1894, 6. 145.)

**Cupric potassium hydrogen hypophosphate**,  $\text{CuH}_2\text{P}_2\text{O}_6, 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 152.)

**Glucinum hypophosphate**,  $\text{Gl}_2\text{P}_2\text{O}_6 + 7\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Moderately sol. in all mineral acids. (Palm, Rostock, 1890.)

+  $3\text{H}_2\text{O}$ . (Rammelsberg.)

**Iron (ferrous) hypophosphate**,  $\text{Fe}_2\text{P}_2\text{O}_8 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in cold  $\text{HCl} + \text{Aq}$ . Decomp. by hot  $\text{HNO}_3 + \text{Aq}$  into  $\text{Fe}_2(\text{P}_2\text{O}_5)_3$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Somewhat sol. in cold  $\text{H}_2\text{SO}_4$ , but a ppt. separates out on heating. (Palm, Rostock, 1890.)

**Iron (ferric) hypophosphate**,  $\text{Fe}_4(\text{P}_2\text{O}_5)_3 + 20\text{H}_2\text{O}$ .

Easily sol. in  $\text{HCl} + \text{Aq}$ . Wholly insol. in  $\text{HNO}_3$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Completely sol. in conc.  $\text{H}_2\text{SO}_4$  by warming a short time, but a ppt. separates out on boiling. (Palm.)

**Lead hypophosphate**,  $\text{Pb}_2\text{P}_2\text{O}_8$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl} + \text{H}_2\text{O}_2$ , or  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Salzer.)

**Lithium hypophosphate**,  $\text{Li}_4\text{P}_2\text{O}_6 + 7\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Salzer, A. 194. 28.) Sol. in 120 pts.  $\text{H}_2\text{O}$  at ord. temp. (Rammelsberg, J. pr. (2) 45. 153.)

$\text{Li}_2\text{H}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ . Deliquescent. (Rammelsberg.)

**Magnesium hypophosphate**,  $\text{Mg}_3\text{P}_2\text{O}_8 + 12\text{H}_2\text{O}$ .

Sol. in 15,000 pts.  $\text{H}_2\text{O}$ ; sl. sol. in acetic, easily in hypophosphoric, or mineral acids. (Salzer, A. 232. 114.)

+  $24\text{H}_2\text{O}$ . (Rammelsberg.)

**Magnesium hydrogen hypophosphate**,

$\text{MgH}_2\text{P}_2\text{O}_6 + 4\text{H}_2\text{O}$ .

Sol. in 200 pts.  $\text{H}_2\text{O}$ . (Salzer, A. 232. 114.)

**Manganese hypophosphate**,  $\text{Mn}_3\text{P}_2\text{O}_8 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in mineral acids, insol. in acetic acid. (Palm, Dissertation, Rostock, 1890.)

**Manganous potassium hydrogen hypophosphate**,  $\text{MnH}_2\text{P}_2\text{O}_6, \text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 3\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 150.)

**Manganous sodium hypophosphate**,  $\text{Mn}_2\text{P}_2\text{O}_8, \text{Na}_4\text{P}_2\text{O}_6 + 11\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in mineral acids. (Palm.)

**Nickel hypophosphate**,  $\text{Ni}_2\text{P}_2\text{O}_8 + 12\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Draue, B. 21. 3401.)

**Nickel potassium hypophosphate**,

$\text{NiK}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 155.)

**Nickel potassium hydrogen hypophosphate**,  $\text{NiH}_2\text{P}_2\text{O}_6, 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 144.)

**Nickel sodium hypophosphate**,  $\text{NiNa}_2\text{P}_2\text{O}_6 + 12\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Easily sol. in dil. acids. (Drawe.)

**Potassium hypophosphate**,  $\text{K}_2\text{P}_2\text{O}_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\frac{1}{4}$  pt.  $\text{H}_2\text{O}$ ; insol. in alcohol. (Salzer, A. 211. 1.)

**Potassium hydrogen hypophosphate**,  $\text{K}_2\text{HP}_2\text{O}_6 + 3\text{H}_2\text{O}$ .

Sol. in  $\frac{1}{2}$  pt.  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium dihydrogen hypophosphate**,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 3\text{H}_2\text{O}$ , and  $+2\text{H}_2\text{O}$ .

Sol. in 3 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium trihydrogen hypophosphate**,  $\text{KH}_2\text{P}_2\text{O}_6$ .

Sol. in  $1\frac{1}{2}$  pts. cold, and  $\frac{1}{2}$  pt. hot  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium pentahydrogen dihypophosphate**,  $\text{K}_2\text{H}_5(\text{P}_2\text{O}_6)_2 + 2\text{H}_2\text{O}$ .

Sol. in  $2\frac{1}{2}$  pts. cold, and  $\frac{1}{4}$  pt. boiling  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Potassium sodium hypophosphate**,  $\text{Na}_2\text{K}_2\text{P}_2\text{O}_6 + 9\text{H}_2\text{O}$ .

Sol. in about 25 pts. cold, and 3 pts. hot  $\text{H}_2\text{O}$ . (Bausa, Z. anorg. 1894, 6. 158.)

**Potassium zinc hydrogen hypophosphate**,  $\text{ZnH}_2\text{P}_2\text{O}_6 \cdot 3\text{K}_2\text{H}_2\text{P}_2\text{O}_6 + 15\text{H}_2\text{O}$ .

Ppt. (Bausa, Z. anorg. 1894, 6. 148.)

**Silver hypophosphate**,  $\text{Ag}_4\text{P}_2\text{O}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  Very sl. sol. in  $\text{H}_4\text{P}_2\text{O}_6 + \text{Aq.}$  (Salzer, A. 232. 114.)

**Sodium hypophosphate**,  $\text{Na}_4\text{P}_2\text{O}_6 + 10\text{H}_2\text{O}$ .

Sol. in about 30 pts. cold, much more easily in hot  $\text{H}_2\text{O}$ . (Salzer.)

**Sodium hydrogen hypophosphate**,  $\text{Na}_2\text{HP}_2\text{O}_6 + 9\text{H}_2\text{O}$ .

Sol. in 22 pts.  $\text{H}_2\text{O}$ . (Salzer.)

**Sodium dihydrogen hypophosphate**,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_6 + 6\text{H}_2\text{O}$ .

Sol. in 45 pts. cold, and 5 pts. boiling  $\text{H}_2\text{O}$ . More sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Insol. in alcohol. (Salzer, A. 187. 331.)

**Sodium trihydrogen hypophosphate**,  $\text{NaH}_2\text{P}_2\text{O}_6$ .

Sol. in  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Sodium trihydrogen dihypophosphate**,

Very efflorescent. Sol. in 15 pts. cold  $\text{H}_2\text{O}$ . (Salzer, A. 211. 1.)

**Thallium hypophosphate**,  $\text{Tl}_4\text{P}_2\text{O}_6$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. in sunlight. (Joly, C. R. 1894, 118. 650.)

**Thallium hydrogen hypophosphate**,  $\text{Tl}_2\text{H}_2\text{P}_2\text{O}_6$ .

Sol. in  $\text{H}_2\text{O}$ . (Joly.)

**Zinc hypophosphate**,  $\text{Zn}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Drawe, B. 21. 3403.)

**Hypophosphorosomolybdic acid.**

**Barium hypophosphorosomolybdate**,  $\text{BaO}, \text{Mo}_7\text{O}_{23}, 3\text{H}_2\text{PO}_3 + 12\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and  $\text{BaCl}_2 + \text{Aq.}$  (Mawrow, Z. anorg. 1902, 29. 156.)

**Hypophosphorous acid**,  $\text{H}_3\text{PO}_3$ .

Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Rose.)

**Aluminum hypophosphite.**

Not deliquescent, but very sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 86.)

**Ammonium hypophosphite**,  $\text{NH}_4\text{H}_2\text{PO}_3$ .

Sol. in  $\text{H}_2\text{O}$ , less deliquescent than the potassium salt. (Wurtz, A. ch. (3) 7. 193.)

Very sol. in absolute alcohol. (Dulong.) Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

**Barium hypophosphite**,  $\text{Ba}(\text{H}_2\text{PO}_3)_2 + \text{H}_2\text{O}$ .

Sol. in 3.5 pts. cold, and 3 pts. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol. (Wurtz, A. 43. 323.)

**Bismuth hypophosphite**,  $\text{Bi}(\text{H}_2\text{PO}_3)_3$ .

Ppt. (Vanino, J. pr. 1906, (2) 74. 150.)  $+ \text{H}_2\text{O}$ . Sol. in acid  $\text{Bi}(\text{NO}_3)_3 + \text{Aq.}$  (Haga, Chem. Soc. 1895, 67. 229.)

**Cadmium hypophosphite.**

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 91.)

**Calcium hypophosphite**,  $\text{Ca}(\text{PH}_2\text{O}_3)_2$ .

Sol. in 6 pts. cold, and not much more sol. in hot  $\text{H}_2\text{O}$ . Insol. in strong, very sol. in weak alcohol. (Rose, Pogg. 9. 361.)

**Calcium cobaltous hypophosphite.**

$2\text{Ca}(\text{PH}_2\text{O}_3)_2, \text{Co}(\text{PH}_2\text{O}_3)_2 + 2\text{H}_2\text{O}$ .

Efflorescent. (Rose, Pogg. 12. 295.)

**Calcium ferrous hypophosphite.**

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 294.)

**Cerous hypophosphite**,  $\text{Ce}(\text{PH}_2\text{O}_3)_3 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1872. 437.)

**Chromium hypophosphite,  $\text{Cr}_2(\text{OH})_2(\text{H}_2\text{PO}_2)_4$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$  or dil. acids.  
 $+3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Wurts, A. ch. (3) 16. 196.)

**Cobaltous hypophosphite,  $\text{Co}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .**

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 87.)

**Cupric hypophosphite,  $\text{Cu}(\text{PH}_2\text{O}_2)_2$ .**

Very sol. in  $\text{H}_2\text{O}$ , but very easily decomp. on heating. (Wurtz, A. ch. (3) 16. 199.)

**Glucinum hypophosphite.**

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 86.)

**Iron (ferrous) hypophosphite,  $\text{Fe}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 12. 294.)

**Iron (ferric) hypophosphite.**

Difficultly sol. in  $\text{H}_2\text{O}$  or acids. Decomp. on boiling. Sl. sol. in  $\text{H}_3\text{PO}_4 + \text{Aq.}$  (Rose.)

**Lead hypophosphite,  $\text{Pb}(\text{PH}_2\text{O}_2)_2$ .**

Difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rose, Pogg. 12. 288.)

**Lithium hypophosphite,  $\text{LiH}_2\text{PO}_2 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1872. 416.)

**Magnesium hypophosphite,  $\text{Mg}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .**

Efflorescent in dry air. Sol. in  $\text{H}_2\text{O}$ . (Rose.)

**Manganous hypophosphite,  $\text{Mn}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$ .**

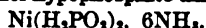
Permanent. Very sol. in  $\text{H}_2\text{O}$ . (Wurts, A. ch. (3) 16. 195.)

**Mercurous hypophosphite nitrate,**

Sl. sol. in  $\text{H}_2\text{O}$  with rapid decomp.  
 Sol. in hot conc.  $\text{HNO}_3$ . (Haga, Chem. Soc. 1895, 67. 227.)

**Nickel hypophosphite,  $\text{Ni}(\text{PH}_2\text{O}_2)_2 + 6\text{H}_2\text{O}$ .**

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 5. 494.)

**Nickel hypophosphite ammonia,**

(Ephraim, B. 1913, 46. 3111.)

**Platinous hypophosphite  $\text{Pt}(\text{PH}_2\text{O}_2)_2$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4 + \text{Aq.}$  etc. Sol. in  $\text{HNO}_3 + \text{Aq.}$  Insol. in alcohol. (Engel, C. R. 91. 1068.)

**Potassium hypophosphite,  $\text{KH}_2\text{PO}_2$ .**

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . sol. in weak, less in absolute alcohol. Insol. in ether. (Wurts, A. ch. (3) 7. 192.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

**Sodium hypophosphite,  $\text{NaH}_2\text{PO}_2 + \text{H}_2\text{O}$ .**

Very deliquescent. Somewhat less sol. than the K salt. Very sol. in absolute alcohol. (Dulong.)

Very sol. in  $\text{H}_2\text{O}$ , and somewhat less sol. in alcohol. (Rammelsberg, B. A. B. 1872. 412.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

**Strontium hypophosphite,  $\text{Sr}(\text{PH}_2\text{O}_2)_2$ .**

Very easily sol. in  $\text{H}_2\text{O}$ . (Dulong.)

Insol. in alcohol. (Wurts.)

**Thallous hypophosphite,  $\text{TlH}_2\text{PO}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1872. 492.)

**Uranyl hypophosphite,  $\text{UO}_2(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg, Chem. Soc. (2) 11. 1.)

**Vanadyl hypophosphite,  $\text{V}_2\text{O}_5(\text{H}_2\text{PO}_2)_4 + 2\text{H}_2\text{O}$ .**

Insol. in cold, al. sol. in hot  $\text{H}_2\text{O}$ .  
 Sol. in hot dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3$  and in warm conc.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ .

Insol. in oxalic acid. (Mawrow, Z. anorg. 1907, 55. 147.)

**Zinc hypophosphite,  $\text{Zn}(\text{H}_2\text{PO}_2)_2 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .  
 $+6\text{H}_2\text{O}$ . Efflorescent. (Wurts, A. ch. (3) 16. 195.)

**Zirconium hypophosphite,  $\text{Zr}(\text{OPH}_2\text{O})_4 + \text{H}_2\text{O}$ .**

Sensitive to light. Insol. in alcohol, by which it is pptd. from aqueous solution. (Hauser, Z. anorg. 1913, 84. 93.)

**Hypophosphotungstic acid.****Potassium hypophosphotungstate,  $4\text{K}_2\text{O}, 6\text{H}_2\text{PO}_2, 18\text{WO}_3 + 7\text{H}_2\text{O}$ .**

Precipitate. Sol. in hot, very al. sol. in cold  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 5. 361.)

**Hyposulpharsenious acid.****Hyposulpharsenites,  $\text{As}_2\text{S}_2, \text{M}_2\text{S}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
 Do not exist. (Nilson, B. 4. 989.)

**Hyposulphuric acid,  $\text{H}_2\text{S}_2\text{O}_4$ .**

See Dithionic acid.

**Hyposulphurous acid,  $\text{H}_2\text{S}_2\text{O}_3$ .***See* Thiosulphuric acid.**Hyposulphurous (Hydrosulphurous) acid,  $\text{H}_2\text{SO}_3$ .**

Known only in dil. aqueous solution, which decomposes rapidly.

Correct formula is  $\text{H}_2\text{S}_2\text{O}_4$ , according to Bernthsen (A. 211. 285.)More sol. in alcohol than in  $\text{H}_2\text{O}$ . (Roesler, Arch. Pharm. (3) 25. 845.)**Ammonium hyposulphite,  $(\text{NH}_4)_2\text{S}_2\text{O}_4$ .**

Known only in solution. (Prudhomme, Bull. Soc. 1899, (3) 21. 326.)

**Ammonium hydrogen hyposulphite,  $\text{NH}_4\text{HS}_2\text{O}_4$ .**

Known only in solution. (Prudhomme, Bull. Soc. 1899, (3) 21. 326.)

**Calcium hyposulphite,  $\text{CaS}_2\text{O}_4 + 1.5\text{H}_2\text{O}$ .**Difficultly sol. in  $\text{H}_2\text{O}$ . (Baslen, B. 1905, 38. 1059.)**Magnesium hyposulphite,  $\text{MgS}_2\text{O}_4$ .**

(Billy, C. R. 1905, 140. 936.)

**Potassium hyposulphite,  $\text{K}_2\text{S}_2\text{O}_4 + 3\text{H}_2\text{O}$ .**

Easily decomp.

Insol. in alcohol. (Baslen, B. 1905, 38. 1058.)

**Sodium hyposulphite,  $\text{Na}_2\text{S}_2\text{O}_4$ .***Anhydrous.* Stable in dry air. (Baslen, B. 1905, 38. 1061.)100 g.  $\text{H}_2\text{O}$  dissolve 24.1 g. of the anhydrous salt at  $20^\circ$ . (Jellinek, Z. anorg. 1911, 70. 130.) $+2\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ :

11.6 g. of the solution contain at:

 $20^\circ$  1.91 g.  $\text{Na}_2\text{S}_2\text{O}_4$  $10^\circ$  1.67 g. " $1^\circ$  1.49 g. "

(Jellinek, Z. anorg. 1911, 70. 128.)

Insol. in alcohol. (Baslen, B. 1905, 38. 1058.)

**Sodium zinc hyposulphite,  $\text{Na}_2\text{S}_2\text{O}_4, \text{ZnS}_2\text{O}_4$ .**Less sol. in  $\text{H}_2\text{O}$  than  $\text{ZnS}_2\text{O}_4$ . (Baslen, B. 1905, 38. 1060.)**Strontium hyposulphite,  $\text{SrS}_2\text{O}_4$ .**Sol. in  $\text{H}_2\text{O}$ . (Moissan, C. R. 1902, 135. 653.)**Zinc hyposulphite,  $\text{ZnS}_2\text{O}_4$ .**Easily sol. in  $\text{H}_2\text{O}$ ; about 1 pt. in 7 pts.  $\text{H}_2\text{O}$ . Forms supersat. solutions readily. (Baslen, B. 1905, 38. 1060.)**Hypovanadic acid,  $\text{V}_2\text{O}_5(\text{OH})_4$ .***See* Vanadium tetrhydroxide.**Hypovanadic acid,  $\text{H}_2\text{V}_2\text{O}_7$ .***See* Vanadous acid.**Hypovanadic acid with vanadic acid.***See* Vanadicovanadic acid.**Imidodimetaarsenic acid.****Ammonium imidodimetaarsenate,** $(\text{NH}_4\text{O}_2\text{As}_2\text{O}_7\text{NH})$ .

(Rosenheim and Jacobsohn, Z. anorg. 1906, 50. 307.)

**Imidochromic acid.****Ammonium imidochromate,** $\text{NH}_4\text{CrO}(\text{ONH}_4)_2$ .Very sol. in  $\text{H}_2\text{O}$  with decomp. (Rosenheim and Jacobsohn, Z. anorg. 1906, 50. 299.)**Ammonium potassium imidochromate,** $\text{NH}_4\text{KCrO}_2\text{NH}$ .Decomp. on solution in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1906, 50. 302.)**Imidodimidochromic acid.****Ammonium imidodimido chromate,** $\text{NH}[\text{CrO}(\text{NH})\text{ONH}_4]_2$ .

(Rosenheim and Jacobsohn, Z. anorg. 1906, 50. 303.)

**Imidomolybdic acid.****Potassium imidomolybdate,  $\text{NKMbO}(\text{OK})_2$ .**

Unstable in air.

Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1906, 50. 305.)**Diimidodiphosphoromamic acid,** $\text{HO}-\text{PO} < \begin{smallmatrix} \text{NH} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{NH}_2$ .

Correct formula for pyrophosphotriamic acid of Gladstone. (Mente, A. 248. 241.)

**Imidodiphosphoric acid,** $\text{HO}-\text{PO} < \begin{smallmatrix} \text{O} \\ \text{NH} \end{smallmatrix} > \text{PO}-\text{OH}$ .

Correct name for pyrophosphamic acid. (Mente, A. 248. 251.)

**Barium imidodiphosphate,  $\text{Ba} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \text{PO} > \text{NH}$ .**Sl. sol. in  $\text{H}_2\text{O}$ . (Mente, A. 248. 243.)**Barium imidodiphosphate, basic,** $\text{Ba} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \begin{smallmatrix} \text{O} \\ \text{O} \end{smallmatrix} \text{PO} > \text{N}-\text{Ba}-\text{N} \begin{smallmatrix} \text{PO}-\text{O} \\ \text{PO}-\text{O} \end{smallmatrix} \text{Ba} +$  $2\text{H}_2\text{O}$ .

Ppt. (Mente.)

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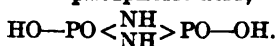
**Ferric imidodiphosphate.**

Sl. sol. in conc. acids. (Mente, A. 248. 241.)

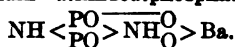
**Silver imidodiphosphate,  $\text{Ag}_3\text{H}_2\text{P}_2\text{NO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . (Stokes, Am. Ch. J. 1896, 18. 660.)

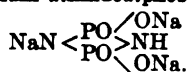
$\text{Ag}_4\text{HP}_2\text{NO}_4$ . Ppt. (Stokes.)

**Diimidodiphosphoric acid,**

Correct name for *pyrophosphodiamic acid*. (Mente, A. 248. 241.)

**Barium diimidodiphosphate,**

Sl. sol. in dil. acids. (Mente, A. 248. 244.)

**Sodium diimidodiphosphate, basic,**

Sl. sol. in  $\text{H}_2\text{O}$ . (Mente, A. 248. 245.)

**Diimidotriphosphoric acid.****Silver diimidotriphosphate,  $\text{Ag}_3\text{H}_2\text{P}_3\text{N}_2\text{O}_8$ .**

Insol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Rather sl. sol. in dil.  $\text{HNO}_3$ . (Stokes, Am. Ch. J. 1896, 18. 657.)

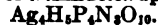
$\text{Ag}_4\text{H}_2\text{P}_3\text{N}_2\text{O}_8$ . Insol. in  $\text{H}_2\text{O}$ . Very sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Decomp. by  $\text{HNO}_3$ . (Stokes.)

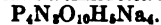
**Trisodium diimidotriphosphate,**

Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Stokes.)

**Triimidotetraphosphoric acid.****Silver triimidotetraphosphate.**

Ppt. (Stokes, Am. Ch. J. 1898, 20. 755.)

**Sodium triimidotetraphosphate,**

Easily sol. in  $\text{H}_2\text{O}$ ; insol. in sodium acetate solution and dil. alcohol. (Stokes, Am. Ch. J. 1898, 20. 754.)

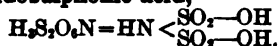
**Imidosulphamide,  $\text{NH}_2\text{SO}_2\text{NH}\cdot\text{SO}_2\text{NH}_2$ .**

"Sulphamide" of Traube.

Very sol. in  $\text{H}_2\text{O}$  with decomp. appreciably sol. in cold, easily sol. in hot methyl and ethyl alcohol. Insol. in  $\text{C}_6\text{H}_6$ , and  $\text{CHCl}_3$ . Sl. sol. in ether, cold and hot acetic ether and glacial acetic acid. Moderately stable toward alkalis. (Hantzsch and Stuer, B. 1905, 38. 1022.)

**Ammonium imidosulphamide,**

(Hantzsch and Stuer.)

**Imidosulphonic acid,**

Ammondisulphonic acid of Claus. Known only in aqueous solution. (Divers and Haga, Chem. Soc. 61. 943.)

Very unstable. (Berglund, B. 9. 252.)

**Ammonium imidosulphonate, basic,**

Sol. in 9 pts. of  $\text{H}_2\text{O}$ . Solution is stable. Insol. in alcohol.

Sl. sol. in warm conc.  $\text{H}_2\text{SO}_4$  without decomp. (Rose, Pogg. 1834, 32. 81.)

Much less sol. than the neutral salt. (Berglund, B. 9. 255.)

"Parasulphatammon."

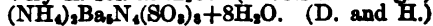
+  $\text{H}_2\text{O}$ . Gradually efflorescent. Sol. in  $\text{H}_2\text{O}$  with subsequent decomp. (Divers and Haga.)

**Ammonium imidosulphonate,  $\text{HN}(\text{SO}_2\text{NH}_4)_2$ .**

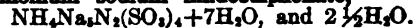
Sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

**Ammonium barium imidosulphonate,**

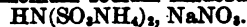
Very sl. sol. in  $\text{H}_2\text{O}$ . (Divers and Haga.)

**Ammonium calcium imidosulphonate.**

(Divers, Chem. Soc. 1892, 61. 968.)

**Ammonium sodium imidosulphonate,**

Very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Divers and Haga.)

**Ammonium sodium imidosulphonate nitrate,**

Very sol. in  $\text{H}_2\text{O}$ . (Divers and Haga.)

**Barium imidosulphonate,  $\text{Ba}[\text{N}(\text{SO}_2)_2\text{Ba}]_2 + 5\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 9. 255.)

Sol. in dil.  $\text{HNO}_3 + \text{Aq}$  without decomp. (Divers and Haga.)

$\text{HN}(\text{SO}_2)_2\text{Ba} + \text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$ . (D. and H.)

**Barium mercury imidosulphonate,**

Almost insol. in cold  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1892, 61. 977.)

**Barium sodium imidosulphonate,**

Sparsely sol. in  $\text{H}_2\text{O}$ . Readily sol. in  $\text{HNO}_3$  or  $\text{HCl}$ . (Divers, Chem. Soc. 1892, 61. 967.)

**Calcium imidosulphonate**,  $\text{Ca}[\text{N}(\text{SO}_2)_2\text{Ca}]_2 + 6\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund.)

**Calcium mercury imidosulphonate**,  $\text{N}_2\text{Hg}[(\text{SO}_2)_2\text{Ca}]_2$ .

Very sol. in  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1896, 69. 1629.)

**Calcium mercury imidosulphonate chloride**,  $(\text{NS}_2\text{O}_2\text{Ca})_2\text{Hg}_2\text{Cl} + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 1896, 69. 1629.)

**Calcium sodium imidosulphonate**,  $\text{NaN}(\text{SO}_2)_2\text{Ca} + 3\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Divers and Haga, Chem. Soc. 61. 968.)

**Lead imidosulphonate**,  $(\text{PbOHSO}_2)_2\text{NPbOH}$ .

Ppt. (Berglund.)

Insol. in  $\text{H}_2\text{O}$ . (Divers and Haga.)

$(\text{PbOH})_2\text{N}(\text{SO}_2)_2$ ,  $\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil.  $\text{HNO}_3$  + Aq. (D. and H.)

**Mercurous imidosulphonate, basic**,  $[\text{Hg}_2\text{N}(\text{SO}_2)_2\text{Hg}]_2\text{O} + 6\text{H}_2\text{O}$ .

Much more sol. in dil.  $\text{HNO}_3$  than mercuric salt. Sol. in cold conc.  $\text{KI}$  + Aq, leaving half  $\text{Hg}$  as metal. (Divers and Haga, Chem. Soc. 1896, 69. 1631.)

**Mercuric imidosulphonate, basic**,  $\text{NH}(\text{SO}_2)_2\text{HgO} \cdot \text{Hg}$ .

Easily decomp. (Divers and Haga.)

**Mercurimercuric imidosulphonate**,  $[\text{Hg}^{\text{II}}\text{N}(\text{SO}_2)_2\text{Hg}]_2\text{O} + 3\text{H}_2\text{O}$ .

(Divers and Haga.)

$[\text{Hg}^{\text{II}}\text{N}(\text{SO}_2)_2\text{Hg}]_2\text{O}$ ,  $[\text{Hg}_2\text{N}(\text{SO}_2)_2\text{Hg}]_2$ ,  $\text{Hg}^{\text{II}}\text{N}(\text{SO}_2)_2\text{Hg}_2\text{O} + 6\text{H}_2\text{O}$ . (Divers and Haga.)

**Mercury sodium imidosulphonate, basic**,  $\text{Hg}_2\text{ON}(\text{SO}_2)_2\text{Na} + 2\text{H}_2\text{O}$ .

Slightly efflorescent. Decomp. by long washing with  $\text{H}_2\text{O}$ . Much more readily sol. in  $\text{HCl}$  than in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ , and is wholly decomp. thereby. (Divers and Haga, Chem. Soc. 1892, 61. 983.)

**Mercury sodium imidosulphonate**,  $\text{HgN}_2(\text{SO}_2\text{Na})_2 + 6\text{H}_2\text{O}$ .

Sparingly sol. in cold  $\text{H}_2\text{O}$ .

Readily sol. in  $\text{HNO}_3$ , and in  $\text{HCl}$ .

Decomp. by  $\text{HCl}$  immediately, but not by  $\text{HNO}_3$ . (Divers and Haga, Chem. Soc. 1892, 61. 981.)

**Potassium imidosulphonate, basic**,  $\text{KN}(\text{SO}_2)_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

Less sol. than neutral salt. (Berglund.)

**Potassium imidosulphonate**,  $\text{HN}(\text{SO}_2\text{K})_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

= Potassium ammondisulphonate of Claus.

Difficultly sol. in cold  $\text{H}_2\text{O}$ , sol. in 64 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . (Fremy.) Gradually decomp. by boiling. (Claus.)

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 9. 255.)

**Potassium mercury imidosulphonate**,  $\text{N}_2\text{Hg}(\text{SO}_2\text{K})_2 + 4\text{H}_2\text{O}$ .

See Mercurimidosulphonic acid.

**Silver imidosulphonate**,  $\text{AgN}(\text{SO}_2\text{Ag})_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund.)

**Silver sodium imidosulphonate**,  $\text{NaN}(\text{SO}_2\text{Ag})_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Divers and Haga.)

$\text{AgNa}_2\text{N}(\text{SO}_2)_2$ . Sl. sol. in  $\text{H}_2\text{O}$ , but more sol. than the two preceding salts. (D. and H.)

**Sodium imidosulphonate**,  $\text{HN}(\text{SO}_2\text{Na})_2 + 2\text{H}_2\text{O}$ .

Not efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Diver and Haga.)

$\text{NaN}(\text{SO}_2\text{Na})_2 + 12\text{H}_2\text{O}$ . Efflorescent. Sl. sol. in cold  $\text{H}_2\text{O}$ , but very sol. in hot  $\text{H}_2\text{O}$ . Sol. in 5.4 pts.  $\text{H}_2\text{O}$  at  $27.5^\circ$ . (Divers and Haga.)

**Sodium strontium imidosulphonate**,  $\text{SrNaN}_2\text{SO}_2 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1896, 69. 1625.)

**Strontium imidosulphonate**,  $\text{Sr}[\text{N}(\text{SO}_2)_2\text{Sr}]_2 + 6\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund.)

$+12\text{H}_2\text{O}$ . Somewhat sol. in hot  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1896, 69. 1623.)

**Imidotrisulphoorthophosphoric acid**,  $\text{NH}_2\text{P}(\text{SH})_3$ .

Insol. in  $\text{CS}_2$ , and readily decomp. by  $\text{H}_2\text{O}$ . (Stock, B. 1906, 39. 1991.)

**Ammonium imidotrisulphoorthophosphate**,  $\text{NHP}(\text{SNH}_2)_3$ .

Very hygroscopic.

Looses  $\text{NH}_3$  in the air.

Somewhat sol. in liquid  $\text{NH}_3$ .

Decomp. by any other solvent in which it is sol. (Stock, B. 1906, 39. 1983.)

**Diammonium hydrogen imidotrisulphoorthophosphate**,  $\text{SHP}(\text{SNH}_2)_2\text{NH}_2$ .

(Stock, B. 1906, 39. 1983.)

**Ammonium dihydrogen ———**,  $\text{SNH}_2\text{P}(\text{SH})_2\text{NH}_2$ .

(Stock.)

**Disodium hydrogen imidotrisulphoorthophosphate**,  $\text{SHP}(\text{SNa})_2\text{NH}$ .

Very easily sol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Somewhat sol. in methyl and ethyl alcohol. (Stock.)

**Diimidopentasulphopyrophosphoric acid**,  $\text{P}_2\text{S}_5\text{N}_2\text{H}_8$ .

Not known in pure state. (Stock, B. 1906, 39. 1967.)

**Ammonium diimidopentasulphopyrophosphate**,  $\text{S}(\text{P}(\text{SNH}_2)_2\text{NH})_2$ .

Very hygroscopic.

Sol. in cold  $\text{H}_2\text{O}$  with decomp. (Stock, B. 1906, 39. 1978.)

**Inidosulphurous acid**.

**Ammonium imidosulphite**,  $\text{HN}(\text{SO}_2\text{NH}_2)_2$ .

Somewhat deliquescent.

Very unstable. Easily sol. in  $\text{H}_2\text{O}$  with decomp. into thiosulphate and amidosulphate.

Insol. in alcohol. (Divers and Ogawa, Chem. Soc. 1901, 79. 1100.)

**Ammonium barium imidosulphite**,  $\text{Ba}(\text{SO}_2\text{NHSO}_2\text{NH}_2)_2$ .

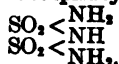
Sol. in  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1901, 79. 1102.)

**Potassium imidosulphite**,  $\text{NH}(\text{SO}_2\text{K})_2$ .

(Divers and Owaga, Proc. Chem. Soc. 1900, 16. 113.)

Very sol. in  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1901, 79. 1101.)

**Imidosulphuryl amide**,  $\text{S}_2\text{O}_4\text{N}_2\text{H}_4 =$



Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by conc.  $\text{HCl}$ . Insol. in alcohol sat. with  $\text{NH}_3$ . (Mente, A. 248. 265.)

**Indic acid**.

**Magnesium indate**,  $\text{MgIn}_2\text{O}_4 + 3\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Renz, B. 1901, 34. 2764.)

**Indium, In**.

Does not decomp. hot  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in acetic acid. Insol. in  $\text{KOH} + \text{Aq}$ . (Winkler, J. pr. 102. 273.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0039 g. In in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

**Indium monobromide**,  $\text{InBr}$ .

Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in acids. Easily sol. in cold conc.  $\text{HCl}$ . (Thiel, Z. anorg. 1904, 40. 328.)

**Indium dibromide**,  $\text{InBr}_2$ .

Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in acids. (Thiel, Z. anorg. 1904, 40. 329.)

**Indium tribromide**,  $\text{InBr}_3$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

**Indium monochloride**,  $\text{InCl}$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  into  $\text{InCl}_2$  and  $\text{In}$ . (Nilson and Pettersson, Chem. Soc. 43. 820.)

**Indium dichloride**,  $\text{InCl}_2$ .

Deliquescent in moist air; decomp. by  $\text{H}_2\text{O}$  into  $\text{InCl}_3$  and  $\text{In}$ . (Nilson and Pettersson, Chem. Soc. 43. 818.)

**Indium trichloride**,  $\text{InCl}_3$ .

Very deliquescent; sol. in  $\text{H}_2\text{O}$  with hissing and great evolution of heat.

**Indium lithium chloride**.

Extremely deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Meyer, A. 150. 144.)

**Indium potassium chloride**,  $3\text{KCl}$ ,  $\text{InCl}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Meyer.)

**Indium trifluoride**,  $\text{InF}_3 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; readily decomp. (Thiel, B. 1904, 37. 175.)

1 l.  $\text{H}_2\text{O}$  dissolves 86.4 g. at  $25^\circ$ . Decomp. on boiling. (Thiel, Z. anorg. 1904, 40. 331.)

+  $9\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ .

Sol. in  $\text{HCl}$  and in  $\text{HNO}_3$ .

Insol. in alcohol and ether. (Chabrie, C. R. 1905, 140. 90.)

**Indium hydrosulphide**.

Decomp. by acids. (Meyer.)

**Indium hydroxide**,  $\text{In}_2\text{O}_3\text{H}_2$ .

Sol. in acids; also in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  but the solution clouds up on standing or boiling, with separation of  $\text{In}_2\text{O}_3\text{H}_2$ . Insol. in  $\text{NH}_4\text{OH}$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Renz, B. 1904, 37. 2110.)

Sl. sol. in alkylamines but completely ppt. by addition of the hydrochloride of the base. (Renz, B. 1903, 36. 2754.)

**Indium monoiodide**,  $\text{InI}$ .

Slowly decomp. in moist air. Not attacked by boiling  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{HNO}_3$  in presence of  $\text{AgNO}_3$ . Very slowly sol. in cold, more rapidly sol. in

hot acids with evolution of  $H_2$ . Very sol. in sulphurous acid.

Insol. in alcohol, ether and chloroform. (Thiel, Z. anorg. 1910, 66. 302.)

**Indium diiodide,  $InI_2$ .**

(Thiel, Z. anorg. 1910, 66. 302.)

**Indium triiodide,  $InI_3$ .**

Deliquescent. (Meyer.)

Sol. in  $CHCl_3$ . Decomp. by xylene. (Thiel, Z. anorg. 1904, 40. 330.)

**Indium nitride,  $InN$ .**

Decomp. by heat. (Franz Fischer, B. 1910, 43. 1469.)

**Indium monoxide,  $InO$ .**

Gradually sol. in  $HCl + Aq$ . (Winkler, J. pr. 94. 1.)

**Indium sesquioxide,  $In_2O_3$ .**

Slowly sol. in cold, easily in hot acids.

Four modifications:

(1) Yellow. Amorphous. Sol. in acids. Its hydroxide is insol. in ammonia and  $NH_4Cl$ .

(2) White. Amorphous. Insol. in acids.

(3) White. Amorphous. Sol. in acids. Its hydroxide is sol. in ammonia, but pptd. by  $NH_4Cl$ .

(4) Crystallized. Crystalline modification is insol. in acids. (Renz, B. 1904, 37. 2112.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

**Indium oxide,  $In_2O_3 = 3InO, 2In_2O_3$  (?).**

(Winkler.)

$In_2O_3 = 2InO, In_2O_3$  (?). (Winkler.)

**Indium oxybromide (?).**

Not decomp. by hot acids or alkalis.

(Meyer, A. 160. 137.)

**Indium oxychloride,  $InOCl$ .**

Very sl. sol. in  $H_2O$ . (Thiel, B. 1904, 37. 176.)

Very sl. sol. in cold or hot dil. acids. Quickly sol. in hot conc. acids. (Thiel, Z. anorg. 1904, 40. 327.)

**Indium triselenide,  $In_2Se_3$ .**

Sol. in strong acids with evolution of  $H_2Se$ . (Thiel, Z. anorg. 1910, 66. 315.)

**Diindium sulphide,  $In_2S$ .**

Sol. in acids. (Thiel, Z. anorg. 1904, 40. 326.)

**Indium monosulphide,  $InS$ .**

Easily sol. in  $HCl$  with evolution of  $H_2S$ . Sol. in  $HNO_3$  with evolution of oxides of nitrogen. (Thiel, Z. anorg. 1910, 66. 314.)

**Indium sesquisulphide,  $In_2S_3$ .**

Partially sol. in  $(NH_4)_2S + Aq$ .

**Indium potassium sulphide,  $In_2S_3, K_2S$ .**

Insol. in  $H_2O$ ; decomp. by weak acids with separation of  $In_2S_3$ ; sol. in conc. acids. (Schneider, J. pr. (2) 9. 209.)

**Indium silver sulphide,  $In_2S_3, Ag_2S$ .**

Insol. in  $H_2O$ . (Schneider, l. c.)

**Indium sodium sulphide,  $In_2S_3, Na_2S + 2H_2O$ .**

Insol. in  $H_2O$ . (Schneider, l. c.)

**Indium monotelluride,  $InTe$ .**

Sol. in  $HNO_3$ ; insol. in  $HCl + Aq$ . (Thiel, Z. anorg. 1910, 66. 318.)

**Infusible white precipitate.**

**Diiodamine,  $NHI_2$ .**

Decomp. by  $H_2O$ .

**Iodammonium iodide,  $NHI_2I$ .**

Decomp. by  $H_2O$ , caustic alkalis, and acids. Sol. in  $KI + Aq$ , alcohol, ether,  $CS_2$ ,  $CHCl_3$ . (Guthrie, Chem. Soc. (2) 1. 239.)

**Iodauric acid,  $HAuI_4$  (?).**

Not known with certainty.

**Ammonium iodaureate.**

Deliquescent. Decomp. by  $H_2O$ . (Johnston, Phil. Mag. (3) 9. 266.)

**Barium iodaureate.**

Sol. in  $BaI_2 + Aq$ .

**Cæsium iodaureate,  $CsAuI_4$ .**

(Gupta, J. Am. Chem. Soc. 1914, 36. 748.)

**Ferrous iodaureate.**

Sol. in  $H_2O$ . (Johnston.)

**Potassium iodaureate,  $KAuI_4$ .**

Decomp. by  $H_2O$ . Sol. in  $KI$ , and  $HI + A$ . (Johnston.)

**Sodium iodaureate.**

Very deliquescent. (Johnston.)

**Iodauricyanhydric acid,  $HAu(CN)_2I_3$ .**

Known only in its salts.

**Barium iodauricyanide,  $Ba[Au(CN)_2I_3]_2 + 10H_2O$ .**

Sl. sol. in cold, easily in hot  $H_2O$ . Easily sol. in alcohol. (Lindbom, Lund. Univ. Arsk. 12. No. 6.)



**Calcium iodaurycyanide**,  $\text{Ca}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$ .

Not stable. (L.)

**Cobalt iodaurycyanide**,  $\text{Co}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$ .

Most insol. of all iodaurycyanides, and only sl. sol. in warm  $\text{H}_2\text{O}$ . Easily sol. in alcohol.

**Potassium iodaurycyanide**,  $\text{KAu}(\text{CN})_2\text{I}_2 + \text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$  and alcohol. (L.)

**Strontium iodaurycyanide**,  $\text{Sr}[\text{Au}(\text{CN})_2\text{I}_2]_2 + 10\text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

### Iodhydric Acid, HI.

Very easily and quickly absorbed by  $\text{H}_2\text{O}$ , with evolution of much heat.

Solution is decomp. on exposure to the air.

1 vol.  $\text{H}_2\text{O}$  absorbs 450 vols. HI at  $10^\circ$ . (Thomson.)

1 vol.  $\text{H}_2\text{O}$  absorbs 425 vols. HI at  $10^\circ$ . (Berthelot, C. R. 76. 679.)

Weak or strong solutions when boiled in an atmosphere of H leave a residue of constant composition, which distils unchanged at  $126^\circ$  (de Luynes), at  $127^\circ$  (Roscoe, Chem. Soc. 13. 146; Naumann; Topsøe), at  $128^\circ$  (Bineau, A. ch. (3) 7. 266); and has a sp. gr. of 1.67 (Naumann), of 1.70 (Bineau, de Luynes), of 1.708 (Topsøe); and contains 56.26 % HI (Bineau), 57.0% HI (Roscoe), 57.75% HI (Topsøe.)

By conducting dry H gas through the aqueous solution of HI, a constant residue is obtained, containing 60.3-60.7% HI if temp. is  $15-19^\circ$ , and 58.2-58.5% HI if temp. is  $100^\circ$ . (Roscoe.)

### Solubility of HI in $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	% HI	Solid Phase
-10	20.3	Ice
-20	29.3	
-30	35.1	
-40	39	
-50	42	
-60	44.4	Ice + HI, $4\text{H}_2\text{O}$
-70	46.2	
-80	47.9	
-60	52.6	
-40	59	
-35.5	64	HI, $4\text{H}_2\text{O}$
-40	65.5	
-49	66.3	
-48	70.3	
-56	73.5	
-52	74	HI, $2\text{H}_2\text{O}$

(Pickering, B. 1893, 26. 2307.)

Solution in  $\text{H}_2\text{O}$  sat. at  $0^\circ$  has sp. gr. = 1.99 (de Luynes, A. ch. (4) 2. 385); 2.0 (Vigier).

### Sp. gr. of HI + Aq.

Sp. gr.	% HI	Temp.
1.017	2.286	$13.5^\circ$
1.0524	7.019	13.5
1.077	10.15	13.5
1.095	12.21	13
1.102	13.09	13.5
1.126	15.73	13.5
1.164	19.97	13.5
1.191	22.63	13.8
1.225	25.86	13.8
1.2535	28.41	13.5
1.274	30.20	13.5
1.309	33.07	13
1.347	36.07	13
1.382	38.68	13
1.413	40.45	13
1.451	43.39	13
1.4865	45.71	13
1.528	48.22	13
1.542	49.13	13.5
1.5727	50.75	13
1.603	53.43	12.5
1.630	53.93	14
1.674	56.15	13.7
1.696	57.28	13
1.703	57.42	12.5
1.706	57.64	13.7
1.708	57.74	12

(Topsøe, B. 3. 403.)

### Sp. gr. of HI + Aq at $15^\circ$ .

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
1	1.008	21	1.175	41	1.414
2	1.015	22	1.185	42	1.429
3	1.022	23	1.195	43	1.444
4	1.029	24	1.205	44	1.459
5	1.037	25	1.216	45	1.475
6	1.045	26	1.227	46	1.491
7	1.053	27	1.238	47	1.508
8	1.061	28	1.249	48	1.525
9	1.069	29	1.260	49	1.543
10	1.077	30	1.271	50	1.561
11	1.085	31	1.283	51	1.579
12	1.093	32	1.295	52	1.597
13	1.102	33	1.307	53	1.615
14	1.110	34	1.320	54	1.634
15	1.118	35	1.333	55	1.654
16	1.127	36	1.346	56	1.674
17	1.137	37	1.359	57	1.694
18	1.146	38	1.372	58	1.713
19	1.155	39	1.386	..	...
20	1.165	40	1.400	..	...

(Topsøe, calculated by Gerlach, Z. anal. 27. 316.)

Sp. gr. of HI+Aq at 15°.

% HI	Sp. gr.	% HI	Sp. gr.	% HI	Sp. gr.
5	1.045	25	1.239	45	1.533
10	1.091	30	1.296	50	1.650
15	1.138	35	1.361	52	1.700
20	1.187	40	1.438	..	...

Only a "moderate degree of accuracy" is claimed for this table. (Wright, C. N. 23. 253.)

+2H<sub>2</sub>O. Mpt.—43°. (Pickering, B. 1893, 26. 2308.)

+3H<sub>2</sub>O. Mpt.—48°. (Pickering.)

+4H<sub>2</sub>O. Mpt.—36.5°. (Pickering.)

### Iodic acid, HIO<sub>3</sub>.

Very sol. in H<sub>2</sub>O and alcohol.

100 g. H<sub>2</sub>O dissolve 286.1 g. HIO<sub>3</sub> at 13.5°.

Sp. gr. of HIO<sub>3</sub>+Aq.=2.4256.

100 g. H<sub>2</sub>O dissolve 293 g. HIO<sub>3</sub> at 18°.

Sp. gr. of HIO<sub>3</sub>+Aq.=2.4711.

(Groschuff, Z. anorg. 1905, 47. 337.)

Solubility of HIO<sub>3</sub> in H<sub>2</sub>O at t°.

Solid phase	t°	G. HIO <sub>3</sub> in 100 g. of the solution	G. I <sub>2</sub> O <sub>5</sub> in 100 g. of the solution
ice	— 0.30	1.78	1.69
"	— 0.67	4.35	4.13
"	— 1.01	7.17	6.81
"	— 1.90	17.66	16.75
"	— 2.38	27.65	26.22
"	— 4.72	54.19	51.42
"	— 6.32	60.72	57.61
"	—12.25	71.04	67.40
"	—13.5	72.2	68.5
"	—15	73.8	70.0
"	—19	76.2	72.3
ice+HIO <sub>3</sub>	—14	72.8	69.1
HIO <sub>3</sub>	0	74.1	70.3
"	+16	75.6	71.7
"	40	77.7	73.7
"	60	80.0	75.9
"	80	82.5	78.3
"	85	83.0	78.7
"	101	85.2	80.8
HIO <sub>3</sub> +HI <sub>2</sub> O <sub>5</sub>	110	86.5	82.1
HI <sub>2</sub> O <sub>5</sub>	125	87.2	82.7
"	140	88.3	83.8
"	160	90.5	85.9

(Groschuff, Z. anorg. 1905, 47. 343.)

Sat. solution has sp. gr. 2.842 at 12.5°, and boils at 104°. (Ditte, B. 6. 1533.) Sat. solution has sp. gr. 2.1629 (1.874 pts. I<sub>2</sub>O<sub>5</sub> in 1 pt. H<sub>2</sub>O) at 13°, and boils at 100°. (Kammerer, Pogg. 138. 400.)

Sp. gr. of HIO<sub>3</sub>+Aq at 15°.

% I <sub>2</sub> O <sub>5</sub>	Sp. gr.	% I <sub>2</sub> O <sub>5</sub>	Sp. gr.
1	1.0053	35	1.4428
5	1.0263	40	1.5371
10	1.0525	45	1.6315
15	1.1223	50	1.7356
20	1.2093	55	1.8689
25	1.2773	60	1.9954
30	1.3484	65	2.1269

(Kammerer.)

According to Thomsen (B. 7. 71) solutions of HIO<sub>3</sub> have sp. gr.—

HIO<sub>3</sub>+ 10H<sub>2</sub>O=1.6609.

HIO<sub>3</sub>+ 20H<sub>2</sub>O=1.3660.

HIO<sub>3</sub>+ 40H<sub>2</sub>O=1.1945.

HIO<sub>3</sub>+ 80H<sub>2</sub>O=1.1004.

HIO<sub>3</sub>+160H<sub>2</sub>O=1.0512.

HIO<sub>3</sub>+320H<sub>2</sub>O=1.0258.

H<sub>2</sub>SO<sub>4</sub> at nearly boiling temp. dissolves 1/3 its weight of iodic acid. (Millon.)

Solubility in HNO<sub>3</sub> containing 27.73% HNO<sub>3</sub>.

100 g. of the sat. solution contain at:

0°	20°	40°	60°
18	21	27	38 g. HIO <sub>3</sub> .

Solubility in HNO<sub>3</sub> containing 40.88% HNO<sub>3</sub>.

100 g. of the sat. solution contain at:

0°	20°	40°	60°
9	10	14	18 g. HIO <sub>3</sub> .

(Groschuff, Z. anorg. 1905, 47. 344.)

Less sol. in HNO<sub>3</sub> than H<sub>2</sub>O; nearly insol. in anhydrous HNO<sub>3</sub>. (Groschuff, Z. anorg. 1905, 47. 347.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 830.)

Unattacked and undissolved by liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1362.)

Insol. in absolute alcohol. Alcohol of 35° B. dissolves half its weight in HIO<sub>3</sub>. (Kammerer.)

+4 1/2 H<sub>2</sub>O.

HIO<sub>3</sub>, I<sub>2</sub>O<sub>5</sub>. (Groschuff, Z. anorg. 1905, 47. 343.)

### Iodates.

The alkali iodates are sol. in H<sub>2</sub>O, the others are al. sol. or insol. therein.

Aluminum iodate, Al(IO<sub>3</sub>)<sub>3</sub> (?).

Deliquescent. (Berzelius.)

Ammonium iodate, NH<sub>4</sub>IO<sub>3</sub>.

Sl. sol. in H<sub>2</sub>O. Sol. in 38.5 pts. H<sub>2</sub>O at 15°, 6.9 pts. at 100°. (Rammelsberg, Pogg. 44. 555.)

Solubility of  $\text{NH}_4\text{IO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at  $30^\circ$ .

% $\text{HIO}_3$ in the solution	% $\text{NH}_4\text{IO}_3$ in the solution	Solid phase
0	4.20	$\text{NH}_4\text{IO}_3$
2.54	3.89	"
4.52	3.83	$\text{NH}_4\text{IO}_3 + \text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3$
4.51	3.86	"
4.56	3.75	"
4.73	3.53	$\text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3$
6.57	1.94	"
8.45	1.09	"
9.12	0.89	"
24.00	0.62	"
36.01	0.41	"
44.43	0.39	"
58.12	0.37	"
76.35	0.31	$\text{NH}_4\text{IO}_3 \cdot 2\text{HIO}_3 + \text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z. anorg. 1905, 45. 341.)

 $+ \text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 146.)**Ammonium diiodate,  $\text{NH}_4\text{H}(\text{IO}_3)_2$ .**Sl. sol. in cold  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 145.)**Ammonium triiodate,  $\text{NH}_4\text{H}_2(\text{IO}_3)_3$ .**Sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 42. 335.)See also solubility in  $\text{HIO}_3$ , under Ammonium iodate. (Meerburg.)**Ammonium cobalt iodate.**Decomp. by  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg.)**Ammonium manganic iodate,  $\text{Mn}(\text{IO}_3)_4 \cdot 2\text{NH}_4\text{IO}_3$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HIO}_3$ . (Berg, C. R. 1899, 128. 675.)**Ammonium oxydimercuriammonium iodate.**

See Oxydimercuriammonium ammonium iodate.

**Ammonium tellurium iodate.**

See Iodotellurate, ammonium.

**Ammonium iodate selenate.**

See Iodoselenate, ammonium.

**Barium iodate,  $\text{Ba}(\text{IO}_3)_2$ .**Anhydrous salt is sol. in 1746 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 600 pts.  $\text{H}_2\text{O}$  at  $100^\circ$  (Rammelsberg, Pogg. 44. 577); in 3018 pts.  $\text{H}_2\text{O}$  at  $13.5^\circ$ , and 681 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Kremers, Pogg. 84. 27.)Solubility of  $\text{Ba}(\text{IO}_3)_2$  in  $\text{H}_2\text{O}$ . 100 g. sat.  $\text{Ba}(\text{IO}_3)_2 + \text{Aq}$  at  $t^\circ$  contain g. anhydrous  $\text{Ba}(\text{IO}_3)_2$ .

$t^\circ$	Grams $\text{Ba}(\text{IO}_3)_2$	$t^\circ$	Grams $\text{Ba}(\text{IO}_3)_2$	$t^\circ$	Grams $\text{Ba}(\text{IO}_3)_2$
Eutectic point $-0.046^\circ = 0.002^\circ$	0.008	$30^\circ$	0.031	$70^\circ$	0.093
$+10^\circ$	0.014	$40^\circ$	0.041	$80^\circ$	0.115
$20^\circ$	0.022	$50^\circ$	0.056	$90^\circ$	0.141
$25^\circ$	0.028	$60^\circ$	0.074	$**99.2^\circ$	0.197

\* Bpt. at 735 mm. pressure = about  $100^\circ$  at 760 mm. pressure.

(Anschütz, Z. phys. Ch. 1906, 56. 241.)

1 l. sat. aq. solution contains 0.284 g.  $\text{Ba}(\text{IO}_3)_2$  at room temp. (Hill and Zink, J. Am. Chem. Soc. 1909, 31. 44.)1 l.  $\text{H}_2\text{O}$  dissolves 0.3845 g.  $\text{Ba}(\text{IO}_3)_2$  at  $25^\circ$ . (Harkins and Winninghof, J. Am. Chem. Soc. 1911, 33. 1828.)Easily sol. in cold  $\text{HCl} + \text{Aq}$ ; difficultly sol. in warm  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)Insol. in  $\text{H}_2\text{SO}_4$ . (Ditte.)100 cc.  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. = 0.90) dissolve 0.0199 g.  $\text{Ba}(\text{IO}_3)_2$ . (Hill and Zink.)Solubility in salts +  $\text{Aq}$  at  $25^\circ$ .

C = concentration of salt in salt solution expressed in equivalents per l.

S = solubility of  $\text{Ba}(\text{IO}_3)_2$  in salts +  $\text{Aq}$  expressed in equivalents per l.

Salt	C	S
$\text{Ba}(\text{NO}_3)_2$	0.001	0.001362
	0.002	0.001212
	0.005	0.0009753
	0.020	0.0006744
	0.050	0.0006131
	0.100	0.0005659
	0.200	0.0005580
$\text{KNO}_3$	0.002	0.001624
	0.010	0.001820
	0.050	0.002640
	0.200	0.003190
$\text{KIO}_3$	0.00010608	0.001510
	0.0005304	0.001242
	0.0010608	0.0009418

(Harkins and Winninghof, J. Am. Chem. Soc. 1911, 33. 1829.)

Insol. in alcohol.

100 cc. 95% alcohol dissolve 0.0011 g.  $\text{Ba}(\text{IO}_3)_2$  at room temp. (Hill and Zink.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

 $+ \text{H}_2\text{O}$ . Sol. in 3333 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and 625 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Gay-Lussac, A. ch. 91. 5.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Barium manganic iodate,**

$Mn(IO_3)_2, Ba(IO_3)_2$ .  
Insol. in  $H_2O$ .  
Insol. in  $HIO_3$ . (Berg, C. R. 1899, 128. 675.)

**Bismuth iodate, basic.**

Insol. in  $H_2O$ . Very difficultly sol. in  $HNO_3 + Aq.$  (Rammelsberg, Pogg. 44. 568.)  
 $Bi(IO_3)_3 + 1\frac{1}{2}H_2O$ . Insol. in  $H_2O$ .

**Cadmium iodate,  $Cd(IO_3)_2$ .**

Very sl. sol. in  $H_2O$ . Easily sol. in  $HNO_3$ , or  $NH_4OH + Aq.$  Sol. in  $Cd(C_2H_3O_2)_2 + Aq.$  (Rammelsberg, Pogg. 44. 566.)  
 $+ H_2O$ . Sl. sol. in  $H_2O$ . Very sol. in dil.  $HNO_3 + Aq.$  (Ditte, A. ch. (6) 21. 145.)

**Cadmium iodate ammonia,  $Cd(IO_3)_2, 2NH_3$ .**

Insol. in  $H_2O$ ; sol. in  $NH_4OH + Aq.$  (Ditte.) A. ch. (6) 21. 145.)  
 $Cd(IO_3)_2, 2NH_3 + H_2O$ . As above. (Ditte.)

**Cæsium iodate,  $CsIO_3$ .**

100 pts.  $H_2O$  dissolve 2.6 pts.  $CsIO_3$  at  $24^\circ$ . Insol. in alcohol. (Wheeler, Sil. Am. J. 144. 123.)

$2CsIO_3, I_2O_5$ . 100 pts.  $H_2O$  dissolve 2.5 pts. at  $21^\circ$ . Not decomp. by hot  $H_2O$ . (Wheeler.)  
 $2CsIO_3, I_2O_5, 2HIO_3$ . Sl. sol. in cold  $H_2O$ . and decomp. thereby into  $2CsIO_3, I_2O_5$ . (Wheeler.)

**Cæsium iodate chloride,  $CsCl, HIO_3$ .**

Decomp. by  $H_2O$  into  $2CsIO_3, I_2O_5$ . (Wheeler.)

**Cæsium hydrogen iodate periodate,**

$HCSiO_3, IO_4 + 2H_2O$ .  
Ppt. Sol. in dil.  $HNO_3$ . (Wells, Am. Ch. J. 1901, 26. 280.)

**Calcium iodate,  $Ca(IO_3)_2$ .**

100 pts. dissolve 0.22 pt. at  $18^\circ$ , and 0.986 pt. at  $100^\circ$ . (Gay-Lussac.) Sol. in conc.  $HCl + Aq.$  (Filhol.) Much more sol. in  $HNO_3 + Aq.$  than in  $H_2O$ . (Rammelsberg.) Insol. in  $H_2SO_4$ . (Ditte.) Scarcely sol. in sat.  $KIO_3 + Aq.$  (Sonstadt, C. N. 29. 209.)

$+ H_2O$ . Sat. solution contains at:

21°	35°	40°	45°
0.37	0.48	0.52	0.54% $Ca(IO_3)_2$
50°	60°	80°	100°
0.69	0.65	0.79	0.94% $Ca(IO_3)_2$

(Mylius and Funk, B. 1897, 30. 1724.)

$+ 6H_2O$ . Efflorescent.

Sol. in 253 pts.  $H_2O$  at  $15^\circ$ , and 75 pts. at  $100^\circ$ . (Rammelsberg.)

Sat. solution contains at:

0°	10°	18°	30°
0.1	0.17	0.25	0.42% $Ca(IO_3)_2$
40°	50°	54°	60°
0.61	0.89	0.14	1.36% $Ca(IO_3)_2$

(Mylius and Funk, B. 1897, 30. 1724.)

Much more sol. in  $HNO_3 + Aq.$  Pptd. by alcohol from  $Ca(IO_3)_2 + Aq.$

Insol. in  $H_2SO_4$ . (Ditte.)

Pptd. by alcohol from aqueous solution. (Henry.)

**Cerous iodate,  $Ce(IO_3)_3 + 2H_2O$ .**

Sl. sol. in cold, easily sol. in hot  $H_2O$  and in acids. (Holmann, J. pr. 75. 321.)

Solubility in  $H_2O$ . 100 cc. of the sat. solution contain 0.1456 g. at  $25^\circ$ . (Rimbach, Z. phys. Ch. 1909, 67. 199.)

Calc. from electrical conductivity of  $Ce(IO_3)_3 + Aq.$ , 100 cc. of the sat. solution contain 0.1636 g.  $Ce(IO_3)_3$  at  $25^\circ$ . (Rimbach, Z. phys. Ch. 1909, 67. 199.)

**Ceric iodate,  $Ce(IO_3)_4$ .**

Slightly hydrolyzed by  $H_2O$ .

0.34 g. is sol. in 100 cc. hot conc.  $HNO_3$ . (Barbieri, Chem. Soc. 1907, 92. (2) 467.)

**Cobaltous iodate,  $Co(IO_3)_2$ .**

Anhydrous. Sol. in warm dil.  $H_3PO_4$ , or  $H_2SO_4 + Aq.$  (Ditte, A. ch. (6) 21. 14.)

Solubility in  $H_2O$

Form	Temp.	% $Co(IO_3)_2$	Mols. of water free salt to 100 mols $H_2O$
$Co(IO_3)_2 + 4H_2O$	0°	0.54	0.028
	18°	0.83	0.038
	30°	1.03	0.046
	50°	1.46	0.065
	60°	1.86	0.084
	65°	2.17	0.098
$Co(IO_3)_2 + 2H_2O$	0°	0.32	0.014
	18°	0.45	0.020
	30°	0.52	0.023
	50°	0.67	0.030
	75°	0.84	0.038
	100°	1.02	0.045
$Co(IO_3)_2$	18°	1.03	0.046
	30°	0.89	0.040
	50°	0.85	0.036
	75°	0.75	0.033
	100°	0.69	0.031

(Meusser, B. 1901, 34. 2435.)

$+ H_2O$ . Sol. in 148 pts.  $H_2O$  at  $15^\circ$  and 90 pts. at  $100^\circ$ . Sol. in  $NH_4OH + Aq.$  (Rammelsberg, Pogg. 44. 561.)

Does not exist. (Meusser, B. 1901, 34. 2434.)

$+ 2H_2O$ . (Meusser.)

$+ 4H_2O$ . (Meusser.)

**Cupric iodate, basic,  $6\text{CuO}$ ,  $3\text{I}_2\text{O}_5 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 9. 400.)  
Mixture of  $\text{CuO}$  and  $\text{Cu}(\text{IO}_3)_2$ . (Ditte, A. ch. (6) 21. 175.)

$2\text{CuO}$ ,  $\text{I}_2\text{O}_5 + \text{H}_2\text{O}$ . Slowly sol. in dil.  $\text{H}_2\text{SO}_4$ . (Granger and de Schulten, Bull. Soc. 1904, (3) 31. 1027.)

**Cupric iodate,  $\text{Cu}(\text{IO}_3)_2$ .**

1 l.  $\text{H}_2\text{O}$  dissolves  $3.32 \times 10^{-3}$  mol.  $\text{Cu}(\text{IO}_3)_2$  at  $25^\circ$ . (Spencer, Z. phys. Ch. 1913, 83. 295.)

Solubility in  $\text{CuSO}_4 + \text{Aq} = 3.28 \times 10^{-3}$  mol. per l. at  $25^\circ$ .

Solubility in  $\text{KIO}_3 + \text{Aq} = 3.29 \times 10^{-3}$  mol. per l. at  $25^\circ$ . (Spencer.)

+  $\text{H}_2\text{O}$ . (Ditte.)  
+  $2\text{H}_2\text{O}$ . Sol. in 302 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 154 pts. at  $100^\circ$ . Sol. in  $\text{HCl} + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Millon.)

**Cupric iodate ammonia,  $\text{Cu}(\text{IO}_3)_2$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 145.)  
 $\text{Cu}(\text{IO}_3)_2$ ,  $4\text{NH}_3 + 2\text{H}_2\text{O}$ . Ppt. (Ephraim, B. 1915, 48. 52.)

+  $3\text{H}_2\text{O}$ . Partially sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Rammelsberg.)

$\text{Cu}(\text{IO}_3)_2$ ,  $5\text{NH}_3$ . (Ephraim.)

$\text{Cu}(\text{IO}_3)_2$ ,  $8\text{NH}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Ditte, A. ch. (6) 21. 145.)

**Decipium iodate,  $\text{Dp}(\text{IO}_3)_2 + 3\text{H}_2\text{O} (?)$ .**

Precipitate; scarcely sol. in  $\text{H}_2\text{O}$ . (Dela-fontaine.)

**Didymium iodate,  $\text{Di}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$ .**

Ppt. (Cleve.)

**Erbium iodate,  $\text{Er}(\text{IO}_3)_2 + 3\text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Hoglund.)

**Glucinum iodate.**

Deliquescent.

**Indium iodate,  $\text{In}(\text{IO}_3)_2$ .**

1 pt. is sol. in 1500 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ .

1 pt. is sol. in 150 pts.  $\text{HNO}_3$  (1:5) at  $80^\circ$ .

Sol. in  $\text{HCl}$  with decomp. Sol. in dil.  $\text{H}_2\text{SO}_4$ . (Mathers, J. Am. Chem. Soc. 1908, 30. 213.)

**Iodine iodate,  $\text{I}(\text{IO}_3)_2$ .**

Decomp. by  $\text{H}_2\text{O}$  or by alcohol. (Fichter, Z. anorg. 1915, 91. 142.)

**Iron (ferrous) iodate.**

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{FeSO}_4 + \text{Aq}$ . (Geiger, Mag. Pharm. 29. 252.)

**Iron (ferric) iodate,  $\text{Fe}_2\text{O}_3$ ,  $\text{I}_2\text{O}_5$ .**

Insol. in acids. (Ditte, A. ch. (6) 21. 145.)  
 $\text{Fe}_2\text{O}_3$ ,  $2\text{I}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Sol. in 500 pts.  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{FeCl}_3 + \text{Aq}$ . (Geiger.)

$3\text{Fe}_2\text{O}_3$ ,  $5\text{I}_2\text{O}_5 + 15\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)

**Lanthanum iodate,  $\text{La}(\text{IO}_3)_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . Very sol. in warm  $\text{HCl} + \text{Aq}$ . (Holzmann, J. pr. 75. 349.)

100 cc. of the sat. solution in  $\text{H}_2\text{O}$  contain 0.1681 g. at  $25^\circ$ . (Rimbach, Z. phys. Ch. 1909, 67. 199.)

Calc. from electrical conductivity of  $\text{La}(\text{IO}_3)_3 + \text{Aq}$ , 100 cc. of the sat. solution contain 0.1871 g.  $\text{La}(\text{IO}_3)_3$  at  $25^\circ$ . (Rimbach.)

**Lead iodate, basic,  $3\text{PbO}$ ,  $\text{Pb}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$ .**

Ppt. (Strömholm, Z. anorg. 1904, 33. 442.)

**Lead iodate,  $\text{Pb}(\text{IO}_3)_2$ .**

Very sl. sol. in  $\text{H}_2\text{O}$  (Pleischl), and difficultly sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)

Insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Very sl. sol. in  $\text{HNO}_3 + \text{Aq}$ , and wholly insol. therein after being heated to  $100^\circ$ . (Ditte, A. ch. (6) 21. 169.)

Sl. sol. in  $\text{H}_2\text{O}$ .  $1.83 \times 10^{-3}$  are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 19 mg.  $\text{Pb}(\text{IO}_3)_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

17.8 mg. are dissolved in 1 l. sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1906, 64. 168.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0307 g.  $\text{Pb}(\text{IO}_3)_2$  at  $25^\circ$ . (Harkins, J. Am. Chem. Soc. 1911, 33. 1830.)

Solubility of  $\text{Pb}(\text{IO}_3)_2$  in salts +  $\text{Aq}$  at  $25^\circ$ .

C = concentration of salt in salt solution expressed in equivalents per l.

S = solubility of  $\text{Pb}(\text{IO}_3)_2$  in salt solution expressed in equivalents per l.

Salt	C	S
$\text{Pb}(\text{NO}_3)_2$	0.0001	0.0000870
	0.001	0.0000411
	0.010	0.0000185
	0.100	0.000016
	0.500	0.000028
	3.0	0.000015
$\text{KNO}_3$	0.002	0.0001141
	0.010	0.0001334
	0.050	0.0002037
	0.200	0.0002544
$\text{KIO}_3$	0.00005304	0.0000697
	0.0001061	0.0000437

(Harkins and Winninghof, J. Am. Chem. Soc. 1911, 33. 1830.)

**Insol. in liquid  $\text{NH}_3$ .** (Gore, Am. Ch. J. 1898, 20. 828.)

**Lithium iodate,  $\text{LiIO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .  
Sol. in 2 pts. cold, and not much less hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg, Pogg. 44. 555.)

Sp. gr. of solution sat. at  $18^\circ = 1.568$ , containing 44.6%  $\text{LiIO}_3$ . 100 g.  $\text{H}_2\text{O}$  dissolve 80.3 pts.  $\text{LiIO}_3$ . (Mylius and Funk, B. 1897, 30. 1718.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+ $\text{H}_2\text{O}$ . Very deliquescent. (Ditte, A. ch. (6) 21. 145.)

**Magnesium iodate,  $\text{Mg}(\text{IO}_3)_2$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 9. 422.)

+ $4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte.)  
Sol. in 9.43 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 3.04 pts. at  $100^\circ$ . (Berzelius.) Very sl. sol. in  $\text{H}_2\text{O}$ . (Serullas, A. ch. 45. 279.) Easily sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Ditte.)

Sat. solution contains at:

$0^\circ$	$10^\circ$	$20^\circ$
6.8	6.4	7.7% $\text{Mg}(\text{IO}_3)_2$ ,
$35^\circ$	$63^\circ$	$100^\circ$
8.9	12.6	19.3% $\text{Mg}(\text{IO}_3)_2$ .

(Mylius and Funk, B. 1897, 30. 1722.)

Sat. aq. solution at  $18^\circ$  contains 6.44%  $\text{Mg}(\text{IO}_3)_2$ , or 6.88 g. are sol. in 100 g.  $\text{H}_2\text{O}$ .  
Sp. gr. of sat. solution = 1.078. (Mylius and Funk, B. 1897, 30. 1718.)

+ $10\text{H}_2\text{O}$ . Sat. aq. solution contains at:

$0^\circ$	$20^\circ$	$30^\circ$	$35^\circ$	$50^\circ$ (m.pt.).
3.1	10.2	17.4	21.9	67.5% $\text{Mg}(\text{IO}_3)_2$ .

(Mylius and Funk, B. 1897, 30. 1723.)

**Manganous iodate,  $\text{Mn}(\text{IO}_3)_2 + \text{H}_2\text{O}$ .**

Sol. in about 200 pts.  $\text{H}_2\text{O}$ . (Rammelsberg.)

Insol. in  $\text{H}_2\text{O}$  and  $\text{HNO}_3 + \text{Aq}$ , even on boiling. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Ditte.)

**Manganous manganic iodate,**

$\text{Mn}(\text{IO}_3)_2, \text{Mn}(\text{IO}_3)_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Berg, C. R. 1899, 128. 675.)

**Manganic potassium iodate,**

$\text{Mn}(\text{IO}_3)_3, 2\text{KIO}_3$ .

Insol. in and only sl. attacked by  $\text{H}_2\text{O}$ .

Insol. in  $\text{HIO}_3$ . (Berg, C. R. 1899, 128. 674.)

**Mercurous iodate,  $\text{Hg}_2(\text{IO}_3)_2$ .**

Insol. in boiling  $\text{H}_2\text{O}$ , or cold  $\text{HNO}_3 + \text{Aq}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . Sol. in very

conc.  $\text{HIO}_3 + \text{Aq}$ . (Lefort, J. Pharm. 1845. 5.)

**Mercuric iodate,  $\text{Hg}(\text{IO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. (Millon, A. ch. (3) 18. 367.) Sol. in  $\text{H}_2\text{O}$ . (Berzelius.) Sol. in dil.  $\text{HCl} + \text{Aq}$ . (Rammelsberg.)

Nearly insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ ,  $\text{HBr}$ , or  $\text{HI} + \text{Aq}$ ; very sl. sol. in  $\text{HNO}_3 + \text{Aq}$ ; insol. in  $\text{HF}$ ,  $\text{H}_2\text{SiF}_6$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Sol. in alkali chlorides, bromides, iodides, cyanides, and cyanates +  $\text{Aq}$ ; also in  $\text{Na}_2\text{S}_2\text{O}_3$ , dil.  $\text{MnCl}_2$ , and  $\text{ZnCl}_2 + \text{Aq}$ . Insol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{S}$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{Na}_2\text{HPO}_4$ , and the alkali chlorates, bromates, and iodates +  $\text{Aq}$ . (Cameron, C. N. 33. 253.)

**Nickel iodate,  $\text{Ni}(\text{IO}_3)_2$ .**

Solubility in  $\text{H}_2\text{O}$ .

Form	Temp.	Percent of $\text{Ni}(\text{IO}_3)_2$ in solution	Mols. water free salt to 100 mols. $\text{H}_2\text{O}$
$\text{Ni}(\text{IO}_3)_2 + 4\text{H}_2\text{O}$	$0^\circ$	0.73	0.033
	$18^\circ$	1.01	0.045
	$30^\circ$	1.41	0.063
$\alpha\text{Ni}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	$0^\circ$	0.53	0.023
	$18^\circ$	0.68	0.030
	$30^\circ$	0.86	0.039
$\beta\text{Ni}(\text{IO}_3)_2 + 2\text{H}_2\text{O}$	$50^\circ$	1.78	0.080
	$8^\circ$	0.52	0.023
	$18^\circ$	0.55	0.0245
	$50^\circ$	0.81	0.035
	$75^\circ$	1.03	0.045
	$100^\circ$	1.12	0.049
$\text{Ni}(\text{IO}_3)_2$	$30^\circ$	1.135	0.050
	$50^\circ$	1.07	0.046
	$75^\circ$	1.02	0.045
	$100^\circ$	0.988	0.044

(Meusser, B. 1901, 34. 2440.)

+ $\text{H}_2\text{O}$ . Sol. in 120.3 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 77.35 pts. at  $100^\circ$ . (Rammelsberg, Pogg. 44. 562.)

Sol. in  $\text{HNO}_3$ , and dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Ditte.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Does not exist (Meusser.)

+ $2\text{H}_2\text{O}$ . See Meusser above.

+ $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . (Ditte, A. ch. 1890, (6) 21. 160.)

+ $4\text{H}_2\text{O}$ . See Meusser above.

**Nickel iodate ammonia,  $\text{Ni}(\text{IO}_3)_2, 4\text{NH}_3$ .**

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in alcohol. (Rammelsberg, Pogg. 44. 562.)

$\text{Ni}(\text{IO}_3)_2, 5\text{NH}_3$ . Ppt. (Ephraim, B. 1915, 48. 53.)

+ $3\text{H}_2\text{O}$ . (Ephraim.)

**Potassium iodate,  $\text{KIO}_3$ .**

1 pt.  $\text{KIO}_3$  dissolves in 13 pts.  $\text{H}_2\text{O}$  at  $14^\circ$ . (Gay-Lussac.)

1 pt.  $\text{KIO}_3$  dissolves at:

0°	in 21.11 pts. $\text{H}_2\text{O}$
20°	" 12.29 "
40°	" 7.76 "
60°	" 5.40 "
80°	" 4.02 "
100°	" 3.10 "

Sat. solution boils at 102°. (Kremers, Pogg. 97. 5.)

Sp. gr. of  $\text{KIO}_3$  + Aq containing:

1	2	3	4	5	% $\text{KIO}_3$
1.010	1.019	1.027	1.035	1.044	
6	7	8	9	10	% $\text{KIO}_3$
1.052	1.061	1.071	1.080	1.090	

(Kremers, Pogg. 96. 62.)

Stable at 10° in  $\text{H}_2\text{O}$  or potassium acetate + Aq. (Eakle, C. C. 1896, II. 649.)

Solubility of  $\text{KIO}_3$  in  $\text{HIO}_3$  + Aq at 30°.

% $\text{HIO}_3$ in the solution	% $\text{KIO}_3$ in the solution	Solid phase
0	9.51	$\text{KIO}_3$
0.64	9.48	$\text{KIO}_3$ + $\text{KIO}_3$ , $\text{HIO}_3$
0.66	9.52	"
0.65	9.46	"
0.65	8.90	$\text{KIO}_3$ , $\text{HIO}_3$
0.67	6.6	"
1.14	4.57	"
1.69	3.63	"
2.02	3.10	"
3.34	2.14	"
5.00	1.32	"
7.09	1.0	"
8.04	0.85	$\text{KIO}_3$ , $\text{HIO}_3$ + $\text{KIO}_3$ , 2 $\text{HIO}_3$
3.47	3.57	$\text{KIO}_3$ , 2 $\text{HIO}_3$ (labile)
4.80	2.90	"
6.45	1.35	"
9.35	0.64	$\text{KIO}_3$ , 2 $\text{HIO}_3$
12.04	0.44	"
17.50	0.30	"
31.20	0.52	"
53.64	0.68	"
62.52	0.72	"
76.40	0.80	$\text{KIO}_3$ , 2 $\text{HIO}_3$ + $\text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z. anorg. 1905, 45. 330.)

More sol. in  $\text{KI}$  + Aq than in  $\text{H}_2\text{O}$ . Sol. in warm  $\text{H}_2\text{SO}_4$  + Aq.

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol.

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . (Ditte, C. R. 70. 621.)

Potassium hydrogen iodate,  $\text{KH}(\text{IO}_3)_2$ .

Sol. in 18.65 pts.  $\text{H}_2\text{O}$  at 17°. (Meineke, A. 261. 360.)

Sol. in 75 pts.  $\text{H}_2\text{O}$  at 15°. Insol. in alcohol. (Serullas, A. ch. 22. 181.)  
See also Meerburg under  $\text{KIO}_3$ .

Potassium dihydrogen iodate,  $\text{KH}_2(\text{IO}_3)_2$ .  
Sol. in 25 pts.  $\text{H}_2\text{O}$  at 15°. (Serullas, A. ch. 43. 117.)

See also Meerburg under  $\text{KIO}_3$ .

Potassium tellurium iodate.

See Iodotellurate, potassium.

Potassium uranyl iodate,  
 $\text{KUO}_2(\text{IO}_3)_2 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , dil. salt solutions and  $\text{UO}_2(\text{NO}_3)_2$  + Aq. (Artmann, Z. anorg. 1913, 79. 340.)

Potassium iodate chloride,  $\text{KH}(\text{IO}_3)_2$ , 2 $\text{KCl}$ .

Sol. in 19 pts.  $\text{H}_2\text{O}$  at 15° with decomp. Cold alcohol dissolves out  $\text{KCl}$ .

Potassium iodate molybdate,  $\text{KIO}_3$ ,  $\text{MoO}_3$  + 2 $\text{H}_2\text{O}$ .

See Molybdatoidate, potassium.

Potassium iodate selenate.

See Iodoselenate, potassium.

Potassium iodate sulphate,  $\text{KIO}_3$ ,  $\text{KHSO}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Marignac, J. B. 1856. 299.)

$\text{KHIO}_3$ ,  $\text{KHSO}_4$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{KHIO}_3$ . (Serullas.)

Potassium iodate tungstate.

See Tungstoidate, potassium.

Rubidium iodate,  $\text{RbIO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 2.1 pts.  $\text{RbIO}_3$  at 23°. Easily sol. in cold  $\text{HCl}$  + Aq. (Wheeler Sill. Am. J. 144. 123.)

Rubidium hydrogen iodate,  $\text{RbH}(\text{IO}_3)_2$ .

Sl. sol. in cold, more readily in hot  $\text{H}_2\text{O}$ ,  $\text{RbIO}_3$  separating on cooling. Insol. in alcohol. (Wheeler.)

$\text{RbH}_2(\text{IO}_3)_2$ . As above. (Wheeler.)

Rubidium iodate chloride,  $\text{RbIO}_3$ ,  $\text{HCl}$ , or  $\text{HIO}_3$ ,  $\text{RbCl}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Wheeler.)

3 $\text{RbCl}$ , 2 $\text{HIO}_3$ . Sol. in  $\text{H}_2\text{O}$ , from which  $\text{RbIO}_3$  separates. (Wheeler.)

Rubidium iodate selenate.

See Iodoselenate, rubidium.

Samarium iodate,  $\text{Sm}(\text{IO}_3)_3 + 6\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

**Scandium iodate**,  $\text{Sc}(\text{IO}_3)_3$ , +10, 13, 15, and  $18\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Crookes, Phil. Trans. 1910, 210. A, 361.)

**Silver iodate**,  $\text{AgIO}_3$ .

$1.89 \times 10^{-4}$  moles or  $5.36 \times 10^{-2}$  g.  $\text{AgIO}_3$  are sol. in 1 liter  $\text{H}_2\text{O}$  at  $25^\circ$ . (Noyes and Kohr, Z. phys. Ch. 1903, 42. 338.)

Sl. sol. in  $\text{H}_2\text{O}$ .  $4.35 \times 10^{-2}$  g. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 40 mg.  $\text{AgIO}_3$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0275 g.  $\text{AgIO}_3$  at  $9.43^\circ$ ; 0.039 g. at  $184^\circ$ ; 0.0539 g. at  $26.6^\circ$ . Solubility increases rapidly with temp. (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.039 g.  $\text{AgIO}_3$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, 67. 108.)

Not completely insol. in  $\text{H}_2\text{O}$ : (Rose.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Naquet, J. B. 1860. 201.) Sol. in conc.  $\text{KI} + \text{Aq}$ . (Ladenburg, A. 135. 1.)

Sol. in 27,700 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ ; in 42.4 pts. 5%  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ ; in 2.1 pts. 10%  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ ; in 1044.3 pts. 35%  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.21) at  $25^\circ$ . (Longi, Gazz. ch. it. 13. 87.)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

Normality $\text{HNO}_3$	G. $\text{AgIO}_3$ dissolved per l.
0.000	0.0503
0.125	0.0864
0.250	0.1075
0.500	0.1414
1.00	0.2067
2.00	0.3319
4.00	0.6985
8.00	1.5875

(Hill and Simmons, Z. phys. Ch. 1909, 67. 602.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Insol. in methyl acetate. (Besold, Dissert. 1906; Naumann, B. 1909, 42. 3790); ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

**Silver iodate ammonia**,  $2\text{AgIO}_3 \cdot 3\text{NH}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Very sol. in cold  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 145.)

$\text{AgIO}_3 \cdot 2\text{NH}_3$ .

Sl. sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rosenheim, A. 1899, 308. 52.)

**Sodium iodate**,  $\text{NaIO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 7.25 pts.  $\text{NaIO}_3$  at  $14.5^\circ$ . (Gay-Lussac.) 100 pts.  $\text{H}_2\text{O}$  dissolve 2.52 pts. at  $0^\circ$ ; 9.07 pts. at  $20^\circ$ ; 14.39 pts. at  $60^\circ$ ; 27.7 pts. at  $80^\circ$ ; 33.9 pts. at  $100^\circ$ . (Krem-

ers, Pogg. 97. 5.) Sat. solution boils at  $102^\circ$  (Kremers),  $105^\circ$  (Ditte).

Sol. in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$  diluted with  $\frac{1}{2}$  vol.  $\text{H}_2\text{O}$ . Crystallizes out on standing over  $\text{H}_2\text{SO}_4$ . (Ditte.)

Solubility of  $\text{NaIO}_3$  in  $\text{HIO}_3 + \text{Aq}$  at  $30^\circ$ .

% $\text{HIO}_3$ in the solution	% $\text{NaIO}_3$ in the solution	Solid phase
0	9.36	$\text{NaIO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$
1.98	9.52	"
4.86	10.22	"
5.86	11.04	"
7.40	11.60	"
9.73	14.73	" } labile
6.76	11.18	$\text{NaIO}_3 + 1\frac{1}{2}\text{H}_2\text{O} + \text{Na}_2\text{O} \cdot 2\text{I}_2\text{O}_5$
6.66	11.28	"
7.80	10.30	$\text{Na}_2\text{O} \cdot 2\text{I}_2\text{O}_5$
9.15	9.00	"
9.93	8.71	"
11.20	7.54	"
11.89	7.21	$\text{Na}_2\text{O} \cdot 2\text{I}_2\text{O}_5 + \text{NaIO}_3 \cdot 2\text{HIO}_3$
11.75	7.18	"
14.62	5.65	$\text{NaIO}_3 \cdot 2\text{HIO}_3$
23.23	3.69	"
32.68	2.91	"
40.91	2.64	"
46.62	2.67	"
55.48	2.12	"
65.47	1.83	"
76.19	1.42	$\text{NaIO}_3 \cdot 2\text{HIO}_3 + \text{HIO}_3$
76.70	0	$\text{HIO}_3$

(Meerburg, Z. anorg. 1905, 45. 334.)

Insol. in alcohol. Sol. in dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)  
+  $1\frac{1}{2}\text{H}_2\text{O}$ . See Meerburg above.

**Sodium diiodate**,  $\text{Na}_2\text{O} \cdot 2\text{I}_2\text{O}_5$ .

See Meerburg under  $\text{NaIO}_3$ .

**Sodium triiodate**,  $\text{NaIO}_3 \cdot 2\text{HIO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 42. 337.)

See also Meerburg under  $\text{NaIO}_3$ .

**Sodium iodate bromide**,  $\text{NaIO}_3 \cdot 2\text{NaBr} + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Sodium iodate chloride**,  $\text{NaIO}_3 \cdot \text{NaCl} + 4\text{H}_2\text{O}$ , and  $2\text{NaIO}_3 \cdot 3\text{NaCl} + 18\text{H}_2\text{O}$ .

Cold  $\text{H}_2\text{O}$  dissolves out  $\text{NaCl}$ .

**Sodium iodate iodide**,  $\text{NaIO}_3 \cdot \text{NaI}$ .

Hot  $\text{H}_2\text{O}$  or alcohol dissolves out  $\text{NaI}$ .

+  $8\text{H}_2\text{O}$ .

+  $10\text{H}_2\text{O}$ .

$2\text{NaIO}_3 \cdot 3\text{NaI} + 20\text{H}_2\text{O}$ . (Penny, A. 37. 202.)



Stable in a solution of  $\text{NaI} + \text{NaOH} + \text{Aq.}$  (Eakle, C. C. 1896, II. 650.)

### Strontium iodate, $\text{Sr}(\text{IO}_3)_2$ .

*Anhydrous.* Insol. in  $\text{H}_2\text{SO}_4$  (Ditte); easily sol. in cold  $\text{HCl} + \text{Aq.}$  (Rammelsberg, Pogg. 44. 575.)

+  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ .

+  $6\text{H}_2\text{O}$ . Sol. in 416 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 138 pts. at  $100^\circ$  (Gay-Lussac); 342 pts. at  $15^\circ$ , and 110 pts. at  $100^\circ$ . Difficultly sol. in warm  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg, Pogg. 44. 575.)

### Thallous iodate, $\text{TlIO}_3$ .

Difficultly sol. in warm  $\text{H}_2\text{O}$ . (Oettinger.)

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg.)

Sl. sol. in  $\text{H}_2\text{O}$ .

$0.58 \times 10^{-1}$  g. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 48. 603.)

$2.12 \times 10^{-1}$  mols. = 0.667 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Spencer, Z. phys. Ch. 1912, 80. 707.)

Sol. in a little  $\text{NH}_4\text{OH} + \text{Aq.}$  also in boiling  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq.}$  Insol. in alcohol. (Oettinger.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  or dil. boiling acids. (Ditte, A. ch. (6) 21. 145.)

**Thallic iodate, basic,  $\text{Tl}(\text{OH})(\text{IO}_3)_2 + \text{H}_2\text{O} = \text{Tl}_2\text{O}_3, 2\text{I}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in cold  $\text{HCl} + \text{Aq.}$  and warm dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Ditte, A. ch. (6) 21. 145.)

### Thallic iodate, $\text{Tl}(\text{IO}_3)_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  Decomp. by alkalis. (Rammelsberg.)

+  $12\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ .

Easily sol. in dil. acids. (Gewecke, Z. anorg. 1912, 75, 275.)

### Thorium iodate, $\text{Th}(\text{IO}_3)_4$ .

Precipitate. (Cleve.)

### Tin (stannous) iodate.

Ppt. Sol. in  $\text{SnCl}_2 + \text{Aq.}$ ; insol. in  $\text{NaIO}_3 + \text{Aq.}$

### Tin (stannic) iodate.

Ppt.

### Uranous iodate.

Precipitate. Very unstable. (Rammelsberg.)

### Uranyl iodate, $\text{UO}_2(\text{IO}_3)_2$ .

Sol. or insol. in  $\text{HNO}_3$  and  $\text{H}_3\text{PO}_4 + \text{Aq.}$  according to method of preparation. (Ditte.)

+  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  (Rammelsberg.)

### Ytterbium iodate, $\text{Yb}(\text{IO}_3)_3 + 6\text{H}_2\text{O}$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 136.)

### Yttrium iodate, $\text{Y}(\text{IO}_3)_3 + 3\text{H}_2\text{O}$ .

Sol. in 190 pts.  $\text{H}_2\text{O}$ . (Berlin.)

### Zinc iodate, $\text{Zn}(\text{IO}_3)_2$ .

*Anhydrous.* (Ditte, A. ch. (6) 21. 145.)

+  $2\text{H}_2\text{O}$ . Sol. in 114 pts. cold, and 76 pts. hot  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 43. 665.)

Sol. in  $\text{HNO}_3$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$

Exists also in a very sol. modification. (Mylius and Funk, B. 1897, 30. 1723.)

### Zinc iodate ammonia, $3\text{Zn}(\text{IO}_3)_2, 8\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  from which it is pptd. by alcohol. (Rammelsberg, Pogg. 44. 563.)

$\text{Zn}(\text{IO}_3)_2, 2\text{NH}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 21. 145.)

$\text{Zn}(\text{IO}_3)_2, 3\text{NH}_3 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Ditte.)

$\text{Zn}(\text{IO}_3)_2, 4\text{NH}_3$ . (Ditte, A. ch. 1890, (6) 21. 164.) (Ephraim, B. 1915, 48. 53.)

### Periodic acid.

See Periodic acid.

### Iodides.

The iodides are in general easily sol. in  $\text{H}_2\text{O}$ ; exceptions are  $\text{HgI}_2$ ,  $\text{PbI}_2$ ,  $\text{AgI}$ ,  $\text{Cu}_2\text{I}_2$ , and  $\text{BiI}_3$ , also the iodides of the Pt metals, all of which are insol.  $\text{SnI}_4$ ,  $\text{SbI}_3$ , and  $\text{TlI}_3$  are decomp. by  $\text{H}_2\text{O}$ . Many iodides are more sol. in solutions of salts than in  $\text{H}_2\text{O}$ , and several are sol. in alcohol or ether.

See under each element.

### Iodine, $\text{I}_2$ .

Sol. in 5524 pts.  $\text{H}_2\text{O}$  at  $0-12^\circ$ . (Wittstein, J. B. 1887. 123.)

Sol. in 7000 pts.  $\text{H}_2\text{O}$ . (Gay-Lussac.)

Sol. in 3800 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Basse.)

Sol. in 500 pts.  $\text{H}_2\text{O}$ . (Jacquelin.)

Sol. in 7196.4 pts.  $\text{Br}_2\text{O}$  at  $18.75^\circ$ . (Abl.)

Pure  $\text{H}_2\text{O}$  dissolves 0.01519173 g. I per litre, or I is sol. in 6582 pts.  $\text{H}_2\text{O}$  at  $6.3^\circ$ . (Doessius and Weith, Zeit. Ch. 12. 378.)

Sol. in about 4500 pts.  $\text{H}_2\text{O}$ . (Hager, Comm. 1883.)

Sol. in 7000 pts.  $\text{H}_2\text{O}$ . (Cap and Garot, J. Pharm. (3) 26. 80.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves 0.3387 g.  $\text{I}_2$ . (Jakowkin, Z. phys. Ch. 1895, 18. 590.)

1 l.  $\text{H}_2\text{O}$  dissolves 1.342 millimols of iodine at  $25^\circ$ . (Noyes, Z. phys. Ch. 1898, 27. 359.)

When iodine is shaken with  $\text{H}_2\text{O}$  at  $15^\circ$ , 1 pt. dissolves in 3750 pts.  $\text{H}_2\text{O}$ ; when iodine and  $\text{H}_2\text{O}$  are heated together and then cooled to  $15^\circ$ , 1 pt. iodine dissolves in 3500 pts.  $\text{H}_2\text{O}$ .

At  $30^\circ$ , 1 pt. is sol. in 2200 pts.  $\text{H}_2\text{O}$ . (Diets, Chem. Soc. 1899, 76, (2) 150.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.279 grams  $\text{I}_2$  at  $25^\circ$ . (McLauchlan, Z. phys. Ch. 1903, 44. 617.)

Solubility of  $I_2$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g. $I_2$ per l. $H_2O$
18	0.2765
25	0.3395
35	0.4661
45	0.6474
55	0.9222

(Hartley, Chem. Soc. 1908, 93. 744.)

Solubility of  $I_2$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g. per l.	milliat. per l.
0	0.1649	1.30
20	0.2941	2.30
40	0.5684	4.56

(Fedotieff, Z. anorg. 1910, 69. 30.)

1.32 millimol  $I_2$  are sol. in 1 l.  $H_2O$ . (Bray, J. Am. Chem. Soc., 1910, 32. 938.)

Calculated from electrical conductivity of sat.  $I_2$ +Aq. 1 l.  $H_2O$  dissolves 0.0006383 mols.  $I_2$  at  $0^\circ$ . (Jones, J. Am. Chem. Soc. 1915, 37. 256.)

Conc.  $H_2SO_4$ ,  $HCl$ ,  $HNO_3$ ,  $H_3PO_4$ ,  $HC_2H_3O_2$ , tartaric, or citric acids+Aq dissolve  $I_2$ , but give it up to  $CS_2$  on shaking therewith. (Tessier, Z. anal. 11. 313.)

Sol. in 150 pts.  $H_2SO_4$  on warming, but crystallizes out in part on cooling. (Kraus.) Much more sol. in  $HBr$ +Aq than in pure  $H_2O$ ;  $HBr$ +Aq of sp. gr. 1.486 dissolves 3-4%. (Bineau.)

Sl. sol. in  $HCl$ +Aq. Easily sol. in even dil.  $HI$ +Aq.

1 l. 0.001 N- $HCl$ +Aq sat. with  $I_2$  contains 0.338 g.  $I_2$ . (Bray and Mackay, J. Am. Chem. Soc. 1910, 32. 1919.)

1 l. 0.1 N- $HNO_3$ +Aq sat. with  $I_2$  contains 0.340 g.  $I_2$ . (Sammet, Z. phys. Ch. 1905, 53. 644.)

1 l. 0.1 N- $H_2SO_4$ +Aq sat. with  $I_2$  contains 0.341 g.  $I_2$ . (Sammet.)

Sol. in  $H_2SO_4$ +Aq with decomp.

1 l. 0.9 N.  $H_3BO_3$  dissolves 0.300 g.  $I_2$  at  $25^\circ$ . (McLauchlan, Z. phys. Ch. 1903, 44. 617.)

100 cc. of a 10% solution of  $BaBr_2$  dissolve 0.231 g.  $I_2$  at  $13.5^\circ$ . (Meyer, Z. anorg. 1902, 30. 114.)

100 cc. of a 10% solution of  $BaCl_2$  dissolve 0.067 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $BaI_2$  dissolve 6.541 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $CaBr_2$  dissolve 0.274 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $CaCl_2$  dissolve 0.078 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

100 cc. of a 10% solution of  $CaI_2$  dissolve 8.062 g.  $I_2$  at  $13.5^\circ$ . (Meyer.)

Easily sol. in boiling dil.  $HgCl_2$ +Aq. (Selmi.)

Solubility in  $HgCl_2$ +Aq at  $25^\circ$ .

## 10 ccm. of the solution contain:

millimols $I_2$	millimols $Hg$
0.0134	0
0.1294	0.9444
0.1460	1.2442
0.1806	1.9542
0.2543	3.3460

(Hers and Paul, Z. anorg. 1914, 85. 214.)

Sol. in solutions of soluble iodides.

100 pts.  $KI$ +200 pts.  $H_2O$  dissolve 153 pts.  $I_2$ ; from this solution  $H_2O$  precipitates  $\frac{1}{2}$  the dissolved  $I_2$ . 100 pts.  $KI$ +400 pts.  $H_2O$  dissolve quickly 76.5 pts.  $I_2$ . If more water is present, the solution takes place more slowly. (Baup.)

$CS_2$  extracts the  $I$  from the above solutions.

Solubility of  $I$  in  $KI$ +Aq at  $7-7.3^\circ$ .

% $KI$ in $KI$ +Aq	Pts $I$ dissolved	Sp. gr. of solution
1.802	1.173	1.0234
3.159	2.303	1.0433
4.628	3.643	1.0668
5.935	4.778	1.0881
7.201	6.037	1.1112
8.663	7.368	1.1382
10.036	8.877	1.1637
11.034	9.949	1.1893
11.893	11.182	1.2110
12.643	12.060	1.2293

(Doessius and Weith, Zeit. Ch. (2) 5. 379.)

Solubility of  $I_2$  in  $KI$ +Aq at room temperature,  $14.5^\circ-15.1^\circ$ .

% $KI$	% $I$	$I/KI$
1.80	1.17	0.651
3.16	2.30	0.729
4.63	3.64	0.786
5.93	4.78	0.805
7.20	6.04	0.839
8.66	7.37	0.851
10.04	8.88	0.884
11.03	9.95	0.902
11.89	11.18	0.940
12.64	12.06	0.954

(Weith and Doessius, Z. phys. Ch. 1898, 26.

Solubility of  $I_2$  in KI+Aq at 15°

% KI	cem. 1/10-n. iodine in 5cmm. of the solution	I/KI
10	35.0	35.0
8	27.1	33.9
6	19.7	32.8
4	12.7	31.8
2	6.25	31.2
1	3.04*	30.4

\* Obtained with 1/100-normal iodine.  
(Bruner, Z. phys. Ch. 1898, 26. 151.)

Solubility of  $I_2$  in KI+Aq at 25°.

Millimols KI per liter	Millimols dissolved iodine per liter
106.3	55.28
53.15	28.03
26.57	14.68
13.29	8.003
6.643	4.667
3.322	3.052
1.661	2.235
0.8304	1.814

(Noyes and Seidenstricker, Z. phys. Ch. 1898, 27. 359.)

## Solubility in KI+Aq at 25°.

KI mol./l.	I G. atoms/l.
1.91	3.29
2.85	5.45
4.51	11.52
5.36	17.12
5.55	17.16

(Abegg, Z. anorg. 1906, 50. 427.)

Solubility of  $I_2$  in KI+Aq at 25°.

Millimol KI per l.	Millimol $I_2$ dissolved
100	51.35
50	25.77
20	11.13
10	6.185
5	3.728
2	2.266
1	1.788

(Bray and MacKay, J. Am. Chem. Soc. 1910, 32. 919.)

## Solubility in KI+Aq at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I

## (a) In equilibrium with excess of KI.

1.733	60.39	0.0		0.0
1.888	54.415	11.63	84.92	4.05
2.066	49.045	23.085	85.94	6.32
2.216	44.82	31.01	80.46	10.84
2.539	38.065	44.56	78.56	15.23
2.560	37.655	45.55	77.32	16.73
2.665	35.805	49.61		
3.232	29.71	62.81	39.99	56.10
3.246	27.92	66.45	38.78	56.27

## (b) In equilibrium with excess of I.

1.349	16.025	18.49	3.04	85.43
1.516	19.705	26.16	4.48	83.87
1.769	22.88	36.06	3.70	89.33
1.910	23.55	40.515	6.49	83.62
2.403	24.78	53.605	8.62	83.81
2.904	24.995	63.125	4.82	92.41
3.082	25.18	66.04	4.00	94.39

## (c) Invariant point. Excess of KI and I.

3.316	26.05	68.06		
	25.96	68.01	16.14	83.77
	26.04	68.16		
	25.92	68.13	11.32	86.56

(Parsons and Whittemore, J. Am. Chem. 1911, 33. 1934.)

## Solubility in KI+Aq at 0°.

KI+Aq		KI+Aq. sat. with $I_2$	
Wt. norm.	Sp. gr. 0°/4°	G. $I_2$ in 1 g. of solution	Sp. gr. 0°/4°
0.09871	(1.0123)	0.01199	(1.0219)
0.09861	1.01231	0.01199	1.02187
0.04969	(1.0061)	0.006094	(1.0109)
0.04966	1.00610	0.006083	1.01089
0.01992	1.00236	0.002535	1.00429
0.01983	(1.0024)	0.0025325	(1.0044)
0.00998	(1.0011)	0.0013532	(1.0020)
0.00992	(1.0011)	0.0013585	(1.0020)
0.004999	(1.0006)	0.0007609	(1.0010)
0.004991	(1.0005)	0.0007577	(1.0011)
0.002000	(1.0001)	0.0004137	(1.0004)
0.002000	(1.0001)	0.0004015	(1.0004)
0.000999	(0.9999)	0.0002839	(1.0002)
0.000992	(1.0000)	0.00028125	(1.0002)

Values in parentheses are found by interpolation.

(Jones and Hartman, J. Am. Chem. Soc. 1915, 37. 247.)

1 mol. KI in alcohol dissolves 2 atoms  $I_2$ , and the solution does not give up I to  $CS_2$ .  
(Jørgensen, J. pr. (2) 2. 347.)

## Solubility in KI+60% alcohol at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% I	% KI

## (a) In equilibrium with excess KI.

1.148	30.93	0.0		0.0
1.191	29.87	4.51	89.13	0.71
1.285	28.39	12.48	86.60	2.27
1.368	28.00	18.60	87.30	3.21
1.427	27.60	21.80	85.75	4.25
1.533	27.00	28.00	84.39	6.05
1.776	25.90	40.52	81.05	10.30
2.250	24.90	52.42	76.21	16.73
2.507	24.40	58.93	73.20	21.04
2.845	22.49	65.75	71.66	24.15
	21.50	68.95	70.04	26.42

## (b) In equilibrium with excess I.

1.134	0.0	23.04	0.0	I
1.530	7.36	43.05	1.40	88.76
1.721	10.60	49.38	2.50	88.21
1.90	12.44	55.33	3.72	87.10
2.11	13.74	59.26	4.41	86.60
2.22	15.20	62.66	5.80	85.20
2.80	17.72	69.10	7.15	85.49
2.99	19.30	71.90	7.45	88.96

## (c) Invariant point. Excess KI and I.

3.162	20.11	72.51		
	20.03	72.46	21.84	74.64
				KI+I
	20.05	72.54		
	19.98	72.44	7.40	89.81 I
	20.08	72.51	20.61	74.09
				KI+I
	20.06	72.44		
	20.05	72.48	33.46	63.19 KI

(Parsons and Corliss, J. Am. Chem. Soc. 1910, 32. 1370.)

## Solubility in KI+40% alcohol at 25°.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor.	
	% KI	% I	% KI	% I.

## (a) In equilibrium with excess KI.

1.339	42.10	0.0		0.0
1.377	40.83	3.76	89.21	0.70
1.455	38.94	10.09	88.80	1.90
1.532	37.41	15.71	88.19	3.02
1.605	36.25	20.52	87.04	4.21
1.655	35.38	24.44	86.08	5.11
1.847	33.26	33.62	83.61	8.41
2.024	31.71	39.99	82.06	10.76
2.169	30.59	44.76	80.80	12.35
2.558	28.56	55.30	75.90	18.63
2.784	26.95	60.27	74.77	20.86
...	24.52	65.93	72.98	23.61
...	23.04	69.93	72.45	25.04

Solubility in KI+40% alcohol at 25°.—  
Continued.

Sp. gr.	Analysis of liquid phase		Analysis of solid phase together with adhering mother liquor	
	% KI	% I	% KI	% I

## (b) In equilibrium with excess I.

0.962	0.0	2.97	0.0	
1.292	8.45	28.70	1.85	84.51
1.581	12.56	40.63	3.41	84.02
...	15.20	49.95	4.98	83.81
2.000	16.02	52.95	5.60	82.96
2.173	17.18	57.38	6.61	83.60
1.749	19.20	66.89	8.45	85.16
2.902	20.12	69.10	7.08	88.81

## (c) Invariant point. Excess KI and I.

3.246	22.50	70.79	19.48	76.24
...	22.43	70.88	69.37	26.14

(Parsons and Corliss, J. Am. Chem. Soc. 1910, 32. 1372.)

See also under KI.

Sol. in KI+nitrobenzene. (Dawson, Chem. Soc. 1902, 81. 529.)

Solubility in KIO<sub>3</sub>+Aq is the same as in H<sub>2</sub>O. (Lami, C. A. 1909. 1622.)Solubility of I<sub>2</sub> in KBr+Aq at 25°.

G. KBr per l.	G. atoms I <sub>2</sub> per l.
60.6	0.0176
106.9	0.0278
175.9	0.0415
229.8	0.0532
281.9	0.0628
330.6	0.0717
377.1	0.0797
411.0	0.0864
461.7	0.0948
509.8	0.1006
548.0	0.1062
567.9 sat.	0.1094

(Bell and Buckley, J. Am. Chem. Soc. 1912, 34. 13.)

## Solubility in NaBr+Aq at 25°.

G. NaBr per l.	G. atoms I <sub>2</sub> per l.
96.4	0.0266
187.7	0.0425
271.8	0.0538
357.4	0.0598
422.4	0.0638
499.1	0.0648
569.9	0.0644
632.0	0.0622
679.7	0.0595
750.5	0.0551
756.1 sat.	0.0550

(Bell and Buckley, J. Am. Chem. Soc. 1912, 34. 13.)

100 cc. of a 10% solution of  $\text{SrBr}_2$  dissolve 0.270 g.  $\text{I}_2$  at 13.50. (Meyer, Z. anorg. 1902, 30. 114.)

100 cc. of a 10% solution of  $\text{SrCl}_2$  dissolve 0.066 g.  $\text{I}_2$  at 18.5°. (Meyer.)

100 cc. of a 10% solution of  $\text{SrI}_2$  dissolve 6.616 g.  $\text{I}_2$  at 13.5°. (Meyer.)

#### Solubility in salts + Aq at 25°.

Salt + Aq	Grams $\text{I}_2$ sol. in 1 liter	Salt + Aq	Grams $\text{I}_2$ sol. in 1 liter
$\frac{1}{2}$ -N. $\text{Na}_2\text{SO}_4$	0.160	N. $\text{NaCl}$	0.575
$\frac{1}{2}$ -N. $\text{K}_2\text{SO}_4$	0.238	N. $\text{KCl}$	0.658
$\frac{1}{2}$ -N. $(\text{NH}_4)_2\text{SO}_4$	0.246	N. $\text{NH}_4\text{Cl}$	0.735
N. $\text{NaNO}_3$	0.257	N. $\text{NaBr}$	3.29
N. $\text{KNO}_3$	0.266	N. $\text{KBr}$	3.801
N. $\text{NH}_4\text{NO}_3$	0.375	N. $\text{NH}_4\text{Br}$	4.003

(McLauchlan, Z. phys. Ch. 1903, 44. 617.)

1.14 g. are sol. in 100 ccm. liquid  $\text{H}_2\text{S}$ . (Antony, Gazz. ch. it. 1905, 35, (1) 206.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. ch. J. 1898, 20. 822.)

Sl. sol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Sol. in liquid  $\text{SO}_2$  (Sestini), and  $\text{SO}_2$  (Weber).

100 pts.  $\text{AsCl}_3$  dissolve 8.42 pts.  $\text{I}$  at 0°; 11.88 pts.  $\text{I}$  at 15°; 36.89 pts.  $\text{I}$  at 96°. (Sloan, C. N. 46. 194.)

Sol. in liquid  $\text{SO}_2$ ,  $\text{AsCl}_3$ ,  $\text{SO}_2\text{Cl}_2$ , and acetaldehyde. (Walden, Z. phys. Ch. 1903, 43. 407.)

Very sol. in liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol. in 10-12 pts. alcohol. (Wittstein.)

Sol. in wood-spirit. (Playfair.)

Abundantly sol. in amyl (Pelletan), and hexyl alcohol (Bovis).

Iodine is sol. in 20 pts. alcohol, 110 pts. oil, 7000 pts.  $\text{H}_2\text{O}$ , 100 pts. glycerine. (Cap and Garot, J. Pharm. (3) 26. 80.)

#### Solubility of $\text{I}_2$ in $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$ at room temperature (14.5°—15.1°).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	61.7
90	29.4
80	16.6
70	9.2
60	4.45
50	3.4
40	1.0
30	0.4
20	0.25
10	0.2
0	0.0

(Bruner, Z. phys. Ch. 1898, 26. 150.)

#### Solubility of $\text{I}_2$ in $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$ at room temperature (14.5°—15.1°).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	58.8
90	36.0
80	23.6
70	16.1
60	10.7
50	6.4
40	3.7
30	1.56
20	0.42
10	0.19
0	....

(Bruner, Z. phys. Ch. 1898, 26. 150.)

#### Solubility in ethyl alcohol + Aq at 25°.

Molecules of $\text{C}_2\text{H}_5\text{OH}$ in 100 molecules $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Molecules of $\text{H}_2\text{O}$ in 100 molecules $\text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	Normality of the iodine solution
0.0	100	0.0022
0.03	99.7(?)	0.0024
0.06	99.4(?)	0.0024
1.12	98.88	0.0023
1.83	98.27(?)	0.0025
9.40	90.60	0.0059
13.48	86.52	0.0111
23.80	76.20	0.0617
50.80	49.20	0.4326
100	0	1.590

(McLauchlan, Z. phys. Ch. 1903, 44. 627.)

#### Solubility in acetic acid + Aq at 25°.

Molecules of $\text{CH}_3\text{COOH}$ in 100 molecules $\text{CH}_3\text{COOH} + \text{H}_2\text{O}$	Molecules of $\text{H}_2\text{O}$ in 100 molecules $\text{CH}_3\text{COOH} + \text{H}_2\text{O}$	Normality of the iodine solution
0.0	100	0.0022
6.98	93.02	0.0049
16.40	83.60	0.0112
31.90	68.10	0.0331
55.70	44.30	0.0882
100	0	0.205

(McLauchlan, Z. phys. Ch. 1903, 44. 627.)

Very sol. in ether, chloroform, and bromoform.

Solubility in ether.

100 g. of the sat. solution contain at:

—83° —90° —108°

15.39 14.58 15.09 g.  $\text{I}_2$ .

(Arctowski, Z. anorg. 1896, 11. 276.)

About as sol. in all fatty oils as in  $\text{CHCl}_3$ , etc. (Gruei, Arch. Pharm. 223. 431.)

Sol. in 56.6 pts. chloroform at 10°. (Duncan, Pharm. J. Trans. 51. 544.)

Solubility in  $\text{CHCl}_3$ .

100 g. of the sat. solution contain at:

—49° —55.5° —60° —69.5° —73.5°  
0.188 0.144 0.129 0.089 0.080 g.  $\text{I}_2$ .

(Arctowski, Z. anorg. 1896, 11. 276.)

Very sol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)

Solubility of  $\text{I}_2$  in  $\text{C}_6\text{H}_6 + \text{CHCl}_3$  at room temperature. (14.5°—15.1°).

Volumes of $\text{C}_6\text{H}_6$ in 100 volumes of $\text{C}_6\text{H}_6 + \text{CHCl}_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	41.05
90	38.8
80	34.6
70	30.5
60	27.4
50	24.4
40	21.0
30	19.2
20	17.8
10	16.0
0	14.3

(Bruner, Z. phys. Ch. 1898, 26. 147.)

Solubility of  $\text{I}_2$  in  $\text{CS}_2 + \text{CHCl}_3$  at room temperature (14.5°—15.1°).

Volumes of $\text{CS}_2$ in 100 volumes of $\text{CS}_2 + \text{CHCl}_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	69.4
90	62.7
80	55.9
70	47.9
60	42.0
50	35.8
40	30.4
30	25.3
20	20.8
10	17.0
0	14.3

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{C}_6\text{H}_6 + \text{CCl}_4$  at room temperature (14.5°—15.1°).

Volumes of $\text{C}_6\text{H}_6$ in 100 volumes of $\text{C}_6\text{H}_6 + \text{CCl}_4$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	41.05
90	37.2
80	33.6
70	29.6
60	26.1
50	22.4
40	19.25
30	16.1
20	13.4
10	10.75
0	8.1

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{CS}_2 + \text{CCl}_4$  at room temperature (14.5°—15.1°).

Volumes of $\text{CS}_2$ in 100 volumes of $\text{CS}_2 + \text{CCl}_4$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	69.1
90	56.9
80	48.6
70	40.7
60	33.9
50	26.9
40	21.8
30	17.7
20	13.25
10	10.2
0	8.1

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$  at room temperature (14.5°—15.1°).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	61.7
90	37.1
80	34.2
70	30.7
60	27.9
50	26.1
40	24.6
30	22.7
20	19.9
10	17.1
0	14.25

(Bruner.)

Solubility of  $\text{I}_2$  in  $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$  at room temperature (14.5°—15.1°).

Volumes of $\text{C}_2\text{H}_5\text{OH}$ in 100 volumes of $\text{C}_2\text{H}_5\text{OH} + \text{CHCl}_3$	Ccm. of 1/10-normal iodine in 5 cc. of the solution
100	58.8
90	51.9
80	44.2
70	35.4
60	31.8
50	30.8
40	27.9
30	25.3
20	21.8
10	17.8
0	14.25

(Bruner.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328); (Eidmann, C. C. 1909, II. 1014.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Sol. in allyl mustard oil, phenyl mustard

oil, phenyl isocyanate, pyridine, and alcohol. (Mathews, J. phys. Chem. 1905, 9. 649.)

Solubility of  $I_2$  in glycerine + Aq at 25°.

G = g. glycerine in 100 g. glycerine + Aq.

$I_2$  = g.  $I_2$  in 100 cc. of the solution.

G	$I_2$	Sp. gr.
0	0.0304	0.9979
7.15	0.0342	1.0198
20.44	0.0482	1.0471
31.55	0.0621	1.0750
40.95	0.0875	1.0995
48.7	0.135	1.1207
69.2	0.278	1.1765
100	1.223	1.2646

(Herz and Knoch, Z. anorg. 1905, 45. 269.)

1 l.  $N-NH_4C_2H_2O_2$  + Aq dissolves 0.440 g.  $I_2$  at 25°.

1 l. 0.7 N- $(NH_4)_2C_2O_4$  + Aq dissolves 0.980 g.  $I_2$  at 25°.

(McLauchlan, Z. phys. Ch. 1903, 44. 617.)

Very sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Solubility in  $CS_2$  at t°.

t°	Grams iodine in 100 g. of sat. solution
-100	0.32
-95	0.37
-90	0.41
-85	0.46
-80	0.51
-75	0.55
-25	3.47
-20	4.14
-15	4.82
-10	5.52
-5	6.58
0	7.89
+5	9.21
10	10.51
15	12.35
20	14.62
25	16.92
30	19.26
36	22.67
40	25.22
42	26.75

(Arctowski, Z. anorg. 1894, 6. 404.)

1 l.  $CS_2$  dissolves 230 g.  $I_2$  at 25°.

1 l.  $CHBr_3$  dissolves 189.55 g.  $I_2$  at 25°.

1 l.  $CCl_4$  dissolves 30.33 g.  $I_2$  at 25°.

(Jakowkin, Z. phys. Ch. 1895, 18. 590.)

Solubility in  $CS_2$ .

100 g. of the sat. solution contain at:

-80°	-87°	-92.5°	-94°
0.509	0.440	0.391	0.378 g. $I_2$ .

(Arctowski, Z. anorg. 1896, 11. 274.)

When an aqueous solution of I is shaken with  $CS_2$ , 400 pts. go into solution in  $CS_2$  for 1 pt. remaining in  $H_2O$ . (Berthelot and Jungfleisch, C. R. 69. 338.)

Abundantly sol. in methane. (Villard, A. ch. 1897, (7) 10. 387.)

Easily sol. in hot, less in cold naphtha. (Pelletier and Walker.)

Sol. in about 8 pts. hot petroleum from Amiano. (de Saussure.)

Sl. sol. in cold, more readily in hot benzene. (Mansfield.) Easily sol. in benzene.

(Moride, A. ch. (3) 39. 452.)

Solubility in benzene.

100 g. of the sat. solution contain at:

4.7°	6.6°	10.5°	13.7°	16.3°
8.08	8.63	9.60	10.44	11.23 g. $I_2$ .

(Arctowski, Z. anorg. 1896, 11. 276.)

1 l. benzene sat. with iodine at 25° contains 139 g. iodine. Abegg, Z. anorg. 1906, 50. 409.)

1 l. nitrobenzene dissolves 50.62 g.  $I_2$  at 16-17°. (Dawson and Gawler, Chem. Soc. 1902, 81. 524.)

Solubility of  $I_2$  in nitrobenzene + iodides at room temp.

Salt	G. per l.	
	Salt	$I_2$
KI	12.35	112.7
"	45.56	295.7
"	115.8	698.2
"	155.2	943.6
NaI	13.55	125
"	57.7	393
"	109.1	738
"	228.	1251
RbI	85.4	421
"	217.5	1060
LiI	84.1	642
CaI	48.2	213
"	223.	858
$NH_4I$	69.5	482
"	94.3	669
$SrI_2$	106.5	599
$BaI_2$	42.2	237
"	158.5	809
Aniline hydriodide	164	721
Dimethyl aniline hydriodide	160	626
Tetramethylammonium iodide	49.3	266
"	51.4	280

(Dawson and Goodson, Chem. Soc. 1904, 85. 796.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Easily sol. in oil of turpentine, but an explosion soon occurs. (Walker.)

Sol. in oil of mandarin. (Luca.)

Sol. in oil of *arnica* root. (Zeller.)

Very sol. in  $CS_2$ , lignone, furfural, glycerine, aldehyde, chloral, warm retinole, toluene, salicylic acid, methyl nitrate, methyl salicylate, mercaptan, amyl carbamate, ethyl sulphhydrate, allyl iodide, ethyl disulphocarbonate, carbon chloride,  $SCl_2$ ,  $ICl_3$ ,  $H_2S_8$ , chlorochromic acid, amyl valerianate, valerianic acid, warm butyric acid, creosote, aniline, quinoline, methylsalicylic acid. Quickly sol. in oil of dill, peppermint, sassafras, and tansy. Slowly sol. in oil of cloves, cinnamon, cajeput, and rue. Other essential oils decompose it. (Various authorities.)

Sol. in potassium croconate + Aq. (Gmelin.)

Sol. in potassium antimony tartrate + Aq. 176 pts.  $H_2O$  + 6 pts. potassium antimony tartrate dissolve 2.75 pts. I; 378 pts.  $H_2O$  + 6 pts. potassium antimony tartrate dissolve 4.12 pts. I.

More sol. in tannic acid than in  $H_2O$ . 1 pt. I is sol. in 450 pts.  $H_2O$  with 3.3 pts. tannic acid at  $12^\circ$ ; 1 pt. I is sol. in 240 pts.  $H_2O$  with 0.015 pt. tannic acid at about  $30^\circ$ . (Koller, Zeit. Ch. 1886, 380.)

200 g.  $H_2O$  containing 0.3 g. tannic acid dissolve 1.0 g. I. (Hager, Comm. 1883.)

Sol. in considerable quantity, especially on warming, in resorcin, orcin, or phloroglucin + Aq, without coloration or formation of HI + Aq. These solutions withdraw I from  $CS_2$  solution, and do not give it up on boiling, but on evaporation in vacuo the I is sublimed in a pure state. (Hlasiwetz, Z. anal. 6. 447.)

Partition coefficient for iodine between  $CS_2$  and Aq at  $25^\circ C$ .

A = concentration of the water layer.

C = concentration of the carbon bisulphide layer.

A	C	$h = C/A$
0.2571	167.6	651.8
0.2195	140.2	638.7
0.1947	122.0	626.4
0.1743	108.3	620.0
0.1605	98.27	612.2
0.1229	73.23	595.8
0.1104	65.81	596.0
0.0939	55.29	590.5
0.0518	30.36	586.2

Partition coefficient for iodine between  $CHBr_3$  and Aq at  $25^\circ C$ .

A = concentration of the water layer.

C = concentration of the  $CHBr_3$  layer.

A	C	$g = C/A$
0.2736	144.36	527.6
0.1752	85.11	485.7
0.1084	49.93	460.5
0.0757	32.65	431.7
0.0517	22.19	429.3

Partition coefficient for iodine between  $CCl_4$  and Aq at  $25^\circ C$ .

A = concentration of the water layer.

C = concentration of the  $CCl_4$  layer.

A	C	$h = C/A$
0.2913	25.61	87.91
0.1934	16.54	85.51
0.1276	10.88	85.30
0.0818	6.966	85.13
0.0516	4.412	85.77

(Jakowkin, Z. phys. Ch. 1895, 18. 586-588.)

G. alcohol in 100 cc. of mixture	$\frac{C \text{ aq. alcohol}}{CCS_2} \times 10^3$
30.5	1.29
26.7	0.76
22.9	0.49
19.1	0.34
16.3	0.28
11.4	0.23
7.6	0.20

(Osaka, Chem. Soc. 1905, 88. (2) 811.)

Division of iodine between  $CS_2$  and  $Na_2SO_4$  + Aq at  $25^\circ$ .

A = concentration of I in  $H_2O$  layer.

C = concentration of I in  $CS_2$  layer.

$Na_2SO_4$ + Aq	A	C
1-N	0.1518	142.4
$1/2$ -N	0.1809	141.7
$1/3$ -N	0.2022	143.6
$1/4$ -N	0.2138	142.4

Division of iodine between  $CS_2$  and  $NaNO_3$  + Aq.

$NaNO_3$ + Aq	A	C
1-N	0.1923	142.4
$1/2$ -N	0.2090	143.7
$1/3$ -N	0.2164	143.5

(Jakowkin, Z. phys. Ch. 1896, 20. 25.)

Partition between  $CHCl_3$  and glycerine.

C = millimols iodine in 10 g.  $CHCl_3$  layer.

W = millimols iodine in 10 g. glycerine layer.

C	W	C/W
0.504	0.244	2.31
0.919	0.397	2.32
0.151	0.500	2.30

(Herz, Z. Elektrochem. 1910, 16. 870.)



Partition of  $I_2$  between  $CHCl_3$  and other solvents.

C = millimols iodine in 10 ccm. of the  $CHCl_3$  layer.

W = millimols iodine in 10 ccm. of the other layer.

Other Solvent	C	W	C/W
Water	0.338	0.0025	134.6
	1.546	0.0120	129.0
	2.318	0.0184	126.3
	3.207	0.0242	132.8
	3.439	0.0259	132.8
75% by vol. $H_2O$ + 25% by vol. glycerine	1.217	0.0183	66.32
	1.893	0.0290	65.33
	2.434	0.0367	66.31
	3.219	0.0483	66.65
50% by vol. $H_2O$ + 50% by vol. glycerine	1.217	0.0405	30.0
	1.835	0.0609	30.1
	2.376	0.0782	30.4
	3.294	0.1020	32.2
25% by vol. $H_2O$ + 75% by vol. glycerine	1.188	0.116	10.25
	1.806	0.173	10.45
	2.656	0.249	10.66
	2.859	0.265	10.80
	3.400	0.312	10.93

(Hers, Z. Elektrochem. 1910, 16, 870.)

Distribution of  $I_2$  between benzene and glycerine at  $t^\circ$ .

$M_1$  = concentration of  $I_2$  in benzene layer expressed in g.-mol. per l.

$M_2$  = concentration of  $I_2$  in glycerine layer expressed in g.-mol. per l.

$t^\circ$	$M_1$	$M_2$
25°	0.00757 0.01610 0.02719 0.04024 0.06255 0.07923 0.10243 0.12201 0.13342 0.16734	0.001604 0.002664 0.004115 0.005794 0.00834 0.01033 0.01324 0.01559 0.01668 0.02081
40°	0.008545 0.01544 0.04432 0.095004 0.13271 0.18508	0.00181 0.002593 0.006242 0.012013 0.01632 0.02193
50°	0.00865 0.01523 0.02683 0.04413 0.0620 0.07832 0.10153 0.12166 0.13199 0.18438	0.00184 0.00253 0.00390 0.00576 0.00744 0.00942 0.01214 0.0145 0.01560 0.02122

(Landau, Z. phys. Ch. 1910, 73, 202.)

Distribution of  $I_2$  between glycerine and  $CCl_4$  at  $t^\circ$ .

$M_1$  = concentration of  $I_2$  in  $CCl_4$  layer expressed in g.-mol. per l.

$M_2$  = concentration of  $I_2$  in glycerine layer expressed in g.-mol. per l.

$t^\circ$	$M_1$	$M_2$
25°	0.002230 0.0024113 0.0048227 0.010452 0.038973 0.04598 0.05820	0.0014386 0.0014596 0.0027014 0.005581 0.019959 0.023948 0.030097
40°	0.00227 0.00239 0.00461 0.01092 0.02540 0.04091 0.06074	0.00127 0.00138 0.00272 0.00482 0.01116 0.01749 0.02701
50°	0.00257 0.00500 0.01363 0.02549 0.04167 0.06309	0.00118 0.00225 0.00596 0.01050 0.01693 0.02502

(Landau, Z. phys. Ch. 1910, 73, 203.)

Distribution of  $I_2$  between ether and ethylene glycol at  $t^\circ$ .

$M_1$  = concentration of  $I_2$  in ether layer, expressed in g.-mol. per l.

$M_2$  = concentration of  $I_2$  in  $C_2H_4O_2$  layer, expressed in g.-mol. per l.

$t^\circ$	$M_1$	$M_2$
0°	0.00843 0.03082 0.06551 0.08105 0.12528 0.31511	0.00571 0.01713 0.03736 0.04605 0.07148 0.17524
25°	0.00870 0.01677 0.02710 0.03046 0.06385 0.11951 0.30820	0.00571 0.01001 0.01586 0.01713 0.03594 0.06725 0.17524

(Landau, Z. phys. Ch. 1910, 73, 205.)

Iodine monobromide,  $IBr$ .

Slowly sol. in  $H_2O$  with slight decomp.

Sol. in  $CHCl_3$ ,  $CS_2$ , ether, and alcohol.

+5 $H_2O$ . (Löwig, Pogg. 14, 485.) Does not exist. (Bornemann, A. 189, 183.)

**Iodine pentabromide,  $\text{IBr}_5$ (?).**

Sol. in  $\text{H}_2\text{O}$  with separation of iodine. (Löwig, Pogg. 14. 485.)

**Iodine monochloride,  $\text{ICl}$ .**

Decomp. by  $\text{H}_2\text{O}$ ; sol. without decomp. in alcohol, ether, and  $\text{HCl} + \text{Aq.}$

Sol. in  $\text{CS}_2$ .

**Iodine hydrogen chloride,  $\text{ICl}$ ,  $\text{HCl}$ .**

Unstable. Sol. in ether. (Schützenberger, C. R. 84. 389.)

**Iodine trichloride,  $\text{ICl}_3$ .**

Deliquescent. With  $\text{H}_2\text{O}$ , a part is dissolved without decomp., and the rest is decomp. The aqueous solution contains more unchanged  $\text{ICl}_3$ , the more conc. it is. (Serullas.) Precipitated from aqueous solution by  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{HCl} + \text{Aq.}$  Sol. in warm conc.  $\text{H}_2\text{SO}_4$  without decomp. Sol. in alcohol, and benzene. Decomp. by small amount of  $\text{CS}_2$ . (Christomanos, B. 10. 434.) Ether does not remove it from aqueous solution. (Serullas.)

**Iodine lithium chloride,  $\text{ICl}_3$ ,  $\text{LiCl} + 4\text{H}_2\text{O}$ .**

See Lithium chloroiodide.

**Iodine trichloride magnesium chloride,  $2\text{ICl}_3$ ,  $\text{MgCl}_2 + 5\text{H}_2\text{O}$ .**

Very deliquescent and easily decomposed. (Filhol, J. Pharm. 25. 442.)

+  $8\text{H}_2\text{O}$ . Hygroscopic. (Weinland, Z. anorg. 1902, 30. 141.)

**Iodine trichloride manganous chloride,  $2\text{ICl}_3$ ,  $\text{MnCl}_2 + 8\text{H}_2\text{O}$ .**

Hygroscopic. (Weinland, Z. anorg. 1902, 30. 139.)

**Iodine trichloride nickel chloride,  $2\text{ICl}_3$ ,  $\text{NiCl}_2 + 8\text{H}_2\text{O}$ .**

Hygroscopic.  $\text{CCl}_4$  dissolves out  $\text{ICl}_3$ . (Weinland, Z. anorg. 1902, 30. 138.)

**Iodine monochloride phosphorus pentachloride,  $\text{ICl}$ ,  $\text{PCl}_5$ .**

Very deliquescent; decomp. by  $\text{H}_2\text{O}$ .

**Iodine potassium chloride,  $\text{ICl}_3$ ,  $\text{KCl}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp.

Ether dissolves out  $\text{ICl}_3$ . (Filhol, J. Pharm. 25. 433, 506.)

See Potassium chloroiodide.

**Iodine sodium chloride,  $\text{ICl}_3$ ,  $\text{NaCl} + 2\text{H}_2\text{O}$ .**

See Sodium chloroiodide.

**Iodine trichloride strontium chloride,  $2\text{ICl}_3$ ,  $\text{SrCl}_2 + 8\text{H}_2\text{O}$ .**

Hygroscopic. (Weinland, Z. anorg. 1902, 30. 142.)

**Iodine trichloride sulphur tetrachloride,  $\text{ICl}_3$ ,  $\text{SCl}_4$ .**

Very deliquescent in air; decomp. by  $\text{H}_2\text{O}$ . Decomp. with formation of clear solution by dil.  $\text{HNO}_3 + \text{Aq.}$  (Weber, Pogg. 128. 459.)

$\text{SCl}_3$ ,  $2\text{ICl}_3$ . (Jaillard, J. B. 1860. 95.)

Correct formula is as above. (Weber, l. c.)  $2\text{ICl}_3$ ,  $\text{SCl}_4$ . Sol. in  $\text{SO}_2\text{Cl}_2$ ,  $\text{SOCl}_2$ ,  $\text{POCl}_3$ , warm  $\text{SCl}_3$ , petroleum ether, ligroin,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CS}_2$ , and abs. ether. (Ruff, B. 1904, 37. 4519.)

**Iodine trichloride zinc chloride,  $2\text{ICl}_3$ ,  $\text{ZnCl}_2 + 8\text{H}_2\text{O}$ .**

Unstable. Hygroscopic. (Weinland, Z. anorg. 1902, 30. 140.)

**Iodine pentafluoride,  $\text{IF}_5$ .**

Fumes in air; decomp. with  $\text{H}_2\text{O}$ . (Gore, C. N. 24. 291.)

Decomp. by  $\text{H}_2\text{O}$  into iodic acid and  $\text{HF}$ . Decomp. by solutions of the alkalis. (Moissan, C. R. 1902, 135. 564.)

**Iodine trioxide,  $\text{I}_2\text{O}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Ogier, C. R. 85. 957; 86. 722.)

Probably a mixture.

**Iodine tetroxide,  $\text{I}_2\text{O}_4$ (?).**

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ ; insol. in alcohol. Decomp. by  $\text{HNO}_3 + \text{Aq.}$  Sol. in  $\text{H}_2\text{SO}_4$ . (Millon, J. pr. 34. 319, 337.)

**Iodine pentoxide,  $\text{I}_2\text{O}_5$ .**

Very sol. in  $\text{H}_2\text{O}$ , and in dil. alcohol. Insol. in absolute alcohol, ether,  $\text{CS}_2$ , chloroform, and hydrocarbons.

Forms hydrates, iodic acid  $\text{HIO}_3$ , and  $3\text{I}_2\text{O}_5$ ,  $\text{H}_2\text{O}$ ; insol. in ordinary alcohol.

For sp. gr. of aqueous solution, see *iodic acid*.

**Iodine oxides,  $\text{I}_{10}\text{O}_{15}$ ,  $\text{I}_5\text{O}_{12}$ .**

The compounds,  $\text{I}_{10}\text{O}_{15}$  (Millon, J. pr. 34. 336), and  $\text{I}_5\text{O}_{12}$  (Kämmerer, J. pr. 83. 81), are probably mixtures.

Millon's oxides are impure  $\text{I}_2\text{O}_5$ . (Kappeler, B. 1911, 44. 3496.)

**Iodine sulphur oxide,  $5\text{I}_2\text{O}_5$ ,  $\text{SO}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Kämmerer.)

$\text{I}_2\text{O}_5$ ,  $3\text{SO}_2$ . Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in hot  $\text{SO}_4$ . (Weber, B. 20. 86.)

=  $(\text{IO})_2(\text{SO}_4)_3$ . Iodyl sulphate (?).

**Iodine oxyfluoride,  $\text{IOF}_3 + 5\text{H}_2\text{O}$ .**

Fumes in air. (Weinland, Z. anorg. 1908, 60. 163.)

**Iodine sulphide,  $\text{S}_2\text{I}_2$ .**

Sol. in  $\text{CS}_2$ . (Linebarger, Am. Ch. J. 1895, 17. 57.)

**Iodine sulphoxide,  $I_2SO_2(?)$ .**

Decomp. by  $H_2O$ . (Schultz-Sellack.)  
 $I_2(SO_2)_2(?)$ . Decomp. by  $H_2O$ . (Weber, J. pr. (2) 25. 224.)  
 $I_2(SO_2)_2(?)$ . As above. (Weber.)  
*See also Iodosulphuric anhydride.*

**Iodiridic acid.****Ammonium iodiridate,  $(NH_4)_2IrI_4$ .**

Very easily sol. in cold  $H_2O$ , decomp. on warming. Insol. in alcohol. (Oppler, J. B. 1857. 263.)

**Potassium iodiridate,  $K_2IrI_4$ .**

Very easily sol. in  $H_2O$ . Insol. in alcohol.

**Sodium iodiridate,  $Na_2IrI_4$ .**

Insol. in cold, sl. sol. in hot  $H_2O$ . Easily sol. in acids. (Oppler.)

**Iodiridous acid.****Ammonium iodiridite,  $(NH_4)_2Ir_2I_{12} + H_2O$ .**

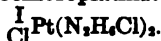
Very sol. in  $H_2O$ , but decomp. on warming. (Oppler.)

**Potassium iodiridite,  $K_2Ir_2I_{12}$ .**

Insol. in  $H_2O$ , or alcohol. Slowly sol. in acids; easily in warm alkalis + Aq.

**Silver iodiridite,  $Ag_2Ir_2I_{12}$ .**

Ppt.

**Iodochloroplatindiamine chloride,**

Sl. sol. in  $H_2O$ .

**Iodochromic acid.****Potassium iodochromate,  $KCrO_2I$ .**

Decomp. by boiling  $H_2O$ . (Guyot, C. R. 73. 46.)

*See also Chromoiodic acid.*

**Iodomolybdic acid.**

*See Molybdoiodic acid.*

**Iodonitratoplatinmonodiamine bromide,**

Very sl. sol. in  $H_2O$ . (Cleve.)

**Iodonitratoplatin diamine nitrate,**

Quite easily sol. in hot  $H_2O$ . (Cleve.)

**Iodopalladous acid.****Potassium iodopalladite.**

Deliquescent. (Lassaigne.)

**Iodophosphoric acid.**

*See Phosphoiodic acid.*

**Iodoplatinamine iodide,  $I_2Pt(NH_3)_2I$ .**

Sol. in  $H_2O$ , especially easily if boiling. (Cleve.)

**Iodoplatin diamine iodide,  $I_2Pt(N_2H_4)_2I$ .**

Sol. in  $H_2O$ , especially when hot. (Cleve.)

**— mercuric iodide,  $I_2Pt(N_2H_4)_2, 2HgI_2$ .**

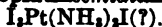
Extremely difficultly sol. in cold  $H_2O$ ; partly decomp. by boiling. (Jørgensen, Gm. K. 3. 1214.)

**— nitrate,  $I_2Pt(N_2H_4NO_2)_2$ .**

More sol. in hot than cold  $H_2O$ .

**— sulphate,  $I_2Pt(N_2H_4)_2SO_4$ .**

Very sl. sol. in  $H_2O$ . (Jørgensen, J. pr. (2) 15. 429.)

**Iodoplatin semidiamine iodide,**

Sl. sol. in  $H_2O$ . (Jørgensen, J. pr. (2) 16. 345.)

**— periodide,  $I_2Pt(NH_3)_2I, I_2$ .**

Moderately sl. sol. in  $H_2O$ . (Cleve.)

**Iododiplatinamine iodide,  $I_2Pt_2(N_2H_4)_2I_4$ .**

Insol. in  $H_2O$ .

**Iododiplatin diamine anhydroiodide,**

Insol. in  $NH_4OH + Aq$ .

**— anhydronitrate,  $I_2Pt_2(N_2H_4)_2O(NO_2)_2$ .**

Easily sol. in warm  $H_2SO_4 + Aq$ . (Cleve.)

**— iodide,  $I_2Pt_2(N_2H_4)_2I_4$ .**

Ppt.

**— nitrate,  $I_2Pt_2(N_2H_4)_2(NO_2)_4 + 4H_2O$ .**

Sl. sol. in cold, moderately sol. in hot  $H_2O$ . (Cleve.)

**— phosphate,  $I_2Pt_2(N_2H_4)_2[O_2P(OH)]_2$ .**

Nearly insol. in  $H_2O$ .

**— sulphate,  $I_2Pt_2(N_2H_4)_2(SO_4)_2$ .**

Nearly insol. in  $H_2O$ .

**— platodiamine sulphate,  $I_2Pt_2(N_2H_4)_2SO_4, Pt(NH_3)_2SO_4$ .**

Very sl. sol. in  $H_2O$ . (Carlgren Sv. V. A. F. 47. 306.)

**Iodoplatinic acid,  $H_2PtI_4 + 9H_2O$ .**

Deliquescent. Easily sol. in  $H_2O$ , with decomp. into  $PtI_4$  and  $HI$  on standing or warming. (Topsoë.)

**Ammonium iodoplatinate,  $(\text{NH}_4)_2\text{PtI}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Topeoé.)  
 $\text{NH}_4\text{I}$ ,  $\text{PtI}_4$ . Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Lassaigne, A. ch. (2) 51. 128.)

**Barium iodoplatinate,  $\text{BaPtI}_4$ .**

Deliquescent, but less so than  $\text{Na}_2\text{PtI}_4$ , which it otherwise resembles. (Lassaigne.)

**Calcium iodoplatinate,  $\text{CaPtI}_4 \cdot 12\text{H}_2\text{O}$ .**

Not so deliquescent as Na salt.

**Cobalt iodoplatinate,  $\text{CoPtI}_4 \cdot 9\text{H}_2\text{O}$ .**

Very deliquescent.

**Lead tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Pb}$ ,  $\text{Pb}(\text{OH})_2$ .**

Ppt. (Belluci, C. C. 1902, I. 625.)

**Magnesium iodoplatinate,  $\text{MgPtI}_4 \cdot 9\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Manganese iodoplatinate,  $\text{MnPtI}_4 \cdot 9\text{H}_2\text{O}$ .**

Very deliquescent.

**Mercuric tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Hg}$ .**

Ppt. (Belluci, C. C. 1902, I. 625.)

**Nickel iodoplatinate,  $\text{NiPtI}_4 \cdot 9\text{H}_2\text{O}$ .**

Very deliquescent.

**Potassium iodoplatinate,  $\text{K}_2\text{PtI}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ .

**Silver tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Ag}_2$ .**

Ppt. (Belluci, C. C. 1902, I. 625.)

**Sodium iodoplatinate,  $\text{Na}_2\text{PtI}_4 \cdot 6\text{H}_2\text{O}$ .**

Not deliquescent, but easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Vauquelin.) Deliquescent. (Lassaigne.)

**Thallium tetraiodoplatinate,  $[\text{PtI}_4(\text{OH})_2]\text{Tl}_2$ .**

Ppt. (Belluci, C. C. 1902, I. 625.)

**Zinc iodoplatinate,  $\text{ZnPtI}_4 \cdot 9\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ .

**Iodoplatinocyanhydric acid,  $\text{H}_2\text{Pt}(\text{CN})_4$ .**

See Periodoplatinocyanhydric acid.

**Silver iodoplatinocyanide,  $\text{Ag}_2(\text{PtI}_2(\text{CN})_2)_2$ .**

Ppt. (Miolati, Gazz. ch. it. 1900, 30. 588.)

**Strontium iodoplatinocyanide platinocyanide,  $\text{SrPt}(\text{CN})_4$ ,  $10\text{SrPt}(\text{CN})_4 \cdot x\text{H}_2\text{O}$ .**

(Holst.)

**Iodopurpleochromium chloride,  $\text{ICr}(\text{NH}_3)_4\text{Cl}_2$ .**

Quite sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 25. 83.)

— **chloroplatinate,  $\text{ICr}(\text{NH}_3)_4\text{PtCl}_4$ .**

Precipitate. (Jørgensen, l. c.)

— **iodide,  $\text{ICr}(\text{NH}_3)_4\text{I}_2$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HI}$ , or  $\text{KI} + \text{Aq}$ ; insol. in alcohol. (Jørgensen, l. c.)

— **nitrate,  $\text{ICr}(\text{NH}_3)_4(\text{NO}_3)_2$ .**

Much less sol. in  $\text{H}_2\text{O}$  than the chloride. (Jørgensen, l. c.)

**Iodopurpleocobaltic iodide,  $\text{CoI}(\text{NH}_3)_4\text{I}_2$ .**  
 (Claudet.)

Does not exist. (Jørgensen, J. pr. (2) 25. 94.)

**Iodopurpleorhodium chloride,  $\text{IRh}(\text{NH}_3)_4\text{Cl}_2$ .**

Relatively easily sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HCl} + \text{Aq}$  and alcohol. Insol. in  $\text{KI} + \text{Aq}$ . (Jørgensen, J. pr. (2) 27. 433.)

— **fluosilicate,  $\text{IRh}(\text{NH}_3)_4\text{SiF}_6$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ .

— **iodoplatinate,  $\text{IRh}(\text{NH}_3)_4\text{PtI}_4$ .**

Ppt.

— **iodide,  $\text{IRh}(\text{NH}_3)_4\text{I}_2$ .**

Very sl. sol. in cold  $\text{H}_2\text{O}$ ; more sol. in hot  $\text{H}_2\text{O}$ ; insol. in dil.  $\text{HI} + \text{Aq}$ , and alcohol. (Jørgensen, J. pr. (2) 27. 433.)

— **nitrate,  $\text{IRh}(\text{NH}_3)_4(\text{NO}_3)_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ , more easily sol. in hot  $\text{H}_2\text{O}$ ; insol. in dil.  $\text{HNO}_3 + \text{Aq}$ , and alcohol.

— **sulphate,  $\text{IRh}(\text{NH}_3)_4\text{SO}_4$ , and  $+3\text{H}_2\text{O}$ .**

Sl. sol. in even hot  $\text{H}_2\text{O}$ . (Jørgensen.)

**Iodoselenic acid.**

**Ammonium iodoselenate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 \cdot \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, B. 1903, 36. 1400.)

$2(\text{NH}_4)_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp.(?). (Weinland.)

**Potassium iodoselenate,  $2\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 \cdot \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weinland.)  
 $2\text{K}_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $2\text{SeO}_3 \cdot 5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp.(?) (Weinland.)

**Rubidium iodoselenate**,  $2\text{Rb}_2\text{O}$ ,  $3\text{I}_2\text{O}_5$ ,  $28\text{SeO}_2$ ,  $+5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weinland.)

### Iodostannous acid.

Data concerning solubility of  $\text{SnI}_2$  in  $\text{HI} + \text{Aq}$  indicate formation of this compound. (Young, J. Am. Chem. Soc. 1897, 19. 853.)

### Iodosulphobismuthous acid.

**Cuprous iodosulphobismuthite**,  $2\text{Cu}_2\text{S}$ ,  $\text{Bi}_2\text{S}_3$ ,  $2\text{BiSI}$ .

Decomp. by  $\text{H}_2\text{O}$  at ord. temp. Decomp. by mineral acids with evolution of  $\text{H}_2\text{S}$ . (Ducatte, C. R. 1902, 134. 1213.)

**Lead iodosulphobismuthite**,  $\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ ,  $2\text{BiSI}$ .

Insol. in  $\text{H}_2\text{O}$ . Partially decomp. by boiling  $\text{H}_2\text{O}$ . Decomp. by dil. mineral acids with evolution of  $\text{H}_2\text{S}$ . (Ducatte.)

### Iodosulphuric acid.

**Ammonium iodosulphate**,  $(\text{NH}_4)_2\text{SO}_4\text{I}_2(?)$ .

Very sol. in  $\text{H}_2\text{O}$ . (Zinno, N. Rep. Pharm. 20. 449.)

**Mercuric iodosulphate**,  $\text{Hg}_2(\text{SO}_4)_2\text{I}_2$ .

See **Mercuric sulphate iodide**.

**Potassium iodosulphate**,  $\text{K}_2\text{SO}_4\text{I}_2(?)$ .

Sol. in 7.14 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Zinno, N. Rep. Pharm. 20. 449.)

**Sodium iodosulphate**,  $\text{Na}_2\text{SO}_4\text{I}_2 + 10\text{H}_2\text{O}$ .

Sol. in 3.64 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  and in dil. alcohol. (Zinno, N. Rep. Pharm. 20. 449.)

Does not exist. (Michaelis and Koethe, B. 6. 999.)

**Iodosulphuric anhydride**,  $\text{ISO}_3$ .

Decomp. very violently by  $\text{H}_2\text{O}$ . (Weber, J. pr. (2) 25. 224.)

**Diiodosulphuric anhydride**,  $\text{I}_2\text{SO}_3$ .

Decomp. with  $\text{H}_2\text{O}$ , but not so violently as  $\text{ISO}_3$ . (Weber, J. pr. (2) 25. 224.)

**Iodotrisulphuric anhydride**,  $\text{I}(\text{SO}_3)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, J. pr. (2) 25. 224.)

### Iodotelluric acid.

**Ammonium iodotellurate**,  $(\text{NH}_4)_2\text{O} \cdot \text{I}_2\text{O}_5$ ,  $2\text{TeO}_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 23. 52.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_2 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Weinland, B. 1900, 33. 1017.)

**Cæsium iodotellurate**,  $\text{Cs}_2\text{TeI}_4$ .

Insol. in  $\text{CaI}$ , or  $\text{HI} + \text{Aq}$ . Decomp. slowly by cold, rapidly by hot  $\text{H}_2\text{O}$ . (Wheeler, Sil. Am. J. 145. 267.)

**Potassium iodotellurate**,  $\text{K}_2\text{TeI}_4 + 2\text{H}_2\text{O}$ .

Sl. efflorescent. Somewhat sol. in  $\text{KI} + \text{Aq}$ , and dil.  $\text{HI} + \text{Aq}$ . (Wheeler.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $\text{TeO}_2 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Partially decomp. on recryst. from  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, 23. 53.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_2 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Weinland.)

**Rubidium iodotellurate**,  $\text{Rb}_2\text{TeI}_4$ .

Sl. sol. in  $\text{HI}$ , or  $\text{RbI} + \text{Aq}$ . Decomp. by  $\text{H}_2\text{O}$ . Somewhat sol. in alcohol. (Wheeler.)

$\text{Rb}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{TeO}_2 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Weinland.)

**Iodotetramine chromium iodide**,

$\text{ICr}(\text{NH}_3)_4\text{I}_2 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Cleve.)

**Iodotetramine cobaltic sulphate**,

$\text{ICo}(\text{NH}_3)_4\text{SO}_4$ .

(Vortmann and Blasberg, B. 22. 2652.)

**Iodotungstic acid**.

See **Tungstiodic acid**.

**Iodous acid**,  $\text{I}_2\text{O}_3$ .

See **Iodine trioxide**.

**Iodovanadic acid**,  $\text{I}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$ .

$2\text{V}_2\text{O}_5$ ,  $3\text{I}_2\text{O}_5 + 18\text{H}_2\text{O}$ . (Ditte, C. R. 102. 757.)

**Ammonium iodovanadate**,  $3(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $5\text{I}_2\text{O}_5 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 103. 1019.)

**Irididiamine compounds**,  $\text{Cl}_2\text{Ir}(\text{NH}_3)_4\text{X}_2$ .

See **Chlorirididiamine compounds**.

**Iridic acid**.

**Potassium iridate (?)**.

Sol. in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$ .

**Iridicyanhydric acid**,  $\text{H}_2\text{Ir}(\text{CN})_4$ .

Easily sol. in  $\text{H}_2\text{O}$ , still more easily in alcohol, less in ether. (Martius, A. 117. 369.)

**Barium iridicyanide**,  $\text{Ba}_2[\text{Ir}(\text{CN})_6]_2 + 18\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in hot or cold  $\text{H}_2\text{O}$ . Nearly insol. in alcohol. Not decomp. by acids.

**Cupric iridicyanide ammonia**,  $\text{Cu}_2\text{Ir}_2(\text{CN})_{12}$ ,  $6\text{NH}_3 + 4\text{H}_2\text{O}$ .

Ppt. Decomp. in air. (Rimbach, Z. anorg. 1907, **52**, 413.)

**Potassium iridicyanide**,  $\text{K}_2\text{Ir}(\text{CN})_6$ .

Easily sol. in  $\text{H}_2\text{O}$ .

**Silver iridicyanide ammonia**,  $\text{Ag}_2\text{Ir}(\text{CN})_6$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$ .

Ppt. Decomp. in the light. (Rimbach, Z. anorg. 1907, **52**, 414.)

**Iridium, Ir.**

Insol. in all acids, including aqua regia, except when in finely divided state, as "iridium black," when it is sol. in aqua regia. (Claus, J. pr. **42**, 251.)

**Iridium ammonia compounds.**

See—

**Chlorirididiamine comps.**,  $\text{ClIr}(\text{NH}_3)_2\text{X}$ .

**Iridotriamine** "  $\text{Ir}(\text{NH}_3)_3\text{X}_3$ .

**Iridopentamine** "  $\text{Ir}(\text{NH}_3)_5\text{X}_3$ .

**Iridotetramine** "  $\text{Ir}(\text{NH}_3)_4\text{X}_3$ .

**Iridoaquopentamine** "  $\text{Ir}(\text{NH}_3)_5(\text{OH})\text{X}_3$ .

**Iridosamine** "  $\text{Ir}(\text{NH}_3)_6\text{X}_3$ .

**Iridosodiamine** "  $\text{Ir}(\text{NH}_3)_4\text{X}_3$ .

**Iridium tribromide**,  $\text{IrBr}_3 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol or ether. (Birnbbaum.)

**Iridium tetrabromide**,  $\text{IrBr}_4$ , or  $\text{H}_2\text{IrBr}_6$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Birnbbaum.)

See Bromiridic acid.

**Iridium hydrogen sesquibromide**,  $3\text{HBr}$ ,  $\text{IrBr}_3 + \text{H}_2\text{O} = \text{H}_2\text{IrBr}_6 + 3\text{H}_2\text{O}$ .

See Bromiridous acid.

**Iridium sesquibromide with MBr.**

See Bromiridite, M.

**Iridium tetrabromide with MBr.**

See Bromiridate, M.

**Iridium phosphorous bromide**,  $\text{IrBr}_3$ ,  $3\text{PBr}_3$ .

Partially decomp. by  $\text{H}_2\text{O}$  into a sol., and insol. modification. Sol. in  $\text{PBr}_3$ . (Geisenheimer.)

$\text{IrBr}_3$ ,  $2\text{PBr}_3$ . Not easily attacked by  $\text{H}_2\text{O}$ .  $\text{IrBr}_3$ ,  $2\text{PCl}_5$ .

See Iridium phosphorus chlorobromide.

**Iridium carbide**,  $\text{IrC}_4(?)$ .

(Berzelius.)

Stable toward  $\text{H}_2\text{O}$ , acids, and alcohol. (Strecker, B. 1909, **42**, 1773.)

**Iridium monochloride**,  $\text{IrCl}$ .

Insol. in acids and bases. (Wöhler, B. 1913, **46**, 1584.)

**Iridium dichloride**,  $\text{IrCl}_2$ .

Insol. in acids and bases. (Wöhler, B. 1913, **46**, 1585.)

**Iridium trichloride**,  $\text{IrCl}_3$ .

Insol. in acids or alkalis. (Claus, C. C. 1861, 690.)

Insol. in  $\text{H}_2\text{O}$ , acids and alkalis, (Leidié, C. R. 1899, **129**, 1251.)

+  $4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Claus.)

**Iridium tetrachloride**,  $\text{IrCl}_4$ , or  $\text{H}_2\text{IrCl}_6(?)$ .

Deliquescent, and easily sol. in  $\text{H}_2\text{O}$ .

**Iridium trichloride with MCl.**

See Chloriridite, M.

**Iridium tetrachloride with MCl.**

See Chloriridate, M.

**Iridium chloride with potassium chloride and sulphite.**

See Chloriridosulphite, potassium.

**Iridium phosphorus chloride**,  $\text{IrP}_2\text{Cl}_6$ .

Insol. in cold  $\text{H}_2\text{O}$ . Sl. decomp. by hot  $\text{H}_2\text{O}$ . (Geisenheimer, A. ch. (6) **23**, 254.)

$\text{IrP}_2\text{Cl}_{10}$ . Very sol. in chloroform. (G.)

$\text{IrP}_2\text{Cl}_{12}$ . Easily sol. in  $\text{PCl}_5$ , or  $\text{CHCl}_3$ , also in  $\text{CS}_2$  with gradual decomp. Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling into  $\text{IrCl}_3$ ,  $3\text{H}_3\text{PO}_4$ . Sl. sol. in benzene, ligroin and  $\text{CCl}_4$ . (Strecker, B. 1909, **42**, 1772.)

+  $\text{H}_2\text{O}$ . Insol. in  $\text{PCl}_5$  at  $100^\circ$ . Very slowly sol. in boiling  $\text{H}_2\text{O}$ . (Geisenheimer, A. ch. (6) **23**, 266.)

$\text{IrP}_2\text{Cl}_{11}$ . Decomp. by  $\text{H}_2\text{O}$  into  $2\text{IrCl}_3$ ,  $3\text{H}_3\text{PO}_4$ ,  $3\text{H}_2\text{PO}_4$ . Violently decomp. by alcohol. Sl. sol. in cold, more in hot  $\text{POCl}_3$ , without decomp. Very sol. in  $\text{PCl}_5$  with decomp. into  $\text{IrP}_2\text{Cl}_{11}$ ; similarly in  $\text{PBr}_3$ . Sol. in  $\text{AsCl}_3$  with combination. Sol. in  $\text{CS}_2$  with decomp. Sol. in  $\text{SCl}_2$  with combination. Easily sol. in cold  $\text{C}_6\text{H}_6$  with decomp. Insol. in  $\text{CCl}_4$ . Sol. in  $\text{CHCl}_3$  with decomp. (Geisenheimer, A. ch. (6) **23**, 254.)

**Iridium phosphorus arsenic chloride**,

$2\text{IrP}_2\text{Cl}_{11}$ ,  $5\text{AsCl}_3$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. into corresponding acid. (Geisenheimer, C. R. **110**, 1336.)

$\text{IrCl}_3$ ,  $2\text{PCl}_5$ ,  $2\text{AsCl}_3$ . Very sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{AsCl}_3$ ; insol. in  $\text{CCl}_4$ . (Geisenheimer.)

**Iridium phosphorus sulphur chloride**,  $\text{IrCl}_3$ ,  $2\text{PCl}_5$ ,  $2\text{SCl}_2$ .

Very sol. in sl. amt.  $\text{H}_2\text{O}$ , with decomp. into an acid analogous to chlorophosphoridic acid. Sol. in  $\text{SCl}_2$ . (Geisenheimer.)

**Iridium phosphorus chlorobromide, IrBr<sub>4</sub>, 2PCl<sub>5</sub>.**

(Geisenheimer, C. R. 111. 40.)

**Iridium dihydroxide, IrO<sub>3</sub>, 2H<sub>2</sub>O = IrO<sub>4</sub>H<sub>4</sub>.**

Insol. in dil. HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Aq. Slowly but completely sol. in HCl+Aq. Sol. in KOH, and NaOH+Aq. (Claus, J. pr. 39. 104.)

**Iridium sesquihydroxide, Ir<sub>2</sub>O<sub>3</sub>H<sub>4</sub>.**

Not attacked by acids, except slightly by conc. HCl+Aq. (Claus, C. C. 1861. 690.)

**Iridium triiodide, IrI<sub>3</sub>.**

Very sl. sol. in cold, somewhat more in hot H<sub>2</sub>O. Insol. in alcohol. (Oppler, J. B. 1857. 263.)

**Iridium tetraiodide, IrI<sub>4</sub>.**

Insol. in H<sub>2</sub>O or acids. (Lassaigne.)

Sol. in solutions of iodides. (Oppler.)

**Iridium triiodide with MI.**

See Iodiridite, M.

**Iridium tetraiodide with MI.**

See Iodiridate, M.

**Iridium dioxide, IrO<sub>2</sub>.**

Very sl. sol. in acids.

Freshly pptd. Sol. in conc. H<sub>2</sub>SO<sub>4</sub>, hot 2-N H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, HCl. Insol. in 2-N KOH and sl. sol. in hot 1-N KOH.

Dried in a desiccator. Sol. in HCl. Insol. in H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, and KOH.

Dried at 100°. Sol. in hot conc. HCl. Insol. in H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, and KOH. (Wöhler, Z. anorg. 1908, 57. 334.)

See also Iridium dihydroxide.

**Iridium trioxide, IrO<sub>3</sub>.**

Unstable. (Wöhler, Z. anorg. 1908, 57. 340.)

**Iridium sesquioxide, Ir<sub>2</sub>O<sub>3</sub>.**

Insol. in acids.

Sol. in conc. H<sub>2</sub>SO<sub>4</sub>, and hot conc. HCl. Forms colloidal solution with dil. HCl. Conc. HNO<sub>3</sub> converts it into the dioxide.

Insol. in KOH+Aq. (Wöhler, Z. anorg. 1908, 57. 339.)

**Iridium oxybromide, Ir<sub>2</sub>Br<sub>2</sub>O<sub>2</sub> = 2IrBr<sub>4</sub>, IrO<sub>2</sub>.**

Not decomp. by H<sub>2</sub>O. (Geisenheimer, A. ch. (6) 23. 286.)

**Iridium phosphide, Ir<sub>2</sub>P.**

(Clarke and Joslin, Am. Ch. J. 5. 231.)

**Iridium sesquiselenide, Ir<sub>2</sub>Se<sub>3</sub>.**

Insol. in HNO<sub>3</sub>; slowly sol. in hot aqua regia. (Chabré and Bouchonnet, C. R. 1903, 137. 1060.)

**Iridium monosulphide, IrS.**

Insol. in HNO<sub>3</sub>+Aq, and very sl. sol. if at all in aqua regia. (Berzelius.)

Sol. in K<sub>2</sub>S, and KSH+Aq.

+xH<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O; sol. in cold HNO<sub>3</sub>+Aq. Insol. in NH<sub>4</sub>Cl+Aq or dil. acids. More sol. in K<sub>2</sub>S+Aq than PtS<sub>2</sub>. (Berzelius.)

**Iridium disulphide, IrS<sub>2</sub>.**

Not attacked by H<sub>2</sub>O, but decomp. when exposed moist in air. Not attacked by sat. HCl+Aq or by conc. HNO<sub>3</sub>+Aq, but is oxidised by fuming HNO<sub>3</sub>+Aq, and aqua regia. Insol. in NH<sub>4</sub> sulphides, or polysulphides+Aq. Slowly sol. in alkali polysulphides+Aq. (Antony, Gazz. ch. it. 23, 1. 190.)

**Iridium sesquisulphide, Ir<sub>2</sub>S<sub>3</sub>.**

Sl. sol. in H<sub>2</sub>O. Sol. in HNO<sub>3</sub>, or K<sub>2</sub>S+Aq.

**Iridotriamine chloride, Ir(NH<sub>3</sub>)<sub>3</sub>Cl<sub>3</sub>.**

Sl. sol. in H<sub>2</sub>O. Not attacked by boiling H<sub>2</sub>SO<sub>4</sub>. (Palmaer, B. 22. 15.)

**Iridotetraamine chloride, Ir(NH<sub>3</sub>)<sub>4</sub>Cl<sub>3</sub>.**

Very sol. in H<sub>2</sub>O. (Palmaer, B. 22. 15.)

— chlorosulphate, [Ir(NH<sub>3</sub>)<sub>3</sub>Cl<sub>2</sub>]SO<sub>4</sub>+4H<sub>2</sub>O.

(Palmaer.)

**Iridopentamine bromide, Ir(NH<sub>3</sub>)<sub>5</sub>Br<sub>2</sub>.**

Sol. in 352 pts. H<sub>2</sub>O at 12.5°. (Palmaer, B. 23. 3817.)

— bromochloride, Ir(NH<sub>3</sub>)<sub>5</sub>ClBr<sub>2</sub>.

Sol. in H<sub>2</sub>O. (Palmaer, B. 24. 2090.)

— bromonitrite, Ir(NH<sub>3</sub>)<sub>5</sub>Br(NO<sub>2</sub>)<sub>2</sub>.

Sol. in 17.9 pts. H<sub>2</sub>O at 18°. (Palmaer.)

— bromosulphate, Ir(NH<sub>3</sub>)<sub>5</sub>BrSO<sub>4</sub>+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Palmaer.)

— carbonate, [Ir(NH<sub>3</sub>)<sub>5</sub>]<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>+3H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Claus, J. pr. 63. 99.)

— trichloride, Ir(NH<sub>3</sub>)<sub>5</sub>Cl<sub>3</sub>.

Sol. in 153.1 pts. H<sub>2</sub>O at 15.1°. (Palmaer, B. 23. 3810.)

Sol. in hot H<sub>2</sub>O containing HCl. (Claus, J. pr. 69. 30.)

— chlorobromide, Ir(NH<sub>3</sub>)<sub>5</sub>ClBr<sub>2</sub>.

Sol. in 213.6 pts. H<sub>2</sub>O at 15°. (Palmaer.)

— chloroiodide, Ir(NH<sub>3</sub>)<sub>5</sub>ClI<sub>2</sub>.

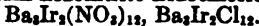
Sol. in 104.5 pts. H<sub>2</sub>O at 15°. (Palmaer.)

— chlorooxalate, Ir(NH<sub>3</sub>)<sub>5</sub>ClC<sub>2</sub>O<sub>4</sub>.

Sl. sol. in H<sub>2</sub>O. (Palmaer.)

**Iridopentamine chloronitrate,**  
 $\text{Ir}(\text{NH}_3)_5\text{Cl}_2(\text{NO}_3)_2$ .Sol. in 51.54 pts.  $\text{H}_2\text{O}$  at  $15.4^\circ$ . (Palmaer.)— **chloronitrite,**  
 $\text{Ir}(\text{NH}_3)_5\text{Cl}(\text{NO}_2)_2$ .Easily sol. in  $\text{H}_2\text{O}$ . (Palmaer.)— **chloroplatinate,**  $\text{Ir}(\text{NH}_3)_5\text{Cl}_2$ ,  $\text{PtCl}_4$ .Very sl. sol. in  $\text{H}_2\text{O}$ . (Palmaer.)— **chlorosulphate,**  $\text{Ir}(\text{NH}_3)_5\text{ClSO}_4 \cdot 2\text{H}_2\text{O}$ .Sol. in 134.5 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Palmaer.)— **hydroxide,**  $\text{Ir}(\text{NH}_3)_5(\text{OH})_2$ .

Known only in solution, which decomp. on evaporation. (Claus.)

— **nitrate,**  $\text{Ir}(\text{NH}_3)_5(\text{NO}_3)_2$ .Moderately sol. in  $\text{H}_2\text{O}$ . (Claus.)Sol. in 349 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Palmaer.)— **sulphate,**  $[\text{Ir}(\text{NH}_3)_5]_2(\text{SO}_4)_3$ .Sol. in  $\text{H}_2\text{O}$ . (Claus.)**Iridoquopentamine bromide,**Sol. in 4 pts.  $\text{H}_2\text{O}$ . Pptd. from aqueous solution by  $\text{HBr} + \text{Aq}$ . (Palmaer, B. 24. 2090.)— **chloride,**  $\text{Ir}(\text{NH}_3)_5(\text{OH}_2)\text{Cl}_2$ .Sol. in 1.2 to 1.5 pts.  $\text{H}_2\text{O}$  at ord. temp. Pptd. by  $\text{HCl} + \text{Aq}$  from aqueous solution. (Palmaer, B. 24. 2090.)— **nitrate,**  $\text{Ir}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_2$ .Sol. in about 10 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . Pptd. from aqueous solution by  $\text{HNO}_3 + \text{Aq}$ . (Palmaer.)**Iridonitrous acid,**  $\text{H}_2\text{Ir}_2(\text{NO}_2)_{12}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 4. 281.)**Ammonium iridonitrite,**  $(\text{NH}_4)_2\text{Ir}_2(\text{NO}_2)_{12}$ .Almost insol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$  with evolution of  $\text{N}_2$ . Decomp. by hot conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ . Insol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Leidié, C. R. 1902, 134. 1583.)**Barium iridonitrite iridochloride,**Sol. in  $\text{H}_2\text{O}$ . (Lang.)**Mercuric iridonitrite,**  $\text{Hg}_2\text{Ir}_2(\text{NO}_2)_{12}$ .Insol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 4. 280.)**Potassium iridonitrite,**  $\text{K}_2\text{Ir}_2(\text{NO}_2)_{12}$ .Sl. sol. in cold, more sol. in boiling  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{KCl} + \text{Aq}$ . (Leidié, Bull. Soc. 1902, (3) 27. 937.) $+2\text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$ .**Potassium iridonitrite iridochloride,**  
 $\text{K}_2\text{Ir}_2(\text{NO}_2)_{12}$ ,  $\text{K}_2\text{Ir}_2\text{Cl}_{12}$ .Sol. in  $\text{H}_2\text{O}$ .**Silver iridonitrite,**  $\text{Ag}_2\text{Ir}_2(\text{NO}_2)_{12}$ .Difficultly sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .**Sodium iridonitrite,**  $\text{Na}_2\text{Ir}_2(\text{NO}_2)_{12} \cdot 2\text{H}_2\text{O}$ .Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ . (Leidié, C. R. 1902, 134. 1583.)**Sodium iridonitrite iridochloride,**Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.) $\text{Na}_2\text{Ir}_2(\text{NO}_2)_{12}$ ,  $\text{Na}_2\text{Ir}_2\text{Cl}_4$ . Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Lang.)**Iridosamine chloride,**  $\text{Ir}(\text{NH}_3)_2\text{Cl}_2$ .Nearly insol. in  $\text{H}_2\text{O}$ . (Skoblikoff, A. 84. 275.)— **sulphate,**  $\text{Ir}(\text{NH}_3)_2\text{SO}_4$ .Easily sol. in  $\text{H}_2\text{O}$ . (Skoblikoff.)**Iridosodiamine chloride,**  $\text{Ir}(\text{N}_2\text{H}_5)_2\text{Cl}_2$ .Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Skoblikoff.)— **nitrate,**  $\text{Ir}(\text{N}_2\text{H}_5)_2(\text{NO}_3)_2$ .Easily sol. in  $\text{H}_2\text{O}$ .— **sulphate,**  $\text{Ir}(\text{N}_2\text{H}_5)_2\text{SO}_4$ .Sl. sol. in cold, easily in boiling  $\text{H}_2\text{O}$ . Sl. sol. in alcohol.**Iridosulphuric acid.****Potassium iridosulphate,**  $\text{K}_2\text{Ir}_2(\text{SO}_4)_6$ .Sol. in  $\text{H}_2\text{O}$ . (de Boisbaudran, C. R. 96. 1406.)**Iridosulphurous acid.****Ammonium iridosulphite,**  $(\text{NH}_4)_2\text{Ir}_2(\text{SO}_3)_6 \cdot 6\text{H}_2\text{O}$ .Slightly sol. in  $\text{H}_2\text{O}$ . (Birnbbaum, A. 136. 179.)**Potassium iridosulphite,**  $\text{K}_2\text{Ir}_2(\text{SO}_3)_6 \cdot 6\text{H}_2\text{O}$ .Slightly sol. in  $\text{H}_2\text{O}$ .**Sodium iridosulphite,**  $\text{Na}_2\text{Ir}_2(\text{SO}_3)_6 \cdot 8\text{H}_2\text{O}$ .Scarcely sol. in  $\text{H}_2\text{O}$ .**Iron, Fe.**Permanent in dry air; oxidises only slowly in moist air, but rapidly when in contact with air and  $\text{H}_2\text{O}$  simultaneously.

Fe does not rust in contact with air and



H<sub>2</sub>O containing alkalies even in very small amounts. (Payen, A. ch. 50. 305.)

Not attacked at ord. temp. by H<sub>2</sub>O free from air. More easily oxidised by NH<sub>4</sub> salts +Aq than by H<sub>2</sub>O when exposed to air simultaneously. (Persoz, A. ch. (3) 24. 506.)

Iron is slowly attacked by distilled H<sub>2</sub>O in presence of air. 100 ccm. distilled water removed 29 mg. from 11.8 sq. cm. iron in one week, while air free from CO<sub>2</sub> was passed through the solution. In presence of CO<sub>2</sub>, 54 mg. were removed. (Wagner, Dingl. 221. 260.)

CO<sub>2</sub> acts as a catalyst for the solution of Fe by H<sub>2</sub>O. (Whitney, J. Am. Chem. Soc. 1903, 25. 394.)

Iron is most easily oxidised when it is exposed to air, and H<sub>2</sub>O is deposited on it at the same time in liquid form.

100 l. sea water dissolve 27.37 g. from 1 sq. metre Fe; 29.16 g. from 1 sq. metre steel; 1.12 g. from 1 sq. metre galvanised Fe. (Calvert and Johnson, C. N. 11). 171.)

Readily sol. in HCl, dil. H<sub>2</sub>SO<sub>4</sub> +Aq, and most other acids.

Action of H<sub>2</sub>SO<sub>4</sub> +Aq (1:12) is very much accelerated by a few drops of PtCl<sub>4</sub> +Aq; the addition of As<sub>2</sub>O<sub>3</sub> arrests the action completely. Tartar emetic and HgCl<sub>2</sub> diminish the action, but do not arrest it. CuSO<sub>4</sub> +Aq strongly accelerates the action, and Ag<sub>2</sub>SO<sub>4</sub> +Aq also to a less extent.

In the case of HCl +Aq, the addition of small amts. of metallic salts also influences the action. Weak HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> +Aq has but little action, and the addition of PtCl<sub>4</sub> increases it; As<sub>2</sub>O<sub>3</sub> stops it; other solutions have no effect. With racemic and tartaric acids the phenomena are the same.

With oxalic acid, PtCl<sub>4</sub> prevents the action. Saline solutions and even distilled H<sub>2</sub>O, when mixed with PtCl<sub>4</sub>, have slight solvent action. (Millon, C. R. 21. 45.)

Above phenomena are due to galvanic action from metal deposited on the iron. (Barreswill, C. R. 21. 292.)

H<sub>2</sub>SO<sub>4</sub> has only sl. action on cast-iron at ord. temp. with exclusion of air.

Weak acids have a strong action at higher temperatures.

Charcoal pig-iron, and case-hardened cast-iron are much less attacked by weak acids at b.-pt. than other sorts of Fe. Scotch pig-iron is most strongly attacked.

99.8% H<sub>2</sub>SO<sub>4</sub> has very sl. action on iron at ord. temp. when air is excluded. (Lunge, Dingl. 261. 131.)

Resistance against dil. H<sub>2</sub>SO<sub>4</sub> +Aq is greatly increased by increase in amt. of C if chemically combined, less so by P or Si. (Ledebur, Dingl. 223. 326.)

**Passive Iron.**—When Fe is treated with pure conc. HNO<sub>3</sub> +Aq of 1.512–1.419 sp. gr., it soon becomes coated with a bluish or black coating, apparently FeO, and when thus

covered Fe is not attacked by HNO<sub>3</sub> +Aq of any strength at ord. temp. or at the temp. of a freezing mixture; but action occurs on heating. Nor is Fe attacked at ord. temp. by acid of 1.401 sp. gr. or even somewhat weaker acid, though action begins at once on heating. Very dil. HNO<sub>3</sub> +Aq attacks Fe at ord. temp. with formation of NH<sub>4</sub>NO<sub>3</sub> and Fe(NO<sub>3</sub>)<sub>3</sub>. The action of HNO<sub>3</sub> +Aq is influenced by PtCl<sub>4</sub>. If acid containing 4.5 equivalents of H<sub>2</sub>O is diluted with 2–3 vols. H<sub>2</sub>O, and then poured on Fe turnings, they dissolve at once with evolution of nitrous fumes and formation of ferric salt, but if to the acid one drop of PtCl<sub>4</sub> be added, only H gas is evolved, and NH<sub>4</sub>NO<sub>3</sub> and Fe(NO<sub>3</sub>)<sub>3</sub> are formed. (Millon, C. R. 21. 47.)

The more H<sub>2</sub>O the acid contains the lower will be the temp. at which the Fe remains passive. Shaking the wire hastens the passivity. Contact with Pt, Au, or C does not prevent it. Fe wire becomes passive by remaining 10 min. in HNO<sub>3</sub> vapour. (Renard, C. R. 79. 159.)

Iron may be made passive by HClO<sub>4</sub>, HBrO<sub>3</sub>, HIO<sub>3</sub>, H<sub>2</sub>CrO<sub>4</sub>, in the same way as by HNO<sub>3</sub>.

Iron may also be made passive by moderate ignition.

Passivity occurs with HNO<sub>3</sub> +Aq of 1.38 sp. gr. after a short time at 31°; but if temp. is 32° passivity does not occur.

Colourless HNO<sub>3</sub> +Aq of 1.42 sp. gr. produces passivity at 55° but not at 56°. Red fuming HNO<sub>3</sub> +Aq of 1.42 sp. gr. produces passivity at 82° but not at 83°. (Ordway, Sill. Am. J. (2) 40. 316.)

The passivity of Fe is destroyed when it is placed in a magnetic field at a much lower temperature than when in normal condition. (Nichols and Franklin, Sill. Am. J. (3) 34. 419.)

Passivity depends on a coating of NO which hinders the action of the acid. All operations which remove this layer terminate the passivity, as shaking, rubbing, placing in a vacuum, etc. (Varenne, C. R. 89. 783.)

When Fe is plunged in HNO<sub>3</sub> +Aq of 1.42 sp. gr. there is a sudden evolution of gas which ceases after 3 to 20 seconds, and the surface becomes bright. The same phenomena take place with a more dilute acid, if of not less than 1.32 sp. gr. In the latter case, there is an immediate evolution of gas, which suddenly ceases and the metal becomes bright, but soon the acid begins to act again at a single point, and the action gradually spreads over the whole surface; this, however, soon ceases again, and we have an "intermittent passivity."

If a part of a piece of iron is immersed in strong acid, the whole of it is made passive. This is explained by the NO spreading over the whole surface by capillarity.

The passivity ceases when the Fe is placed in dil. acid, after a longer or shorter time,

according to the dilution of the acid,—when the acid has sp. gr. = 1.30, after 11 days

"	"	1.28	"	5	"
"	"	1.26	"	32	hours
"	"	1.16	"	12	"

Iron may also be made passive by long standing in NO gas under pressure. (Varenne, C. R. 90. 998.)

Fe is made passive by a coating of  $\text{Fe}_2\text{O}_3$ , not by NO. (Schonbein, Pogg. 39. 342.) (Beetz, Pogg. 67. 286.) (Ramann, B. 14. 1430.)

Passivity may also be caused by  $\text{NH}_4\text{NO}_3$ , +Aq. ammoniacal  $\text{AgNO}_3$ +Aq.  $\text{Fe}(\text{NO}_3)_3$ ,  $\text{Fe}(\text{NO}_3)_2$ ,  $\text{Al}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ , etc.+Aq instead of  $\text{HNO}_3$ +Aq. (Ramann, B. 14. 1933.)

Hardly attacked by either dil. or conc. acids when they are under high pressure. (Cailliet C. R. 68. 395.)

Iron is dissolved by  $\text{HNO}_3$ +Aq, even when very conc., but no gas is evolved and the process is very slow.

$\text{HNO}_3$ +Aq of the following sp. gr. dissolves the given amts. from strips of pure Fe.

Sp. gr. of acid	Diminution of weight in 24 hours
1.28	0.82%
1.34	0.75
1.38	0.29
1.48	0.34
1.53	5.80

(Gautier and Charpy, C. R. 113. 1451.)

Insol. in liquid chlorine below  $90^\circ$ . (Lange, Zeit. angew. Ch. 1900, 13. 686.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898, 20. 828.)

Not attacked by alkalis.

Sol. in  $\text{NaOH}$ +Aq (34%) when air is blown through the liquid. (Zirnité, Ch. Ztg. 12. 355.)

$\text{NaOH}$ +Aq attacks iron and steel. (Venator, Dingl. 261. 133.)

$\text{NaOH}$ +Aq has slight action on Fe between  $15^\circ$  and  $100^\circ$ . (Lunge, Dingl. 261. 131.)

Presence of alkalis prevent rusting entirely, and fats and oils greatly hinder it. (Wagner.)

Sol. in alkali hydrogen carbonates +Aq. (Berzelius.)

Sat.  $\text{NaCl}$ +Aq has sl. but perceptible action on Fe.  $\text{NH}_4\text{Cl}$ +Aq has stronger action than  $\text{NaCl}$ +Aq. (Lunge.)

100 ccm.  $\text{H}_2\text{O}$  containing 0.5 g.  $\text{NaCl}$  or  $\text{KCl}$  removed 42 mg. from 11.8 sq. cm. iron in one week, while air free from  $\text{CO}_2$  was passed through the solution, and 72 mg. in presence of  $\text{CO}_2$ .

100 ccm.  $\text{H}_2\text{O}$  containing 1 g.  $\text{NH}_4\text{Cl}$  removed 45 mg., and 76 mg. respectively under the above conditions.

100 ccm.  $\text{H}_2\text{O}$  containing 0.8 g.  $\text{MgCl}_2$  re-

moved 49 mg., and 65 mg. respectively under the above conditions.

Not attacked by 100 ccm.  $\text{H}_2\text{O}$  containing 1 g.  $\text{Na}_2\text{CO}_3$ , or by  $\text{CaO}_2\text{H}_2$ +Aq. (Wagner, Dingl. 221. 260.)

Action of  $\text{KClO}_3$ +Aq.  $\text{KClO}_3$ +Aq (6.3%  $\text{KClO}_3$ ) oxidised 11.21 g. cast iron and 20.1 g. pure iron from a surface of 1 sq. metre in 7 hours;  $\text{KClO}_3$ +Aq (25%  $\text{KClO}_3$ ) oxidised 24.59 g. cast, and 44.90 g. pure Fe under above conditions;  $\text{Ca}(\text{ClO}_3)_2$ ,  $\text{CaCl}_2$ +Aq ( $20^\circ$  Baume) obtained by passing Cl through  $\text{CaO}_2\text{H}_2$ +Aq oxidised 85 g. cast, and 95 g. pure Fe under the above conditions. (Lunge and Deggele, J. Soc. Chem. Ind. 4. 32.)

Easily sol. in organic acids.

#### Comparative action of oils on Fe.

	Amount Fe dissolved
Neatsfoot oil	0.0875 grains
Colza "	0.0800 "
Sperm "	0.0460 "
Lard "	0.0250 "
Olive "	0.0062 "
Linseed "	0.0050 "
Seal "	0.0050 "
Castor "	0.0048 "
Paraffine "	0.0045 "
Almond "	0.0040 "
"Lubricating" oil	0.0018 "

(Watson, C. N. 42. 190.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0097 g. Fe in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

Fe dissolves in albumen solution to the extent of 1 to 2 per cent. (Buchner, Arch. Pharm. (3) 20. 417.)

Attacked by sugar+Aq at  $115$ – $120^\circ$ , also by inverted sugar or malt extract, not by glycerine or mannite+Aq. (Klein and Berg, C. R. 102. 1170.)

#### Iron arsenide, $\text{FeAs}_2$ .

Min. *Löllingite*. Sol. in  $\text{HNO}_3$ +Aq with separation of  $\text{As}_2\text{O}_3$ .

$\text{Fe}_2\text{As}_3$ . Min. *Leucopyrite*.

#### Iron arsenide sulphide, $\text{FeAs}_2\text{S}_2$ .

Min. *Arsenopyrite*. Sol. in  $\text{HNO}_3$ +Aq with separation of S and  $\text{As}_2\text{O}_3$ ; wholly sol. in aqua regia; not attacked by  $\text{HCl}$ +Aq.

#### Iron boride, $\text{Fe}_3\text{B}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in hot dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ , and in hot conc.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . Sol. in hot dil., or cold conc.  $\text{HNO}_3$ . (Jassonneix, C. R. 1907, 145. 122.)

$\text{FeB}$ . Sol. in molten alkali carbonates; not sol. in dil. or conc.  $\text{H}_2\text{SO}_4$  in the cold; sol. in boiling  $\text{H}_2\text{SO}_4$ , and in  $\text{HNO}_3$ . (Moissan, Bull. Soc. 1895, (3) 13. 958.)

Stable in dry air. Decomp. by aqua regia,

but not readily sol. in conc.  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$ . (Moissan, C. R. 1895, 120. 176.)

$\text{FeBr}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  and in hot conc.  $\text{HCl}$ . (Jassonneix, C. R. 1907, 145. 122.)

#### Iron (ferrous) bromide, $\text{FeBr}_2$ .

Sol. in  $\text{H}_2\text{O}$ . Decomp. by heating on air. Sat.  $\text{FeBr}_2 + \text{Aq}$  contains at:

-21°	-7°	+10°	21°
47.0	48.3	52.3	53.7% $\text{FeBr}_2$ ,
37°	50°	65°	95°
56.0	58.0	59.4	63.3% $\text{FeBr}_2$ .

(Étard, A. ch. 1894, (7) 2. 541.)

+4 $\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; pptd. from cooled aq. solution. (Volkmann, C. C. 1894, II. 611.)

+6 $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Löwig.)

+9 $\text{H}_2\text{O}$ . (Volkmann.)

#### Ferric bromide, $\text{FeBr}_3$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Löwig.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

+6 $\text{H}_2\text{O}$ . Sol. in alcohol and ether. (Bolschakoff, C. C. 1898, II. 660.)

#### Ferrous mercuric bromide.

Deliquescent. (v. Bonsdorff.)

#### Ferric rubidium bromide, $\text{Rb}_2\text{FeBr}_6 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 7. 332.)

#### Ferrous stannic bromide.

See Bromostannate, ferrous.

#### Ferrous bromide nitric oxide, $3\text{FeBr}_2, 2\text{NO}$ .

Sol. in  $\text{H}_2\text{O}$ . Not isolated. (Thomas, C. R. 1896, 123. 944.)

#### Ferric bromochloride, $\text{FeCl}_2\text{Br}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. Notably sol. in chloroform, benzene, and toluene. Insol. in  $\text{CS}_2$ . (Lenormand, C. R. 116. 820.)

#### Iron carbide, $\text{Fe}_3\text{C}$ .

(Gurlt, J. B. 1856, 781.)

Mixture of Fe and  $\text{FeC}_4$ . (Tunner, Polyt. Centralbl. 1861. 1227.)

$\text{Fe}_3\text{C}$ . (Karsten, J. pr. 40. 229.)

$\text{Fe}_3\text{C}$ . Sol. in hot conc.  $\text{HCl}$ ; oxidized slowly by moist air. (Campbell, Am. Ch. J. 1896, 18. 840-841.)

$\text{Fe}_3\text{C}_2$ . (Rammelsberg, C. C. 1847. 60.)

#### Iron molybdenum carbide, $\text{Fe}_3\text{C}, \text{Mo}_3\text{C}$ .

Sol. in hydracids; insol. in  $\text{HNO}_3$ . (Williams, C. R. 1898, 127. 484.)

#### Iron tungsten carbide, $2\text{Fe}_3\text{C}, 3\text{W}_3\text{C}$ .

Insol. in  $\text{H}_2\text{O}$  and hydracids; sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Williams, C. R. 1898, 127. 411.)

#### Iron carbonyl, $\text{Fe}(\text{CO})_5$ .

Slowly decomp. on air. Not attacked by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . Conc.  $\text{HNO}_3$ ,  $\text{Cl}_2 + \text{Aq}$ , or  $\text{Br}_2 + \text{Aq}$  decomp. easily. Sol. in alcoholic solution of  $\text{KOH}$  or  $\text{NaOH}$  with subsequent decomp. Sol. in alcohol, ether, benzene, mineral oils, etc. (Mond and Langer, Chem. Soc. 59. 1090.)

$\text{Fe}_3(\text{CO})_{12}$ . Decomp. on air. Not attacked by  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Sol. in alcoholic potash. Very much less sol. in organic solvents than  $\text{Fe}(\text{CO})_5$ . (Mond and Langer.)

#### Ferrous chloride, $\text{FeCl}_2$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  with evolution of heat, or in alcohol. Insol. in ether. (Jahn.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)

Sol. in 1 pt. strong alcohol. (Wenzel.)

Sp. gr. of  $\text{FeCl}_2 = \text{Aq}$  at 15.5°.

Sp. gr.	% $\text{FeCl}_2$	% $\text{FeCl}_2, 4\text{H}_2\text{O}$
1.05	5.40	8.45
1.06	6.43	10.09
1.07	7.47	11.69
1.08	8.48	13.29
1.09	9.49	14.86
1.10	10.47	16.41
1.11	11.45	17.86
1.12	12.42	19.46
1.13	13.37	20.96
1.14	14.31	22.41
1.15	15.24	23.87
1.16	16.15	25.31
1.17	17.05	26.73
1.18	17.94	28.13
1.19	18.83	29.51
1.20	19.68	30.85
1.21	20.50	32.14
1.22	21.39	33.53
1.23	22.24	34.84
1.24	23.05	36.11
1.25	23.86	37.38
1.26	24.68	38.67
1.27	25.44	39.87
1.28	26.19	41.04
1.29	26.98	42.29
1.30	27.75	43.49
1.31	28.49	44.65
1.32	29.23	45.81
1.33	29.96	46.94
1.34	30.68	48.08
1.35	31.39	49.18
1.36	32.10	50.30
1.37	32.79	51.39
1.38	33.47	52.46
1.39	34.14	53.50
1.40	34.80	54.55
1.41	35.46	55.57
1.42	36.09	56.56
1.43	36.73	57.55
1.44	37.33	58.51

(Dunn, J. Soc. Chem. Ind. 1902, 21. 390.)

Insol. in liquid HF. (Franklin, Z. anorg. 1906, 46. 2.)

Sol. in acetone; insol. in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sl. sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Yellow modification is sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 21.)

+2H<sub>2</sub>O. (Jonas.)

+4H<sub>2</sub>O. Deliquescent. Easily sol. in alcohol. Sol. in 0.68 pt. cold H<sub>2</sub>O. (Reimann, Mag. Pharm. 17. 215.)

Sat. aq. solution contains at:

16°	18°	25°	28°	43°
40.5	40.9	41.0	42.5	44.4% FeCl <sub>3</sub>
50°	53°	72°	89°	96° 118°
45.0	45.9	49.2	51.3	51.0 51.7% FeCl <sub>3</sub>

(Étard, A. ch. 1894, (7) 2. 537.)

100 g. FeCl<sub>3</sub>, 4H<sub>2</sub>O + Aq contain 17.54 g. Fe at 22.8°; 18.59 g. at 43.2°. (Boecke, N. Jahrb. Min. 1911, I, 61.)

More sol. in water containing NO than in pure H<sub>2</sub>O. (Gay, Bull. Soc. (2) 44. 175.)

Sol. in hot HCl + Aq. (Sabatier, Bull. Soc. 1895, (3) 13. 599.)

[Sabatier could not obtain FeCl<sub>3</sub> + 6H<sub>2</sub>O of Lescœur.]

Ferroferric chloride, Fe<sub>3</sub>Cl<sub>8</sub> + 18H<sub>2</sub>O.

Deliquescent. (Lefort, J. Pharm. (4) 10. 85.)

Ferric chloride, Fe<sub>2</sub>Cl<sub>6</sub> or FeCl<sub>3</sub>.

Very deliquescent, and sol. in H<sub>2</sub>O with evolution of great heat.

100 mols. H<sub>2</sub>O dissolve mols. anhydrous Fe<sub>2</sub>Cl<sub>6</sub> at t°.

t°	Mols. Fe <sub>2</sub> Cl <sub>6</sub>	t°	Mols. Fe <sub>2</sub> Cl <sub>6</sub>
66	29.20	80	29.20
70	29.42	100	29.75
75	28.92	..	...

(Roozeboom, Z. phys. Ch. 10. 477.)

See also hydrated salts below.

Solution in H<sub>2</sub>O is decomp. into colloidal Fe<sub>2</sub>O<sub>3</sub>, xH<sub>2</sub>O and HCl, upon heating if conc., and on simple standing if dil.

Krecke (J. pr. (2) 3. 286) gives the following table.

% FeCl <sub>3</sub> in solution	Temp. at which Graham's colloidal hydrate is formed	Temp. at which Saint Gilles' colloidal hydrate is formed	Temp. at which oxychlorides are formed	Temp. at which Fe <sub>2</sub> O <sub>3</sub> is formed
32	100-130°	...	100°+	140°
16	100-120	...	"	120
8	100-110	...	"	110
4	90-100	...	90	...
2	87	...	87	...
1	83	100-130°	...	...
0.5	75	"	...	...
0.25	64	"	...	...
0.125	54	"	...	...
0.0625	36	"	...	...

Sp. gr. of Fe<sub>2</sub>Cl<sub>6</sub> + Aq.

% Fe <sub>2</sub> Cl <sub>6</sub>	Sp. gr. at 4.8°	Sp. gr. at 9.7°	Sp. gr. at 14.6°	Sp. gr. at 19.7°
49.61	1.5609	1.5575	1.5540	1.5497
41.00	1.4413	1.4387	1.4361	1.4335
36.95	...	1.3847	1.3824	1.3800
33.25	1.3381	1.3359	1.3339	1.3317
24.60	1.2351	1.2334	1.2318	1.2298
22.54	1.2140	1.2129	1.2107	1.2090
16.79	1.1534	1.1521	1.1507	1.1491
10.45	1.0939	1.0930	1.0918	1.0901
4.65	...	...	1.0382	...
2.70	...	...	1.0221	...

(Schult, from Gerlach, Z. anal. 37. 278.)

Sp. gr. of Fe<sub>2</sub>Cl<sub>6</sub> + Aq increases or diminishes between 8° and 24° for a decrease or increase of temp. of 1° by the following amts.

% Fe <sub>2</sub> Cl <sub>6</sub>	Corr.	% Fe <sub>2</sub> Cl <sub>6</sub>	Corr.
50-60	0.0008	30-39	0.0005
45-49	0.0007	20-29	0.0004
40-44	0.0006	10-19	0.0003

(Hager, I. c.)

Sp. gr. of  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$  at  $17.5^\circ$ .

$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.
1	1.0073	21	1.1644	41	1.3746
2	1.0146	22	1.1746	42	1.3870
3	1.0219	23	1.1848	43	1.3994
4	1.0292	24	1.1950	44	1.4118
5	1.0365	25	1.2052	45	1.4242
6	1.0439	26	1.2155	46	1.4367
7	1.0513	27	1.2258	47	1.4492
8	1.0587	28	1.2365	48	1.4617
9	1.0661	29	1.2464	49	1.4742
10	1.0734	30	1.2568	50	1.4867
11	1.0814	31	1.2673	51	1.5010
12	1.0894	32	1.2778	52	1.5153
13	1.0974	33	1.2883	53	1.5296
14	1.1054	34	1.2988	54	1.5439
15	1.1134	35	1.3093	55	1.5582
16	1.1215	36	1.3199	56	1.5729
17	1.1297	37	1.3305	57	1.5876
18	1.1378	38	1.3411	58	1.6023
18	1.1378	38	1.3411	58	1.6023
19	1.1458	39	1.3517	59	1.6170
20	1.1542	40	1.3622	60	1.6317

(Franz, J. pr. (2) 5. 283.)

Sp. gr. of  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$  at  $17.5^\circ$ .

$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.
1	1.008	21	1.191	41	1.428
2	1.016	22	1.202	42	1.441
3	1.025	23	1.212	43	1.454
4	1.033	24	1.223	44	1.469
5	1.042	25	1.234	45	1.481
6	1.051	26	1.245	46	1.494
7	1.060	27	1.256	47	1.507
8	1.069	28	1.268	48	1.520
9	1.078	29	1.280	49	1.533
10	1.087	30	1.292	50	1.547
11	1.095	31	1.304	51	1.560
12	1.104	32	1.316	52	1.573
13	1.113	33	1.328	53	1.587
14	1.123	34	1.340	54	1.600
15	1.131	35	1.352	55	1.612
16	1.140	36	1.364	56	1.624
17	1.150	37	1.376	57	1.636
18	1.160	38	1.390	58	1.648
19	1.170	39	1.403	59	1.659
20	1.180	40	1.415	60	1.670

(Hager, Comm. 1883.)

Sp. gr. of conc.  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$  at  $20-21^\circ$ .

$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.	$\frac{\%}{\text{Fe}_2\text{Cl}_6}$	Sp. gr.
60	1.669	65	1.715	70	1.758
61	1.679	66	1.724	71	1.766
62	1.688	67	1.733	72	1.774
63	1.697	68	1.742	73	1.782
64	1.706	69	1.750	74	1.790

(Hager, l. c.)

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq}$ .

$t^\circ$	Sat. solution contains per 100 mols. $\text{H}_2\text{O}$		Solid phase
	mols. $\text{HCl}$	mols. $\text{FeCl}_3$	
30	0	12.70	$\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$
"	5.92	16.07	
"	0	20.90	
25	0	10.90	
"	2.33	23.72	
"	0	24.50	
20	0	10.20	
"	5.60	23.60	
"	0	25.70	
10	0	9.10	
"	8.75	8.00	
"	16.70	16.65	
"	13.80	23.35	
0	0	8.25	
"	7.52	6.51	
"	13.37	6.33	
"	16.80	8.70	
"	18.45	10.23	
"	20.40	15.40	
"	20.10	16.00	
"	19.95	17.70	
"	19.00	22.75	
"	18.05	23.40	
-10	0	7.40	
"	19.46	10.37	
"	20.48	20.54	
"	20.25	21.56	
-12.5	22.14	16.69	
-15	0	6.98	
"	21.30	9.65	
-20	0	6.56	
"	7.50	4.90	
"	15.30	5.09	
"	20.56	7.08	
30	0	25.20	$\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$
"	4.25	27.80	
"	0	30.24	
25	0	23.50	
"	2.33	23.72	
"	7.50	29.75	
"	0	31.50	
20	0	22.50	
"	5.60	23.60	
"	11.05	29.20	
"	11.05	29.20	
"	0	32.00	
15	10.75	23.50	
"	14.90	28.35	
10	13.80	23.35	
"	17.80	27.75	
"	17.80	27.75	
0	18.05	23.40	
"	19.50	25.93	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq.}$ —Continued.

$t^\circ$	Sat. solution contains per 100 mols. $\text{H}_2\text{O}$		Solid phase
	mols. $\text{HCl}$	mols. $\text{FeCl}_3$	
50	0	35.00	$\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$
"	3.25	39.95	
44	0	33.50	
"	3.04	33.80	
"	10.62	34.64	
"	11.50	35.60	
"	10.70	38.00	
40	0	32.40	
"	13.40	37.45	
33	0	31.00	
"	15.70	37.06	
30	0	30.24	
"	17.20	34.00	
"	17.15	36.75	
25	0	29.00	
"	7.50	29.75	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	19.50	35.25	
20	0	27.90	
"	11.05	29.20	
"	15.80	30.68	
"	21.25	34.25	
15	14.90	28.35	
"	16.40	29.32	
10	17.80	27.75	
"	18.80	28.70	
"	24.50	32.75	
0	24.12	30.04	
"	26.00	32.16	
-10	24.95	29.60	
"	26.05	30.60	
"	27.30	32.05	
70	0	44.0	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
"	6.75	50.00	
"	0	55.80	
65	0	42.60	
"	10.25	50.00	
"	3.75	57.25	
"	0	59.00	
60	0	41.40	
"	14.25	50.00	
"	10.70	55.25	
"	0	61.00	
55	0	40.64	
"	19.00	50.72	
"	16.71	53.60	
"	0	62.00	
50	0	39.92	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 4\text{H}_2\text{O}$
"	3.25	39.95	
"	21.24	49.33	
"	20.04	52.60	
44	0	39.00	
"	10.70	38.00	
"	14.80	38.70	
"	24.14	50.10	
40	13.40	37.45	
"	27.00	50.80	
33	15.70	37.06	
"	29.20	42.70	
"	31.08	46.85	
"	30.81	47.65	
33	30.45	48.70	$\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$
30	17.15	36.75	
"	31.20	43.49	
"	33.80	47.80	
"	32.60	49.93	
25	19.50	35.25	
"	20.60	35.34	
"	31.34	41.58	
"	33.00	43.00	
"	34.65	44.80	
20	21.25	34.25	
"	28.81	37.57	
"	34.23	42.02	
"	35.40	43.16	
15	29.40	36.50	
"	33.60	40.03	$\text{Fe}_2\text{Cl}_6$ anhydrous
10	24.50	32.75	
"	35.04	39.95	
0	26.00	32.16	
"	34.60	38.11	
-10	27.30	32.05	
"	33.56	36.25	
-20	30.08	32.76	
"	32.65	35.44	
45	0	58.00	$\text{Fe}_2\text{Cl}_6$ anhydrous
"	31.28	50.08	
"	40.65	48.60	
40	0	58.00	
"	27.00	50.80	
"	42.01	48.64	
35	0	58.00	
"	29.01	50.33	
"	37.04	49.20	
30	0	58.00	
"	32.60	49.93	
"	34.40	49.72	
40	42.50	47.52	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 4\text{H}_2\text{O}$
"	42.01	48.64	
35	39.47	46.57	
"	37.04	49.20	
30	40.21	42.54	
"	38.20	44.70	
"	35.55	47.30	
"	34.40	49.72	
25	40.41	40.25	
"	39.03	41.38	
"	35.74	45.24	
20	39.50	39.25	
"	35.40	43.16	
10	38.62	37.48	
"	37.46	38.33	
"	36.30	38.70	
"	35.04	39.93	
0	37.27	36.60	$\text{Fe}_2\text{Cl}_6$ anhydrous
"	34.60	38.11	
-10	37.92	35.32	
"	34.54	36.00	
"	33.56	36.25	
-20	37.80	34.50	
"	34.10	34.84	
"	32.56	35.44	

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{HCl} + \text{Aq.}$ —Continued.

t°	Sat. solution contains per 100 mols. $\text{H}_2\text{O}$		Solid phase
	mols. $\text{HCl}$	mols. $\text{FeCl}_3$	
— 4.5	20.50	24.50	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 8\text{H}_2\text{O}$
"	20.66	25.74	
"	23.42	27.40	
— 6	29.10	24.73	
"	26.18	21.75	
"	24.41	21.50	
"	23.25	21.35	
"	21.73	21.84	
"	19.73	25.50	
"	24.42	28.45	
"	28.20	27.04	
—10	20.48	20.54	
"	24.90	18.94	
"	28.75	20.34	
"	31.42	28.53	
"	28.25	30.25	
"	26.05	30.50	
—15	24.50	15.83	$\text{Fe}_2\text{Cl}_6, 2\text{HCl}, 12\text{H}_2\text{O}$
—15	28.40	31.89	
—20	19.44	12.10	
"	22.83	11.63	
"	25.20	11.60	
"	27.20	11.31	
"	31.08	11.51	
"	34.13	12.90	
"	33.93	31.77	
"	30.08	32.76	
"	28.70	32.88	
—10	12.01	11.99	
"	19.78	14.02	
"	20.95	16.20	
"	20.25	20.20	
"	17.73	20.70	
"	15.44	19.65	
—12.5	22.14	16.69	
—15	21.30	9.65	
"	24.50	15.83	
—20	9.96	9.94	
"	13.32	8.57	
"	16.90	7.35	
"	18.97	7.16	
"	20.56	7.08	
"	23.40	7.20	
"	24.85	9.88	
"	25.20	11.60	
"	25.40	12.37	
"	25.59	13.39	

(Rooseboom and Schreinemakers, Z. phys. Ch. 1894, 15. 633.)

Solubility of  $\text{Fe}_2\text{Cl}_6 + \text{NH}_4\text{Cl}$ .  
See  $\text{NH}_4\text{Cl} + \text{Fe}_2\text{Cl}_6$  under  $\text{NH}_4\text{Cl}$ .

Solubility of  $\text{Fe}_2\text{Cl}_6$  in  $\text{CsCl}$ .  
See  $\text{CsCl} + \text{Fe}_2\text{Cl}_6$  under  $\text{CsCl}$ .

Solubility of  $\text{FeCl}_3 + \text{KCl}$  in  $\text{H}_2\text{O}$  at 21°.

Substance added		Pts. by weight sol. in 100 pts. of solution	
$\text{FeCl}_3$ grams	$\text{KCl}$ grams	$\text{FeCl}_3$	$\text{KCl}$
0	25	0	34.97
13	28	13.44	24.45
18	21	23.18	16.54
3	18.5	28.05	11.69
28	16	35.72	11.68
31	10.5	36.62	11.19
36.2	9	37.35	13.67
41.5	8	42.03	7.88
46.5	6	51.69	7.54
52	0.5	...	...
155	0	83.89	0

(Hinrichsen and Sachsel, Z. phys. Ch. 1904, 50. 95.)

 $\text{FeCl}_3 + \text{NaCl}$ .Solubility of  $\text{FeCl}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at 21°.

Substance added		Pts. by weight sol. in 100 pts. of solution	
$\text{FeCl}_3$ grams	$\text{NaCl}$ grams	$\text{FeCl}_3$	$\text{NaCl}$
0	3.6	0	36.10
1.8	3.0	24.27	9.10
3.6	2.5	25.40	8.45
5.5	2.0	26.40	5.25
7.2	1.5	38.15	3.90
9.0	1.0	43.38	2.45
10.8	0.5	46.75	2.11
10.8	0	83.39	0

(Hinrichsen and Sachsel, Z. phys. Ch. 1904, 50. 94.)

Solubility of  $\text{FeCl}_3$  in  $\text{NaCl} + \text{Aq}$  at t°.

t°	Substance added		% of Fe in the solution
	$\text{FeCl}_3$	$\text{NaCl}$	
10	40	20	15.2
10	60	20	15.2
10	100	20	15.16
20	60	20	16.2
20	80	20	16.18
20	100	20	16.2
30	70	30	17.7
30	90	30	17.6
30	110	30	17.67
50	30	20	23.5
50	45	20	23.9
40	35	30	25.4
40	50	30	25.5
30	30	20	23.8
30	45	20	24.0
17.6	30	20	24.47
17.6	50	20	24.5

(Hinrichsen and Sachsel, Z. phys. Ch. 1904, 50. 95.)

Difficultly sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Attacked by liquid  $\text{NO}_2$  in the presence of traces of moisture. (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol. in liquid  $\text{SO}_2$ . (Walden, B. 1899, 32. 2864.)

Sol. in alcohol ether, acetic ether (Cann. C. R. 102. 363), and acetone (Krug and M'Elroy, J. anal. Ch. 6. 184.)

Sl. sol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

1 g.  $\text{FeCl}_3$  is sol. in 1.59 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.160$ . (Naumann, B. 1904, 37. 4333.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Sl. sol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 22.)

Sublimed.

Sol. in  $\text{AsCl}_3$ ,  $\text{POCl}_3$ ,  $\text{SO}_2\text{Cl}_2$  and  $\text{PBr}_3$ ; sl. sol. in  $\text{PCl}_5$ . (Walden, Z. anorg. 1900, 25. 214.)

The salts with different amts. of crystal  $\text{H}_2\text{O}$  have different solubilities. (Rooseboom. +4 $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $73.5^\circ$ .)

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 4\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$
50	19.96	69	21.53	72.5	26.15
55	20.32	72.5	23.35	70	27.90
60	20.70	73.5	25.00	66	29.20

(Rooseboom, Z. phys. Ch. 10. 477.)

+5 $\text{H}_2\text{O}$ . Correct formula for +6 $\text{H}_2\text{O}$  salt.

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$
12	12.87	30	15.12	55	19.15
20	13.95	35	15.64	56	20.00
27	14.85	50	17.50	55	20.32

(Rooseboom.)

Melts in crystal  $\text{H}_2\text{O}$  at  $31^\circ$  (Engel, C. R. 104. 1708); at  $56^\circ$  (Rooseboom.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. Sol. in alcohol. Ether dissolves out  $\text{Fe}_2\text{Cl}_6$ .

M.-pt. is  $31^\circ$ . (Ordway.) Contains only 5 $\text{H}_2\text{O}$ . (Rooseboom.)

+7 $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at  $32.5^\circ$ .

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 7\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$
20	11.35	32	13.55	30	15.12
27.4	12.15	32.5	14.99	25	15.54

(Rooseboom.)

+12 $\text{H}_2\text{O}$ . Less deliquescent than  $\text{Fe}_2\text{Cl}_6$  or  $\text{Fe}_2\text{Cl}_6 + 5\text{H}_2\text{O}$ .

100 mols.  $\text{H}_2\text{O}$  dissolve mols.  $\text{Fe}_2\text{Cl}_6$  from  $\text{Fe}_2\text{Cl}_6 + 12\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$	$t^\circ$	Mols. $\text{Fe}_2\text{Cl}_6$
-55	2.75	30	5.93	27.4	11.20
-41	2.81	35	6.78	20	12.15
-27	2.98	36.5	7.93	10	12.83
0	4.13	37	8.33	8	13.70
10	4.54	38	9.29	....	...
20	5.10	30	10.45	....	...

(Rooseboom.)

Sol. in alcohol. Ether dissolves out  $\text{Fe}_2\text{Cl}_6$ . Melts in crystal  $\text{H}_2\text{O}$  at  $37^\circ$  (Rooseboom); at  $35.5^\circ$  (Ordway.)

**Ferric hydrogen chloride,  $\text{FeCl}_3 \cdot \text{HCl} + 2\text{H}_2\text{O}$ .**  
Decomp. by  $\text{H}_2\text{O}$ . (Sabatier, Bull. Soc. (2) 197.)

More sol. in  $\text{H}_2\text{O}$  than  $\text{FeCl}_3$ . (Engel, C. R. 104. 1708.)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride.

+6 $\text{H}_2\text{O}$ . (Rooseboom and Schreinemakers.)

For solubility, see  $\text{FeCl}_3 + \text{HCl}$ , under ferric chloride.

**Ferrous lithium chloride,  $\text{FeCl}_2 \cdot \text{LiCl} + 3\text{H}_2\text{O}$ .**  
(Chassevant, A. ch. (6) 30. 17.)

**Ferric magnesium chloride,  $\text{FeCl}_3 \cdot \text{MgCl}_2 + \text{H}_2\text{O}$ .**

Deliquescent. (Neumann, B. 18. 2890.)

**Ferrous mercuric chloride,  $\text{FeCl}_2 \cdot \text{HgCl}_2 + 4\text{H}_2\text{O}$ .**

Deliquescent. (v. Bonsdorff.)

**Ferric nitrosyl chloride,  $\text{FeCl}_3 \cdot \text{NOCl}$ .**

Very deliquescent. (Weber, Pogg. 118. 477.)

**Ferric phosphoric chloride,  $\text{FeCl}_3 \cdot \text{PCl}_5$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Baudrimont, A. ch. (4) 2. 15.)



**Iron (ferrous) potassium chloride,  $\text{FeCl}_2$ ,  $2\text{KCl}+2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ferric potassium chloride,  $\text{FeCl}_3$ ,  $2\text{KCl}+\text{H}_2\text{O}$ .**

A little  $\text{H}_2\text{O}$  dissolves out  $\text{FeCl}_3$ . (Fritzsche J. pr. 18. 483.)

Sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 71. 332.)

**Ferric rubidium chloride,  $\text{FeCl}_3$ ,  $3\text{RbCl}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl}+\text{Aq}$ . (Godeffroy, Arch. Pharm. (3) 9. 343.)

$\text{FeCl}_3$ ,  $2\text{RbCl}+\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Neumann, A. 244. 329.)

Sol. in  $\text{H}_2\text{O}$ . (Walden, Z. anorg. 1894, 7. 332.)

**Ferric sulphur chloride,  $\text{FeCl}_3$ ,  $\text{SCl}_2$ .**

Very sensitive toward heat and moisture. (Ruff, B. 1904, 37. 4518.)

**Ferric thallium chloride,  $\text{FeCl}_3$ ,  $3\text{TlCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Can be crystallised from  $\text{HCl}+\text{Aq}$ . (Wöhler, A. 144. 250.)

**Ferrous chloride ammonia,  $3\text{FeCl}_2$ ,  $2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rogstadius, J. pr. 86. 310.)

$\text{FeCl}_2$ ,  $6\text{NH}_3$ . Loses  $4\text{NH}_3$  at  $100^\circ$ . (Miller, Am. Ch. J. 1895, 17. 577.)

$\text{FeCl}_2$ ,  $2\text{NH}_3$ . Decomp. in the air (Miller).

**Ferric chloride ammonia,  $\text{FeCl}_3$ ,  $\text{NH}_3$ .**

Slowly deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat. (Rose, Pogg, 24. 302.)

$\text{FeCl}_3$ ,  $6\text{NH}_3$ . Not deliquescent; not sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  with decomp. (Miller, Am. Ch. J. 1895, 17. 577.)

Loses  $\text{NH}_3$  to give  $\text{FeCl}_2$ ,  $5\text{NH}_3$ , and  $\text{FeCl}_3$ ,  $4\text{NH}_3$ .

**Ferric chloride cyanhydric acid,  $\text{FeCl}_3$ ,  $2\text{HCN}$ .**

Deliquescent. (Klein, A. 74. 85.)

**Ferrous chloride nitric oxide,  $\text{FeCl}_2$ ,  $\text{NO}$ .**

Sol. in  $\text{H}_2\text{O}$  without evolution of gas. (Thomas, C. R. 1895, 121. 204.)

$+2\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$  without decomp. (Thomas, C. R. 1895, 120. 448.)

$2\text{FeCl}_2$ ,  $\text{NO}$ . Very hygroscopic. (Thomas, C. R. 1895, 121. 129.)

$10\text{FeCl}_2$ ,  $\text{NO}$ . Very hygroscopic. (Thomas, C. R. 1895, 121. 128.)

**Ferric chloride nitric oxide,  $\text{Fe}_2\text{Cl}_6$ ,  $\text{NO}$ .**

Very hygroscopic. Loses  $\text{NO}$  when exposed to the air.

$2\text{Fe}_2\text{Cl}_6$ ,  $\text{NO}$ . Very hygroscopic. In contact with  $\text{H}_2\text{O}$  gives off  $\text{NO}$ . (Thomas, C. R. 1895, 120. 447.)

**Iron (ferrous) fluoride,  $\text{FeF}_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol and ether. Partly sol. in hot  $\text{HCl}+\text{Aq}$ ; slowly sol. in cold, easily in hot  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{SO}_4$ . (Poulenc, C. R. 115. 941.)

$+8\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ ; more easily if it contains  $\text{HF}$ . (Berzelius.)

**Ferroferric fluoride,  $\text{FeF}_2$ ,  $\text{FeF}_3+7\text{H}_2\text{O}$ .**

Sol. in dil.  $\text{HF}+\text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 268.)

**Ferric fluoride,  $\text{FeF}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol or ether. Sl. attacked by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4+\text{Aq}$ . (Poulenc, C. R. 115. 941.)

$+4\frac{1}{2}\text{H}_2\text{O}$ . More sol. in hot than cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Scheurer-Kestner, A. ch. (3) 68. 472.)

**Ferric nickel fluoride,  $\text{FeF}_3$ ,  $\text{NiF}_2+7\text{H}_2\text{O}$ .**

Sl. sol. in dil.  $\text{HF}+\text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 268.)

**Ferrous potassium fluoride,  $\text{FeF}_2$ ,  $\text{KF}+2\text{H}_2\text{O}$ .**

(Wagner, B. 19. 896.)

$\text{FeF}_3$ ,  $2\text{KF}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ferric potassium fluoride,  $\text{FeF}_3$ ,  $2\text{KF}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ , especially if hot. (Berzelius.)

$+ \text{H}_2\text{O}$ . (Christensen, J. pr. (2) 35. 164.)

$\text{FeF}_3$ ,  $3\text{KF}$ . Properties as above. (Berzelius.)

**Ferric sodium fluoride,  $\text{FeF}_3$ ,  $2\text{NaF}+\frac{1}{2}\text{H}_2\text{O}$ .**

Rather easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. on heating. Very sol. in  $\text{FeCl}_3+\text{Aq}$ . (Nicklès, J. Pharm. (4) 10. 14.)

$\text{FeF}_3$ ,  $3\text{NaF}$ . (Wagner, B. 19. 896.)

**Ferric thallous fluoride,  $2\text{FeF}_3$ ,  $3\text{TlF}$ .**

Sol. in hot  $\text{H}_2\text{O}$ , less sol. in cold. Sl. sol. in  $\text{HF}$ . (Ephraim, Z. anorg. 1909, 61. 239.)

**Ferrous titanium fluoride.**

See Fluotitanate, ferrous.

**Ferric zinc fluoride,  $\text{FeF}_3$ ,  $\text{ZnF}_2+7\text{H}_2\text{O}$ .**

Sl. sol. in dil.  $\text{HF}+\text{Aq}$ . (Weinland, Z. anorg. 1899, 22. 269.)

**Ferrous hydroxide,  $\text{FeO}_2\text{H}_2$ .**

Sol. in 150,000 pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 509.)

Insol. in  $\text{KOH}$ , or  $\text{NaOH}+\text{Aq}$ . Sol. in  $\text{NH}_4$  salts  $+\text{Aq}$ . Sl. sol. in  $\text{NaC}_2\text{H}_3\text{O}_2+\text{Aq}$ . (Mercer.)

Not pptd. in presence of  $\text{Na citrate}$ . Insol. in boiling cane sugar  $+\text{Aq}$ , but al. sol. when  $\text{KOH}$  has been added. Not pptd. in presence of much  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ . (Rose.)

Solubility in glycerine + Aq containing about 60% by vol. of glycerine.

100 ccm. of the solution contain 1.0 g.  $\text{FeO}$ . (Müller, Z. anorg. 1905, 43. 322.)

**Iron (ferric) hydroxides,  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .**

Many indefinite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$  are known, and uncertainty exists as to their composition.

According to van Bemmelen (R. t. c. 7. 106) there are probably no true definite compounds of  $\text{Fe}_2\text{O}_3$  and  $\text{H}_2\text{O}$ .

According to Tommasi (B. 12. 1924, 2334), there are two series of Fe hydroxides,  $\alpha$ , red hydroxides, and  $\beta$ , yellow hydroxides.

*$\alpha$  Hydroxides.*  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (unstable),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $50^\circ$ ), and  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $92^\circ$ ).

Sol. in dil. acids and in  $\text{Fe}_2\text{Cl}_6$  + Aq. and pptd. from the latter solution by  $\text{Na}_2\text{SO}_4$  or  $\text{H}_2\text{SO}_4$  + Aq.

*$\beta$  Hydroxides.*  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (stable below  $70^\circ$ ),  $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $105^\circ$ ),  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (loses  $\text{H}_2\text{O}$  at  $150^\circ$ ).

Sl. sol. in acids, and insol. in  $\text{Fe}_2\text{Cl}_6$  + Aq. (Tommasi.)

The following more or less uncertain data are given.

$2\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  + Aq. Very sl. sol. in  $\text{HNO}_3$  + Aq. (Davies, Chem. Soc. (2) 4. 69.)

Min. *Turgite*.

$\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . Insol. in cold acids, difficultly sol. in warm  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  + Aq. and especially in warm  $\text{HNO}_3$  + Aq. (Schiff, A. 114. 199.)

Min. *Göthite*.

$2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sl. sol. in tartaric, citric, or acetic acids, but easily sol. in  $\text{HCl}$  + Aq. (Wittstein.)

Scarcely attacked by conc.  $\text{HNO}_3$ , or  $\text{HCl}$  + Aq. Sol. in acetic acid or dil.  $\text{HNO}_3$ , or  $\text{HCl}$  + Aq. from which solution it is pptd. by trace of alkali salts. (St. Gilles.)

Min. *Lamonte*.

$3\text{Fe}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ . (Muck.)

$\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  + Aq.

Min. *Xanthosiderite*.

$\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ . Sl. sol. in acetic acid of 1.03 sp. gr., but easily sol. if of 1.076 sp. gr. Sol. in mineral acids. (Limberger, J. B. 1853. 70.)

Pptd.  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O} = \text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  (?). Insol. in  $\text{H}_2\text{O}$ , or in solutions of the alkalis or  $\text{NH}_4$  salts. When recently pptd. is easily sol. in acids. (Fresenius.)

Sl. sol. in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts + Aq. (Odling.)

Apparently insol. in  $\text{NH}_4\text{Cl}$ , or  $(\text{NH}_4)_2\text{CO}_3$  + Aq. (Brett, 1837.)

Sl. sol. in conc., but insol. in dil.  $\text{KOH}$  + Aq. (Chodnew, J. pr. 23. 221.)

Sl. sol. in very conc.  $\text{KOH}$  + Aq free from  $\text{CO}_2$ . (Völcker, A. 59. 34.)

Not at all sol. in pure conc.  $\text{KOH}$  + Aq, solubility noticed by previous observers being caused by the presence of silicic acid. (Sand-rock.)

Sl. sol. in conc. alkali carbonates + Aq.

When freshly pptd., it is not acted upon by conc.  $\text{K}_2\text{CO}_3$  + Aq. (Grotthaus.)

Readily sol. in conc.  $(\text{NH}_4)_2\text{CO}_3$  + Aq, but pptd. by addition of  $\text{H}_2\text{O}$ .

Sol. in excess of  $(\text{NH}_4)_2\text{CO}_3$  + Aq when pptd. by that reagent. (Wohler.)

Sol. in solutions of the alkali bicarbonates. (Berzelius.)

Sol. in aqueous solutions of water-glass. (Ordway.)

Immediately dissolved by  $\text{H}_2\text{SO}_4$  + Aq.

Sol. in  $\text{NH}_4\text{F}$  + Aq. (Helmholtz, Z. anorg. 3. 124.)

Sol. in conc.  $\text{Al}_2(\text{SO}_4)_3$  + Aq. (Schneider, B. 23. 1352.)

Sl. sol. in a solution of  $\text{MgCO}_3$  (?). (Bischhof.)

Insol. in ethylamine, or amylamine + Aq. (Wurtz, A. ch. (3) 30. 472.)

Sol. in boiling solution of  $\text{Bi}(\text{NO}_3)_3$ , with pptn. of  $\text{Bi}_2\text{O}_3$ . (Persoz.)

Sol. in  $\text{Cr}_2\text{Cl}_6$  + Aq; after 3 months 15 mols.  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  were dissolved by 1 mol.  $\text{Cr}_2\text{Cl}_6$ . (Béchamp, A. ch. (3) 57. 296.)

Insol. in fumaric acid, even when freshly pptd.

When recently pptd., it is easily sol. in  $\text{KHC}_4\text{H}_4\text{O}_6$  + Aq, but after drying it is difficultly sol. therein.

When moist easily sol. in  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq, but after drying is scarcely sol. therein when cold, and only sl. sol. when hot. (Werther.)

Easily sol. in acetic, citric, and other acids. (Wittstein.)

Solubility in glycerine + Aq containing about 60% by vol. of glycerine.

100 ccm. of the solution contain 0.8 g.  $\text{Fe}_2\text{O}_3$ . (Müller, Z. anorg. 1905, 43. 322.)

Easily sol. in aqueous solution of sacrates of Ca, Ba, Sr, K, Na. (Hunton, 1837.)

Unacted upon by cane sugar + Aq. (Gladstone.)

Sl. sol. in cane sugar + Aq, from which it is pptd. by  $(\text{NH}_4)_2\text{S}$  + Aq, but not by  $\text{NH}_4\text{OH}$ , or  $\text{K}_4\text{FeC}_6\text{N}_8$  + Aq. (Peschier.)

Solubility of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$  in sugar solutions. 1 l. of sugar solution of given strength dissolves mg. of  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .

% Sugar	Mg. $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$		
	at $17.4^\circ$	at $45^\circ$	at $75^\circ$
10	3.4	3.4	6.1
30	2.3	2.7	3.8
50	2.3	1.9	3.4

(Stolle, Z. Ver. Zuckerind. 1900, 50. 340.)

Not pptd. from solutions by alkalis or alkali carbonates in presence of many organic substances, as tartaric acid, sugar, etc.

Not pptd. by  $\text{NH}_4\text{OH}$  from solutions containing  $\text{Na}_4\text{P}_2\text{O}_7$ . (Rose, Pogg. 76. 19.)

Not pptd. by  $\text{NH}_4\text{OH}$  in presence of Na citrate. (Spiller.)

**Soluble.** (a) *By dialysis.* Solutions containing 1% can be concentrated somewhat, whereupon they gelatinise. They also gelatinise by cold, or addition of traces of  $\text{H}_2\text{SO}_4$ , alkalis, alkali carbonates or sulphates, or neutral salts, not, however, by  $\text{HCl}$ ,  $\text{HNO}_3$ , alcohol, or sugar. (Graham, A. 121. 46.)

When a dil. solution of a solid organic acid, or an alkali, or salt is added to a dialysed solution of  $\text{Fe}_2\text{O}_3\text{H}_2$ , a coagulum sol. in  $\text{H}_2\text{O}$  is formed, but if the solutions are conc. the separating coagulum is no longer sol. in  $\text{H}_2\text{O}$ . (Athenstädt, C. C. 1871. 822.)

(b) *Pean St. Gilles' hydroxide, or meta-iron hydroxide.* Sol. in  $\text{H}_2\text{O}$ . Pptd. from solution by traces of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ , +Aq, and alkalis; the ppt. is insol. in cold acids, but sol. in pure  $\text{H}_2\text{O}$ . (Pean St. Gilles, A. ch. (3) 46. 47.)

See also table by Krecke in the article on ferric chloride.

**Iron (Ferroferric) hydroxide,  $\text{Fe}_2\text{O}_3$ ,  $\text{H}_2\text{O}$  (?)**

Sol. in acids.

$\text{Fe}_2\text{O}_3$ , 4 $\text{H}_2\text{O}$ . (Lefort.)

**Ferrous iodide,  $\text{FeI}_2$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ . Solution decomp. on evaporating.

+4 $\text{H}_2\text{O}$ . Very deliquescent; al. sol. in  $\text{H}_2\text{O}$ ; sol. in ether. (Jackson, Am. Ch. J. 1900, 24. 19.)

+5 $\text{H}_2\text{O}$ . Deliquescent. Sol. in alcohol. Sol. in sugar +Aq, and solution is much more stable than aqueous solution. Easily sol. in glycerine.

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)

+6 $\text{H}_2\text{O}$ , and +9 $\text{H}_2\text{O}$ . Very sol.; pptd. from cooled aq. solution. (Volkman, C. C. 1894, II. 611.)

**Ferric iodide,  $\text{FeI}_3$ .**

Has not been isolated. Solution of I in  $\text{FeI}_3$  +Aq in the molecular ratio of I :  $\text{FeI}_3$  probably contains  $\text{FeI}_3$ .

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

**Ferrous mercuric iodide,  $\text{FeI}_2$ , 2 $\text{HgI}_2$  + 6 $\text{H}_2\text{O}$ .**

As the corresponding Mg salt. (Duboin, C. R. 1907, 145. 714.)

**Ferrous iodide ammonia,  $\text{FeI}_2$ , 6 $\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Jackson, Am. Ch. J. 1900, 24. 27.)

**Ferrous mercuric iodide.**

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{HC}_2\text{H}_3\text{O}_2$  or alcohol.

**Iron molybdenide,  $\text{FeMo}_2$ .**

Attacked by  $\text{HCl}$  +Aq with difficulty. Sol. in hot conc.  $\text{H}_2\text{SO}_4$ . (Steinacker.)

**Iron nitride.**

Easily decomp. by  $\text{H}_2\text{O}$  when finely powdered. (Rossel, C. R. 1895, 121. 942.)

$\text{Fe}_3\text{N}$ . Easily sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$  +Aq. Very slowly decomp. by  $\text{H}_2\text{O}$ . (Stahlschmidt, Pogg. 125. 37.)

Sol. in  $\text{HCl}$  with decomp.; decomp. by steam and by  $\text{H}_2\text{S}$  at 200°. (Fowler, C. N. 1894, 68. 152.)

$\text{Fe}_3\text{N}_2$ . Probably the same as the above compound. (Rogstadius, J. pr. 86. 307.)

**Iron nitrososulphantimonate,  $\text{Fe}_2\text{S}(\text{NO})\text{Sb}_2\text{S}_4$ .**

(Low, C. C. 1865. 948.)

Does not exist, but was impure sodium ferrotetranitrososulphide. (Pawel, B. 15. 2600.)

**Iron nitrososulphides.**

See Ferrotetranitrososulphidic acid and Ferroheptanitrososulphide, ammonium.

$\text{Fe}_2\text{S}_2\text{H}_2(\text{NO})_4$ . (Roussin, C. R. 46. 224.)

$\text{Fe}_2\text{S}_2(\text{NO})_4 + 2\text{H}_2\text{O}$ . (Porcizinsky, A. 125. 302.)

$\text{Fe}_2\text{S}_2(\text{NO})_{10} + 4\text{H}_2\text{O}$ . (Rosenberg, B. 3. 312.)

The compound to which the above formula were given was impure, according to Pawel (B. 12. 1407 and 1949; 15. 2600), and contained more or less Na or  $\text{NH}_4$ . Pawel considers the substance as  $\text{NH}_4$  salt of ferroheptanitrososulphidic acid, which see.

$\text{Fe}_2\text{S}_2\text{N}_2\text{O}_8 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , alcohol, ether,  $\text{CHCl}_3$ , acetone and ethyl acetate. Insol. in benzene and light petroleum. (Marie, C. R. 1896, 122. 138.)

**Iron sodium nitrososulphide,  $3\text{Na}_2\text{S}$ ,  $\text{Fe}_2\text{S}_2$ , 2 $\text{NO}$ .**

(Roussin.)

$\text{Na}_2\text{Fe}_2\text{S}_2(\text{NO})_{10}$ . (Rosenberg.)

Correct formula is  $\text{Na}_2\text{S}_2(\text{NO})_2\text{Fe}_2$ , sodium ferrotetranitrososulphide.

**Iron nitrososulphocarbonate,  $\text{Fe}_2\text{S}(\text{NO})\text{CS}_2 + 3\text{H}_2\text{O}$ .**

(Low, C. C. 1865. 948.)

Correct formula is  $\text{Na}_2\text{S}_2(\text{NO})_7\text{Fe}_2 + 2\text{H}_2\text{O}$ , sodium ferroheptanitrososulphide. (Pawel, B. 15. 2600.)

**Ferrous oxide,  $\text{FeO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids.

Easily sol. in  $\text{HCl}$ , and  $\text{HNO}_3$  +Aq; nearly insol. in  $\text{H}_2\text{SO}_4$ , even when heated. (Tissandier, C. R. 74. 531.)

**Ferric oxide,  $\text{Fe}_2\text{O}_3$ .**

Attacked by acids with difficulty, the more so the higher it has been heated.  $\text{HCl}$  +Aq is the best solvent, in which it is more quickly sol. by long digestion at a gentle heat than by boiling. (Fresenius.)

Most easily sol. in 16 pts. of a mixture of 8 pts.  $\text{H}_2\text{SO}_4$  and 3 pts.  $\text{H}_2\text{O}$ . (Mitscherlich, J. pr. 81. 110.)

Solubility of  $\text{Fe}_2\text{O}_3$  in  $\text{HF} + \text{Aq}$  at  $25^\circ$ .

	Time	G. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
N-HF	4½ hrs.	0.1581
	21½ "	0.2235
	45½ "	0.2279
0.5N-HF	2½ "	0.0579
	8½ "	0.0884
	23½ "	0.1045
	56½ "	0.1162
0.25N-HF	2½ "	0.0180
	8½ "	0.0345
	24½ "	0.0475
	142½ "	0.0534
equal amts. N-HF + N-HCl	2½ "	0.1011
	8½ "	0.1611
	23½ "	0.1976
	96 "	0.2223
	264 "	0.2297

(Deussen, Z. anorg. 1905, 44. 414.)

Solubility of  $\text{Fe}_2\text{O}_3$  in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ .

	Time	G. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
N-HCl	4½ hrs.	0.0409
	21½ "	0.1230
	45½ "	0.2125
0.5N-HCl	2½ "	0.0126
	8½ "	0.0188
	23½ "	0.0382
	56½ "	0.0672
0.25N-HCl	2½ "	0.0040
	8½ "	0.0054
	24½ "	0.0120
	142½ "	0.0306
equal vol. N-HCl + N-NaF	2½ "	0.0444
	8½ "	0.0640
	23½ "	0.0743
	72½ "	0.0757
	215 "	0.0766

(Deussen, l. c.)

Solubility of  $\text{Fe}_2\text{O}_3$  in N-oxalic acid at  $25^\circ$ .

Time	G. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
1½ hrs.	0.0310
6½ "	0.0790
22 "	0.1960
94 "	0.2326

(Deussen.)

Absolutely insol. in  $\text{Br}_2 + \text{Aq.}$  (Balard.)  
 Insol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Rose.)  
 Insol. in  $\text{KOH} + \text{Aq.}$  (Chodnew, J. pr. 23. 222.)

Slowly sol. in an aq. solution of calcium hydrogen carbonate. The velocity of the reaction may be much increased by the addition of small amounts of alkali sulphate or  $\text{CaSO}_4$ . (Robland, Z. anal. 1909, 48. 629.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Solubility in (calcium succrate + sugar) + Aq.  
 1 l. solution containing 418.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 6.26 g.  $\text{Fe}_2\text{O}_3$ ; 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 4.71 g.  $\text{Fe}_2\text{O}_3$ ; 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 3.08 g.  $\text{Fe}_2\text{O}_3$ . (Bodenbender, J. B. 1865. 600.)

Solubility of  $\text{Fe}_2\text{O}_3$  in sugar solutions. 1 l. of sugar solution of given strength dissolves mg.  $\text{Fe}_2\text{O}_3$ .

% Sugar	mg. $\text{Fe}_2\text{O}_3$	
	at $17.5^\circ$	at $45^\circ$
10	1.4	2.0
30	1.4	...
50	0.8	1.1

(Stolle, Z. Ver. Zuckerind, 1900, 50. 340.)

*Calcined.*Solubility of calcined  $\text{Fe}_2\text{O}_3$  in acids at  $25^\circ$ .

Acid	Time	g. $\text{Fe}_2\text{O}_3$ in 10 ccm. of the solution
N-HF	4½ hrs.	0.0889
	43½ "	0.2035
	129½ "	0.2194
N-HCl	4½ "	0.0224
	43½ "	0.1000
	139½ "	0.1910

(Deussen, Z. anorg. 1905, 44. 413.)

*See also Ferric hydroxide.*

Min. *Hematite*. Rather easily sol. in  $\text{HCl} + \text{Aq.}$  but not readily sol. in other acids.

*Metalron oxide.**See Ferric hydroxides.***Ferroferric oxide,  $6\text{FeO}, \text{Fe}_2\text{O}_3$ .**

$\text{FeO}, \text{Fe}_2\text{O}_3 = \text{Fe}_3\text{O}_4$ . With insufficient  $\text{HCl} + \text{Aq}$  for complete solution,  $\text{FeO}$  is dissolved and  $\text{Fe}_2\text{O}_3$  left. (Berzelius.)

Insol. in  $\text{HNO}_3 + \text{Aq}$  at the ordinary temperature. (Millon.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Solubility of  $\text{Fe}_2\text{O}_3$  in sugar solutions. 1 l. of sugar solution of given strength dissolves mg.  $\text{Fe}_2\text{O}_3$ .

% Sugar	mg. $\text{Fe}_2\text{O}_3$		
	at 17.5°	at 45°	at 75°
10	10.3	10.3	12.4
30	12.4	10.3	12.4
50	14.5	10.3	14.5

(Stolle, Z. Ver. Zuckerind. 1900, 50. 340.)

Min. *Magnetite*. Insol. in  $\text{HNO}_3$ , but sol. in hot  $\text{HCl} + \text{Aq}$ .

Iron sesquioxide zinc oxide,  $\text{Fe}_2\text{O}_3$ ,  $\text{ZnO}$ .

See Ferrite, zinc.

### Ferric oxybromide.

Basic ferric bromides containing three equivalents, or less, of base to one of acid may be obtained dissolved in  $\text{H}_2\text{O}$ . (Ordway, Am. J. Sci. (2) 26. 202.)

The most basic soluble compound obtained by three months' digestion of  $\text{Fe}_2\text{O}_3\text{H}_2$  with  $\text{Fe}_2\text{Br}_3 + \text{Aq}$ , is  $\text{Fe}_2\text{Br}_3$ ,  $14\text{Fe}_2\text{O}_3$ . (Béchamp.)

### Ferric oxychlorides.

(a) *Soluble*.  $\text{Fe}_2\text{O}_3\text{H}_2$  dissolves in  $\text{Fe}_2\text{Cl}_6 + \text{Aq}$ . By digesting until the acid reaction of the chloride has disappeared a solution of  $\text{Fe}_2\text{Cl}_6$ ,  $2\text{Fe}_2\text{O}_3$ , is obtained. (Pettenkofer, Report. (2) 41. 289.)

By digesting for several days in the cold,  $\text{Fe}_2\text{Cl}_6$ ,  $5\text{Fe}_2\text{O}_3$ , is obtained, and still more basic compounds by further addition of  $\text{Fe}_2\text{O}_3\text{H}_2$ . When the solution contains  $\text{Fe}_2\text{Cl}_6$ ,  $12\text{Fe}_2\text{O}_3$ , it gelatinises, but still dissolves completely in  $\text{H}_2\text{O}$ . The most basic soluble compound is  $\text{Fe}_2\text{Cl}_6$ ,  $20\text{Fe}_2\text{O}_3$ . (Béchamp, A. ch. (3) 57. 296.)

If the digestion is carried on several weeks, a solution containing  $\text{Fe}_2\text{Cl}_6$ ,  $23\text{Fe}_2\text{O}_3$ , is obtained; this can be boiled and diluted without pptn., but  $\text{Fe}_2\text{O}_3\text{H}_2$  is precipitated by the addition of very many salts. (Ordway, Sill. Am. J. (2) 26. 197.)

Solutions containing 10 or less molecules  $\text{Fe}_2\text{O}_3$  to 1 mol.  $\text{Fe}_2\text{Cl}_6$  can be dried without the oxychloride becoming insoluble. (Ordway.)

The above solutions do not become cloudy by boiling or diluting. (Phillips.)

A very dil. solution of  $\text{Fe}_2\text{Cl}_6$ ,  $10\text{Fe}_2\text{O}_3$ , remains clear after protracted boiling, and may be boiled without decomp. even when  $\text{Fe}_2\text{Cl}_6$ ,  $20\text{Fe}_2\text{O}_3$ , is present. (Béchamp.)

$\text{HNO}_3$ , and  $\text{HCl} + \text{Aq}$  form precipitates in the above solutions, which are sol. on addition of more  $\text{H}_2\text{O}$ .  $\text{H}_2\text{SO}_4 + \text{Aq}$  forms a precipitate insol. in  $\text{H}_2\text{O}$ . (Béchamp.)

$\text{Fe}_2\text{Cl}_6$ ,  $9\text{Fe}_2\text{O}_3$ , is easily sol. in  $\text{H}_2\text{O}$ , weak alcohol, and glycerine; but solutions are pptd. by small amts. of  $\text{H}_2\text{SO}_4$ ,  $\text{M}_2\text{SO}_4$ , citric or

tartaric acids, or a few drops of  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Jeannel; C. R. 46. 799.)

Solutions containing 5 mols.  $\text{Fe}_2\text{O}_3$  to 1 mol.  $\text{Fe}_2\text{Cl}_6$  are completely precipitated by  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{KNO}_3$ ,  $\text{NaNO}_3$ ,  $\text{Zn(NO}_3)_2$ ,  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ ,  $\text{MgCl}_2$ ,  $\text{ZnCl}_2$ ,  $\text{KBr}$ , or  $\text{KSCN}$ . (Béchamp.)

$\text{Ba(NO}_3)_2$  does not precipitate solutions of less than 18–20  $\text{Fe}_2\text{O}_3$  to 1  $\text{Fe}_2\text{Cl}_6$ .

$\text{Pb(NO}_3)_2$ , or  $\text{Pb(C}_2\text{H}_3\text{O}_2)_2$ , do not precipitate solutions containing the compound  $\text{Fe}_2\text{Cl}_6$ ,  $12\text{Fe}_2\text{O}_3$ , but a mixture of the two salts causes complete precipitation.

Solution has been obtained containing 116  $\text{Fe}_2\text{O}_3$  to 1  $\text{FeCl}_3$ , probably owing to a formation of soluble colloidal  $\text{Fe}_2\text{O}_3$ . (Magnier de la Source, C. R. 90. 1352.)

Solubility determinations in the system  $\text{Fe}_2\text{O}_3$ ,  $\text{HCl}$  and  $\text{H}_2\text{O}$ , show that at 25° no definite basic chloride is formed, but that the stable solid phase is one of a series of solid solutions containing  $\text{Fe}_2\text{O}_3$ ,  $\text{HCl}$  and  $\text{H}_2\text{O}$ . (Cameron, J. phys. Chem. 1907, 11. 694.)

(b) *Insoluble*.  $\text{Fe}_2\text{Cl}_6$ ,  $6\text{Fe}_2\text{O}_3 + 9\text{H}_2\text{O}$ .

(1) By exposing  $\text{FeCl}_3 + \text{Aq}$  to air. Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{HCl} + \text{Aq}$ . (Wittstein.)

(2) From  $\text{FeCl}_3 + \text{Aq}$  and  $\text{HNO}_3$ . Insol. in  $\text{H}_2\text{O}$ , and sl. sol. in  $\text{HCl} + \text{Aq}$ . (Béchamp.)  $2\text{Fe}_2\text{Cl}_6$ ,  $25\text{Fe}_2\text{O}_3 + 41\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Béchamp.)

$\text{Fe}_2\text{Cl}_6$ ,  $2\text{Fe}_2\text{O}_3 + 3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with residue of  $\text{Fe}_2\text{O}_3$ ; sl. sol. in dil. acids. (Roussseau, C. R. 110. 1032.)

$\text{Fe}_2\text{Cl}_6$ ,  $3\text{Fe}_2\text{O}_3$ . As above. (Roussseau, C. R. 113. 542.)

Ferric oxyfluoride,  $3\text{Fe}_2\text{O}_3$ ,  $2\text{FeF}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Scheurer-Kestner.)

Ferric oxysulphide,  $\text{Fe}_2\text{O}_3$ ,  $3\text{Fe}_2\text{S}_3$ .

(Rammelsberg.)

Iron phosphide,  $\text{FeP}$ .

Very slowly (Freese), not (Hvoslef, A. 100. 99) sol. in hot  $\text{HCl} + \text{Aq}$ . Still more insol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Freese.)

Slowly sol. in  $\text{HNO}_3 + \text{Aq}$ , and easily sol. in aqua regia. (Struve.)

Insol. in ammonium citrate +  $\text{Aq}$ ; sl. sol. in  $\text{HCl}$ . (Dennis, J. Am. Chem. Soc. 1894, 16. 483.)

$\text{Fe}_3\text{P}$ . Slowly but completely sol. in  $\text{HCl}$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in hot conc.  $\text{H}_2\text{SO}_4$ , in  $\text{HNO}_3$ , and in aqua regia. (Freese, Pogg. 132. 225.)

Insol. in all acids except in a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Maronneau, C. R. 1900, 130. 657.)

$\text{Fe}_2\text{P}_3$ . Very slowly sol. in hot conc.  $\text{HCl} + \text{Aq}$ . 0.1 g. dissolves by 4 days' heating with  $\text{HCl} + \text{Aq}$ ; 0.3 g. dissolves in hot conc.  $\text{H}_2\text{SO}_4$  in  $1\frac{1}{2}$  hours; 0.4 g. in 2 hours in  $\text{HNO}_3 + \text{Aq}$ . Quite easily sol. in aqua regia on warming. (Freese.)

$\text{Fe}_3\text{P}_3$ . Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , and aqua regia. Sol. in potassium hypobromite solu-

tion. (Granger, Bull. Soc. 1896, (3) 15. 1086.)

$\text{Fe}_3\text{P}_2$ . Very slowly sol. in boiling  $\text{HCl} + \text{Aq}$ . Easily sol. in  $\text{HNO}_3$  or aqua regia. (Struve, J. B. 1860. 77.)

Mixture. (Freese, Pogg. 132. 225.)

Almost insol. in aqua regia. Sol. in fused alkali. (Granger.)

$\text{Fe}_2\text{P}$ . Nearly insol. in dil. acids; rapidly sol. in  $\text{HNO}_3$  or aqua regia; decomp. by conc.  $\text{HCl}$  or  $\text{KOH} + \text{Aq}$ . (Schneider, J. B. 1886. 2026.)

Of the nine iron phosphides described the constitution has been established for only two,  $\text{Fe}_3\text{P}$  and  $\text{Fe}_2\text{P}$ .

$\text{Fe}_2\text{P}$ . Sol. in conc.  $\text{HCl}$ .

$\text{Fe}_3\text{P}$ . Sol. in hot aqua regia. Insol. in other acids. (Le Chatelier, C. R. 1909, 149. 709.)

### Iron selenide, $\text{Fe}_3\text{Se}$ .

Not attacked by  $\text{HNO}_3$  or acetic acid. Sl. attacked by conc.  $\text{HCl}$ . Readily attacked by aqua regia. Sol. in  $\text{HF}$ . (Vigouroux, C. R. 1905, 141. 829.)

$\text{FeSe} + \text{zH}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Insol. in alkalies, or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Reeb, J. Pharm. (4) 9. 173.)

$\text{Fe}_2\text{Se}_3$ . Sol. in dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$  with evolution of  $\text{H}_2\text{Se}$ . Sol. in conc.  $\text{HNO}_3 + \text{Aq}$ . (Little, A. 112. 211.)

$\text{Fe}_3\text{Se}_4$ . Decomp. by fuming  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 130. 1711.)

$\text{Fe}_2\text{Se}_3$ . Decomp. by fuming  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 130. 1711.)

$\text{FeSe}_2$ . Insol. in conc.  $\text{HCl}$ ; decomp. by fuming  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 130. 1711.)

### Iron silicide, $\text{Fe}_3\text{Si}$ .

Difficultly sol. in  $\text{HCl} + \text{Aq}$ ; easily sol. even in dil.  $\text{HF} + \text{Aq}$ . (Hahn, A. 129. 57.)

$\text{Fe}_2\text{Si}$ . Not easily sol. in conc.  $\text{HCl}$  and  $\text{HNO}_3$ , but readily sol. in  $\text{HF}$ . (Moissan, C. R. 1895, 121. 623.)

$\text{Fe}_3\text{Si}_2$ . Sol. in hot  $\text{HCl} + \text{Aq}$  only when most finely powdered. (Hahn.)

$\text{FeSi}_2$ . Not attacked by conc.  $\text{HF}$  or  $\text{H}_2\text{SO}_4$ . (Hahn.)

Sol. in cold  $\text{HF}$ . (de Chalmot, Am. Ch. J. 1897, 19. 123.)

Existence questioned by Jouve, (Bull. Soc. 1901, 25. 290-293.)

$\text{Fe}_2\text{Si}_2$ . Sol. in  $\text{HF}$  and in fused  $\text{KNO}_3$  and  $\text{KNaCO}_3$ . (de Chalmot, J. Am. Chem. Soc. 1895, 17. 924.)

### Iron semisulphide, $\text{Fe}_2\text{S}$ .

Sol. in dil. acids with decomposition. (Arfvedson, Pogg. 1. 72.)

### Ferrous sulphide, $\text{FeS}$ .

Decomp. by dil. acids, with evolution of  $\text{H}_2\text{S}$  and without separation of  $\text{S}$ , except with  $\text{HNO}_3 + \text{Aq}$ .

$+ \text{zH}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ , especially if hot. (Berzelius.)

1 l.  $\text{H}_2\text{O}$  dissolves  $70.1 \times 10^{-6}$  moles  $\text{FeS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Very violently decomp., even by dil. acids. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{H}_2\text{S}$ , or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sl. sol. in  $\text{Na}_2\text{S}$ , or  $\text{K}_2\text{S} + \text{Aq}$ . Sol. in  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq}$ . (de Koninck, Z. angew. Ch. 1891. 204.)

Insol. in  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Brett.) Not completely pptd. in presence of  $\text{Na}$  citrate. (Spiller.)

Contrary to assertion of Persoz, it can be nearly completely pptd. in presence of  $\text{Na}_4\text{P}_2\text{O}_7$  by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Rose, Pogg. 76. 18.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. 16. 2015.)

Sol. in  $\text{KCN} + \text{Aq}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Solubility of  $\text{FeS}$  in sugar solutions. 1 l. sugar of given strength dissolves mg.  $\text{FeS}$ .

% Sugar	mg. $\text{FeS}$		
	at $17.5^\circ$	at $45^\circ$	at $75^\circ$
10	3.8	3.8	5.3
30	7.1	9.1	7.2
50	9.9	19.8	9.1

(Stolle, Z. Ver. Zuckerind. 1900, 50. 300.)

*Colloidal*.—A very dilute solution has been obtained which coagulated very readily. (Winninger, Bull. Soc. (2) 49. 452.)

### Ferric sulphide, $\text{Fe}_2\text{S}_3$ .

Decomp. by dil.  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  with evolution of  $\text{H}_2\text{S}$ , leaving a residue of  $\text{FeS}$ .

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in alcoholic ammonia. Sl. sol. in  $(\text{NH}_4)_2\text{S} + \text{very dil. Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Phipson, C. N. 30. 139.)

### Iron disulphide, $\text{FeS}_2$ .

Insol. in dil.  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Decomp. by  $\text{HNO}_3$ , or aqua regia with separation of  $\text{S}$ . Insol. in a 10% solution of alkali sulphide.

Min. *Pyrite*, *Marcasite*. Sol. in a mixture of  $\text{Na}_2\text{S}$  and  $\text{NaOH} + \text{Aq}$ ,  $\text{Na}_2\text{S} + \text{Aq}$ , or mixture of  $\text{Na}_2\text{S}$  and  $\text{NaSH} + \text{Aq}$ ; insol. in cold  $\text{NaSH} + \text{Aq}$ . Marcasite is more easily sol. in above than pyrite. (Becker, Sill. Am. J. (3) 33. 199.)

### Ferroferric sulphide, $\text{Fe}_3\text{S}_4$ , or $\text{Fe}_2\text{S}_3$ .

Min. *Pyrrhotite*. Sol. in dil. acids with a residue of  $\text{S}$ . Extremely slowly sol. in a 10% solution of alkali sulphides. (Terrell, C. R. 69. 1360.)

**Iron (ferrous) nickel sulphide,  $2\text{FeS}, \text{NiS}$ .**

*Min. Pentlandite.*

**Ferrous phosphorus sulphide,  $\text{FeS}, \text{P}_2\text{S}_3$ .**

(Berzelius.)

$2\text{FeS}, \text{P}_2\text{S}_3$ . Slowly decomp. by  $\text{H}_2\text{O}$ . Insol. in boiling  $\text{HCl} + \text{Aq}$ ; decomp. by aqua regia. (Berzelius, A. 46. 256.)

**Iron potassium sulphide (potassium sulphoferrite),  $\text{K}_2\text{Fe}_2\text{S}_4 = \text{K}_2\text{S}, \text{Fe}_2\text{S}_3$ .**

Insol. in cold or hot  $\text{H}_2\text{O}$ . Violently attacked by dil. acids. Not decomp. by boiling with alkalis, alkali carbonates, or sulphides + Aq. Decomp. by  $\text{KCN}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Preis, J. pr. 107. 16.)

$\text{K}_2\text{S}, 2\text{FeS}$ . (Schneider, Pogg. 136. 460.)

**Iron silver sulphide (silver sulphoferrite),  $\text{Ag}_2\text{S}, \text{Fe}_2\text{S}_3$ .**

Not attacked by dil.  $\text{HCl} + \text{Aq}$ ; decomp. by conc.  $\text{HCl} + \text{Aq}$ . (Schneider.)

$2\text{Ag}_2\text{S}, \text{FeS}_2$ . (Schneider, Pogg. 136. 305.)

$\text{Ag}_2\text{S}, 3\text{FeS}, \text{FeS}_2$ . *Min. Sternbergite*. Decomp. by aqua regia.

**Iron sodium sulphide (sodium sulphoferrite),  $\text{Na}_2\text{Fe}_2\text{S}_4 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by very dil. acids. (Schneider, Pogg. 136. 302.)

**Iron sulphophosphide,  $\text{Fe}_2\text{PS}_3$ .**

Attacked by acids at  $100^\circ$ . Decomp. by boiling  $\text{NaOH} + \text{Aq}$ . (Ferrand, A. ch. 1899, (7) 17. 410.)

**Ferrous telluride,  $\text{FeTe}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Fabre, C. R. 106. 277.)

**Kermes.**

See Antimony trisulphide.

**"Knallplatin" compounds.**

See Fulminoplatinum compounds.

**Krypton, Kr.**

Absorption by  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Coefficient of absorption det. by two series of experiments	
0	0.1249	0.1166
10	0.0965	0.0877
20	0.0788	0.0670
30	0.0762	0.0597
40	0.0740	0.0561
50	0.0823	0.0610

(Antropoff, Roy. Soc. Proc. 1910, 83. A. 480.)

**Lanthanic acid.**

**Barium metalanthanate,  $\text{Ba}(\text{H}_2\text{La}_2\text{O}_{11})_2$ .**

(Baskerville, J. Am. Chem. Soc. 1904, 26. 79.)

**Lithium metalanthanate,  $\text{LiH}_2\text{La}_2\text{O}_{11} + 2\text{H}_2\text{O}$ .**  
(Baskerville.)

**Potassium metalanthanate,  $\text{KH}_2\text{La}_2\text{O}_{11} + 15\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Baskerville.)

**Sodium metalanthanate,  $\text{NaH}_2\text{La}_2\text{O}_{11} + 4\text{H}_2\text{O}$ .**

Almost insol. in  $\text{H}_2\text{O}$ , but decomp. by it. (Baskerville.)

**Disodium tetralanthanate,  $\text{Na}_4\text{La}_4\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ . (Baskerville.)

**Lanthanicotungstic acid.**

**Ammonium lanthanicotungstate,  $2(\text{NH}_4)_2\text{O}, \text{La}_2\text{O}_3, 16\text{WO}_3 + 16\text{H}_2\text{O}$ .**

Ppt. Insol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1904, 26. 1481.)

**Barium lanthanicotungstate,  $5\text{BaO}, \text{La}_2\text{O}_3, 16\text{WO}_3 + 16\text{H}_2\text{O}$ .**

Ppt. (E. F. Smith.)

**Silver lanthanicotungstate,  $5\text{Ag}_2\text{O}, \text{La}_2\text{O}_3, 16\text{WO}_3 + 4\text{H}_2\text{O}$ .**

Very insol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Lanthanum, La.**

Slowly decomp. cold, rapidly hot  $\text{H}_2\text{O}$ . Not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , but energetically by cold conc.  $\text{HNO}_3 + \text{Aq}$ . Sol. in dil. acids. (Hillebrand and Norton, Pogg. 155. 633.)

**Lanthanum bromide,  $\text{LaBr}_3 + 7\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Not very sol. in absolute alcohol. Insol. in ether. (Cleve, Sv. V. A. H. Bih. 2. No. 7.)

**Lanthanum nickel bromide,  $2\text{LaBr}_3, 3\text{NiBr}_3 + 18\text{H}_2\text{O}$ .**

Deliquescent. (Frerichs and Smith, A. 191. 355.)

**Lanthanum zinc bromide,  $2\text{LaBr}_3, 3\text{ZnBr}_3 + 36\text{H}_2\text{O}$ .**

Very deliquescent. (F. and S.)

**Lanthanum carbide,  $\text{LaC}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Pettersson, B. 1895, 23. 2422.)

Sol. in conc.  $\text{H}_2\text{SO}_4$  and dil. acids; insol. in conc.  $\text{HNO}_3$ .

Sol. in fused oxidizing agents; decomp. by  $H_2O$  at ordinary temps. (Moissan, C. R. 1890, 123. 149.)

**Lanthanum chloride,  $LaCl_3$ .**

Anhydrous. Deliquescent. (Hermann.)

Insol. in acetone. (Naumann, B. 1904, 37. 329.)

+ $7\frac{1}{2}H_2O$ . Not deliquescent. (Zschiesche.)

Easily sol. in alcohol. (Hermann.)

**Lanthanum mercuric chloride,  $2LaCl_3, HgCl_2, +\frac{1}{2}H_2O$ .**

Not deliquescent. Very sol. in  $H_2O$ . (Marignac, Ann. Min. (5) 15. 272.)

**Lanthanum stannic chloride.**

See Chlorostannate, lanthanum.

**Lanthanum fluoride,  $LaF_3, +H_2O$ .**

Precipitate. Sl. sol. in  $HCl + Aq$ . (Cleve.)

**Lanthanum hydrogen fluoride,  $2LaF_3, 3HF$ .**

Precipitate. (Frerichs and Smith, A. 191. 355.)

Does not exist. (Cleve, B. 11. 910.)

**Lanthanum hydride,  $La_3H_3$ .**

Decomp. by dil. acids. (Winkler, B. 24. 1966.)

$LaH_3$ . Decomp. by  $H_2O$ . Sol. in acids with evolution of  $H_2$ . Decomp. by alkalis. (Muthmann, A. 1902, 325. 266.)

**Lanthanum hydroxide,  $La_2O_3H_3$ .**

Insol. in  $H_2O$ ; easily sol. in acids; insol. in  $KOH$ , or  $NaOH + Aq$ .

Sol. in citric acid. (Baskerville, J. Am. Chem. Soc. 1904, 26. 49.)

**Lanthanum zinc iodide,  $2LaI_3, 3ZnI_2, +27H_2O$ .**

Very sol. in  $H_2O$ . (Frerichs and Smith, A. 191. 358.)

**Lanthanum nitride,  $LaN$ .**

Decomp. by  $H_2O$  with evolution of  $NH_3$ .

Sol. in mineral acids. Decomp. by alkali. (Muthmann, A. 1902, 325. 275.)

**Lanthanum oxide,  $La_2O_3$ .**

Easily sol., even when ignited, in mineral and acetic acids. (Hermann.)

Sol. in boiling conc.  $NH_4Cl + Aq$ . (Mosander.)

Sol. in cold conc.  $NH_4NO_3 + Aq$ . (Damour and Deville.)

Insol. in  $(NH_4)_2CO_3 + Aq$ . (Mosander.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Lanthanum peroxide,  $La_2O_5$ .**

Sol. in  $HCl, H_2SO_4, HNO_3$ , and  $H_2C_2O_4 + Aq$  with decomp. (Cleve, Bull. Soc. (2) 43. 359.)

$La_2O_5 + xH_2O$ . Unstable. Sol. in dil.  $H_2SO_4 + Aq$  with decomp. (Melikoff, Z. anorg. 1899, 21. 71.)

**Lanthanum oxybromide,  $LaOBr$ .**

Ppt. (Frerichs and Smith.)

**Lanthanum oxychloride,  $3La_2O_3, 2LaCl_3$ .**

Insol. in  $H_2O$ . Difficultly and slowly sol. in  $HCl$ , or  $HNO_3 + Aq$ . (Hermann.)

$LaOCl$ . Boiling  $H_2O$  dissolves only traces. (Frerichs and Smith.)

**Lanthanum sulphide,  $La_2S_3$ .**

Decomp. by  $H_2O$  and acids. (Didier.)

**Lanthanum disulphide,  $LaS_2$ .**

Decomp. by heat. (Biltz, Z. anorg. 1911, 71. 435.)

**Lead, Pb.**

Lead, in contact with  $H_2O$  and air free from  $CO_2$ , gives a solution of  $PbO$  which turns litmus blue and turmeric red, and is turned brown with  $H_2S$ .

$H_2O$  which has been boiled does not dissolve Pb if there is no access of air. When shaken up with air it dissolves 0.01 to 0.008%  $PbO$  in 2 hours. Pure spring water, containing  $1\frac{1}{2}$  grains salts in 2 pounds  $H_2O$  and no  $CO_2$ , when conducted through a lead pipe 150 feet long, dissolves so much lead that it turns brown with  $H_2S$ . (Yorke, Phil. Mag. J. 5. 82.)

$CO_2$  or small amts. of salts prevent the solution of Pb. 1 vol.  $H_2O$  with  $\frac{1}{4}$  vol.  $CO_2$  dissolves only a trace of Pb. Spring  $H_2O$ , containing in 10 pounds 1.21 grains  $NaCl$  and  $CaCl_2$ , and 6.4 grains  $CaCO_3$  dissolved in  $CO_2$ , does not dissolve lead. (Yorke.)

If the amt. of salts in solution equals  $\frac{1}{100}$  the amt. of  $H_2O$ , and especially if they are carbonates, very slight amts. of Pb are dissolved. (Christison, Phil. Mag. J. 21. 158.)

$CaCO_3$  dissolved in  $CO_2$  water decreases the solubility of Pb more than any other salt.

Distilled  $H_2O$ , quietly standing in a closed flask with lead and air free from  $CO_2$ , deposits white flocks of  $PbO_2H_2$ , and dissolves  $\frac{1}{100}$  pt.  $PbO$ . The solution has an alkaline reaction. (v. Bonsdorff, Pogg. 41. 305.)

Water of  $3^\circ$  hardness does not take up enough Pb to become injurious. (Clarke, J. B. 1866. 608.)

Soluble carbonates increase the solubility of Pb in  $H_2O$  (Nevins, C. C. 1851. 608); especially  $(NH_4)_2CO_3$ . (Böttger.)

Presence of  $H_2SO_4$  decreases the solubility of Pb. (Hornford, Chem. Gaz. 1849. 247.)

$H_2O$  containing  $K_2SO_4$  takes up only a trace of Pb. (Wetzlar, Schw. J. 54. 324.)

Presence of sulphates diminishes (Christison), does not diminish (Graham, Miller, and Hoffmann), the action of  $H_2O$  on Pb.

$CaSO_4$  protects Pb, but it is attacked by much  $MgSO_4$ . (Nevins.)

$NaCl + Aq$  dissolves only a trace of Pb.

100 pt. of a chloride in  $H_2O$  is not sufficient to prevent the solubility of Pb in  $H_2O$ . (Christison.)

Presence of chlorides increases the solubility. (Graham, Miller, and Hoffmann; Nevins.)

$H_2O$  containing  $KNO_3$  does not corrode Pb.

Nitrates hinder the action of  $H_2O$ . (v. Bonsdorff.)

Nitrates increase the action of  $H_2O$ . (Graham, Miller, and Hoffmann.) Nitrates have no influence. (Kersting.)

10 lbs. of  $H_2O$  dissolved the following amts. from Pb pipes in 24 hours: if distilled  $H_2O + 1\%$   $Na_2CO_3$ , 0.38 grain Pb; if Duna water, 0.19 grain Pb; if canal water, 0.15 grain Pb; if distilled  $H_2O + 1\%$   $NH_4NO_3$ , 0.15 grain Pb; if hard well water, 0.04 grain Pb; if distilled  $H_2O + 1\%$   $KNO_3$ , 0.01 grain Pb. (Kersting, Dingl. 169. 183.)

200 l. Manchester drinking water dissolved 2.094 g. from 1 sq. metre Pb in 8 weeks; 9 l. well water dissolved 1.477 g. from 1 sq. metre Pb in 8 weeks; 11 l. distilled  $H_2O$  containing



are dissolved 110.003 g. from 1 sq. metre Pb in 8 weeks; distilled  $H_2O$  free from air dissolved 1.829 g. from 1 sq. metre Pb in 8 weeks; sea water dissolved 0.038 g. from 1 sq. metre Pb in 8 weeks. (Calvert and Johnson, C. N. 16. 171.)

A lead pipe taken up in Paris, which had been exposed to action of ordinary  $H_2O$  for 200 years, was found perfectly smooth and uncorroded. (Belgrand, C. R. 77. 1055.)

Pb is attacked by all waters, hard or soft; even highly calcareous water dissolves some lead. (Mayençon and Bergeret, C. R. 78. 484.)

Pure distilled  $H_2O$  does not act on Pb, but extremely small quantities of  $NH_3$ ,  $HNO_3$ , etc. cause an action; but for this action on Pb the presence of air and  $CO_2$  is also required. (Stallman, Dingl. 180. 366.)

100 ccm. distilled  $H_2O$  dissolved 3 mg. from 11.8 sq. cm. lead in one week when air without  $CO_2$  was passed through the solution. 8 mg. were dissolved when the air contained  $CO_2$ . (Wagner, Dingl. 221. 260.)

Action of dil. salt solutions on lead. In 500 ccm. of the solutions containing salt, bright sheets of lead of 5600 sq. metres' surface were so suspended that the liquid reached all parts of the metal without hindrance, and the amts. dissolved determined after 24, 48, and 72 hours of action.

Salt	Grammes salt per litre	Dissolved Pb in mg. per litre		
		after 24	48	72 hrs.
$NH_4NO_3$	0.020	13.0	...	25
"	0.040	15.0	...	32
"	0.080	15.0	...	...
$\{ KNO_3 +$	$\{ 0.020$			
$\{ NaNO_3$	$\{ 0.050$	2.0	2.0	...
$\{ KNO_3 +$	$\{ 0.040$			
$\{ Na_2SO_4$	$\{ 0.212$	0.8	1.0	...
$\{ KNO_3 +$	$\{ 0.045$			
$\{ K_2CO_3$	$\{ 0.308$	...	...	0.3
$\{ KNO_3 +$	$\{ 0.070$			
$\{ K_2SO_4$	$\{ 0.504$	...	...	0.5
$\{ CaSO_4$	$\{ 0.252$	0.4	...	0.8
	0.408	0.4	1.0	...
$K_2CO_3$	0.310	...	...	0.2
"	0.516	...	...	0.2
$CaCl_2$	0.250	0.5	0.5	0.5
"	0.510	0.3	...	0.4
$Na_2SO_4$	0.200	...	...	0.8
"	0.400	...	...	0.5
$\{ NH_4NO_3 +$	$\{ 0.020$			
$\{ CaCl_2$	$\{ 0.080$	...	...	1.8
$\{ NH_4NO_3 +$	$\{ 0.020$			
$\{ K_2CO_3 +$	$\{ 0.100$	...	...	0.4
$\{ Na_2SO_4$	$\{ 0.200$			
$\{ Na_2SO_4 +$	$\{ 0.200$			
$\{ K_2CO_3 +$	$\{ 0.040$	...	...	0.1
$\{ CaCl_2$	$\{ 0.100$			
Water from L. Katrine		1.0	1.0	1.5
Distilled water		2.0	2.0	3.0

(Muir, C. N. 25. 294.)

Action of salt solutions on 11.8 sq. cm. Pb in one week while air either with or without  $CO_2$  was passed through the solution. Solubility of Pb in salt solutions.

100 ccm. solutions containing the given amts. salts dissolve Pb in mg.:—

Salt	g. salt in 100 ccm.	mg. Pb dissolved	
		without $CO_2$	with $CO_2$
KCl	0.5	21	12
NaCl	0.5	21	12
$NH_4Cl$	1.0	12	5
$MgCl_2$	0.83	20	35
$K_2SO_4$	1.0	0	0
$KNO_3$	1.0	14	20
$Na_2CO_3$	1.0	0	..
NaOH	0.923	430	..
$CaO \cdot H_2$	Saturated	137	..

(Wagner, Dingl. 221. 260.)

Solubility of Pb in salt solutions.

25 sq. cm. were acted upon by a solution containing 0.2 g. salt in a litre for 21 days.

Three series of experiments were carried on. I. In corked flasks. II. In beakers covered with porous paper; diameter of mouth of beaker = 11.5 cm. III. In basins covered with porous paper; diameter of mouth of basin = 14.5 cm. IV. In corked flasks with constant current of air. V. In beakers half filled and covered with porous paper, the lead being suspended so that equal amts. of surface were above and beneath the liquid.

The amts. in mgs. of Pb dissolved were as follows:—

Salt used	I.	II.	III.	IV.	V.
$NH_4NO_3$	1.8	4.0	16.0	...	...
$KNO_3$	1.6	0.5	6.0	1.5	...
$CaCl_2$	3.0	2.8	5.5	3.5	3.5
$(NH_4)_2SO_4$	0.7	1.3	16.0	5.0	2.5
$K_2CO_3$	0.3	0.3	0.7	0.6	0.3
Dist. $H_2O$	1.5	0.8	4.2	2.0	...

(Muir, Chem. Soc. 36. 660.)

$H_2O$  sat. with  $CO_2$  dissolves 0.012 g. Pb to a litre in 3 days. (Marais, C. R. 77. 1529.)

Action of  $H_2O$  charged with  $CO_2$  under 760 mm. pressure on Pb. 3 mg. of Pb were dissolved per litre in 24 hours, and the amt. was not increased by further action. The addition of 100 mg.  $K_2CO_3$  + 20 mg.  $NH_4NO_3$  to a litre prevented all action.

Action of  $H_2O$  charged with  $CO_2$  under 6 atmos. pressure on Pb.

14.8 mg. were dissolved per l. in 24 hours, and 24 mg. per l. in 48 hours.

Action of various salt solutions added to above solution of  $CO_2$  were as follows:—

	mg. salt per l.	mg. Pb dissolved	
		after 24 hrs.	after 48 hrs.
K <sub>2</sub> CO <sub>3</sub> . . . .	80	13.2	32.0
K <sub>2</sub> CO <sub>3</sub> . . . .	160	....	6.0
CaCl <sub>2</sub> . . . .	160	32.0	44.0
NH <sub>4</sub> NO <sub>3</sub> . . . .	16	5.0	....
NH <sub>4</sub> NO <sub>3</sub> . . . .	40	10.0	35.0
Distilled H <sub>2</sub> O . . . .	...	14.8	24.0

(Muir, C. N. 33. 125.)

The corrosion of Pb by ordinary distilled H<sub>2</sub>O depends upon the presence of CO<sub>2</sub> and O. If the dissolved CO<sub>2</sub> is double the amt. of the dissolved O, the action is most energetic. When CO<sub>2</sub> is wholly absent and O present, the action is very slight, and when the H<sub>2</sub>O contains 1½ or more vol. % CO<sub>2</sub> with normal amt. of oxygen, there is no visible corrosion. Pure distilled H<sub>2</sub>O containing neither O nor CO<sub>2</sub> has no action on Pb. In the above cases the greater part of the Pb remains in the form of a white ppt. or crust on the Pb, but in the case where O and CO<sub>2</sub> are both present in the ratio of 1 : 2, very small amts. of Pb go into solution in a few days; the amt., however, diminishes on standing. As the amt. of CO<sub>2</sub> increases, the amt. of Pb dissolved in the H<sub>2</sub>O also increases.

NH<sub>4</sub>OH alone does not protect Pb from corrosion, but when in combination with CO<sub>2</sub> the action is much diminished.

CaO, H<sub>2</sub>, and NaOH + Aq attack Pb much more actively in absence of CO<sub>2</sub> and presence of air. In absence of dissolved O neither CaO, H<sub>2</sub>, nor NaOH attacks Pb.

Na<sub>2</sub>CO<sub>3</sub> + Aq in absence of CO<sub>2</sub> attacks Pb slightly, but NaHCO<sub>3</sub> + Aq has not the slightest action.

CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub> + Aq also has not the slightest action on Pb, and the presence of CaCO<sub>3</sub> and CO<sub>2</sub> wholly prevents H<sub>2</sub>O attacking Pb.

CaSO<sub>4</sub> + Aq in presence of air forms a crust on Pb, but no Pb is found in solution, but if air is excluded there is no visible action. Presence of CO<sub>2</sub> causes a strong corrosive action.

H<sub>2</sub>O containing CaSO<sub>4</sub> and CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub> does not attack Pb.

The above reactions are not in the least altered by the presence of moderate amts. of nitrates, chlorides, or ammonium, or organic compounds; but ammonium salts in excess have a strong solvent action on Pb. (Muller, J. pr. (2) 36. 317.)

See also an extended report of the action of H<sub>2</sub>O on Pb made to the Water Committee of Huddersfield, England, in 1886, by Messrs. Crookes, Odling, and Tidy.

Very extended researches are published by Cornelley and Frew (Jour. Soc. Chem. Ind. 7. 15), of which only the general conclusions can be given here.

The action of slaked lime, limestone, sand calcium silicate, mortar, etc., was tested. The results were as follows:—

1. In nearly all cases the corrosion is greater with free exposure to the air than when air is excluded. The difference is especially great in those cases where the greatest action on the lead takes place. Aluminum hydroxide and blue clay form exceptions, and exert a greater corrosive action when air is excluded. In the case of CaCO<sub>3</sub>, old mortar, CaSiO<sub>3</sub>, or a mixture of CaCO<sub>3</sub> and CaO, H<sub>2</sub>, the exclusion or presence of air makes no appreciable difference.

KNO<sub>3</sub> + Aq shows a peculiar behaviour. In the presence of air it acts nearly as much on the Pb as pure H<sub>2</sub>O, but when air is excluded it exerts nearly as much retarding action as CaSiO<sub>3</sub>.

2. In the presence of air the action of H<sub>2</sub>O on Pb is considerably increased by the presence of NH<sub>4</sub>NO<sub>3</sub> or CaO, H<sub>2</sub>; with exclusion of air, by CaSO<sub>4</sub>, also by a mixture of CaO, H<sub>2</sub>, and sand. All the other investigated substances, even KNO<sub>3</sub>, hinder the action of H<sub>2</sub>O on Pb either with or without exclusion of air.

3. CaO, H<sub>2</sub> + Aq exerts in all cases a much greater corrosive action than pure H<sub>2</sub>O, and although this action is diminished by sand yet fresh mortar very quickly destroys lead pipes when in contact therewith. Old mortar, on the other hand, and also CaSiO<sub>3</sub> and CaCO<sub>3</sub>, have a protective action.

4. The fact is very important that sand, CaCO<sub>3</sub>, old mortar, CaSiO<sub>3</sub>, and a mixture of sand and CaCO<sub>3</sub> afford considerable protection to lead against H<sub>2</sub>O. A mixture of limestone and sandstone has more effect than the two substances separately.

5. CaSiO<sub>3</sub> totally prevents the corrosive action of KNO<sub>3</sub> and NH<sub>4</sub>NO<sub>3</sub>, so that the lead is not attacked by solutions of those salts any more than by H<sub>2</sub>O containing CaSiO<sub>3</sub> alone. Sand, and a mixture of sand and CaCO<sub>3</sub> have a similar effect, but not to such a degree.

6. The protective influence of CaCO<sub>3</sub> does not appear to depend on the presence of CO<sub>2</sub> and the formation of CaH<sub>2</sub>(CO<sub>3</sub>)<sub>2</sub>.

7. MgCO<sub>3</sub> prevents the corrosion of Pb as much as CaSiO<sub>3</sub>. (Carnelley and Frew, Jour. Soc. Chem. Ind. 7. 15.)

Pb in contact with Zn or Fe is protected thereby from the solvent action of H<sub>2</sub>O, and in fact the action is nearly null. Sn, on the other hand, increases the action. This is of importance in regard to the use of tin-coated lead pipes.

The presence of Ca salts does not influence the action of the H<sub>2</sub>O on Pb, hard or soft H<sub>2</sub>O provided it contains CO<sub>2</sub> having a strong corrosive action. Removal of air from H<sub>2</sub>O diminishes the solvent action. Simple filtration will remove all Pb from H<sub>2</sub>O if suitable filters are used. (Flögel, J. B. 1888. 2645.)

**Lead hydrogen bromide**,  $5\text{PbBr}_2$ ,  $2\text{HBr} + 10\text{H}_2\text{O}$ .

Sol. in  $\text{HBr} + \text{Aq.}$  (Ditte, C. R. **92**, 718.)

**Lead magnesium bromide**,  $\text{PbBr}_2$ ,  $2\text{MgBr}_2 + 16\text{H}_2\text{O}$ .

Very deliquescent. Decomp. immediately by  $\text{H}_2\text{O}$  or alcohol. (Otto and Drewes, Arch. Pharm. **229**, 585.)

**Lead potassium bromide (potassium bromoplumbite)**,  $\text{PbBr}_2$ ,  $\text{KBr} + \text{H}_2\text{O}$ .

(Remsen and Herty, Am. Ch. J. **14**, 124.)

$+\text{H}_2\text{O}$ . (Wells, Sill. Am. J. **145**, 129.)

$\text{PbBr}_2$ ,  $2\text{KBr}$ . Sol. in a little  $\text{H}_2\text{O}$  without decomp., but decomp. by an excess with separation of  $\text{PbBr}_2$ . (Lowig.)

$+\text{H}_2\text{O}$ . (Wells, Sill. Am. J. **145**, 129.)

$2\text{PbBr}_2$ ,  $\text{KBr}$ . (Wells.)

**Lead potassium perbromide**,  $\text{K}_2\text{Pb}_2\text{Br}_8 + 4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Wells, Z. anorg. **4**, 340.)

**Lead rubidium bromide**,  $\text{PbBr}_2$ ,  $2\text{RbBr} + \frac{1}{2}\text{H}_2\text{O}$ .

(Wells, Sill. Am. J. **146**, 34.)

$2\text{PbBr}_2$ ,  $\text{RbBr}$ . (Wells.)

**Lead sodium bromide.**

Decomp. by  $\text{H}_2\text{O}$ . (Lowig.)

**Lead bromochloride**,  $\text{PbBrCl} = \text{PbBr}_2$ ,  $\text{PbCl}_2$ .

Can be recrystallised from  $\text{H}_2\text{O}$  without decomp. (Iles, C. N. **43**, 216.)

$3\text{PbCl}_2$ ,  $\text{PbBr}_2$ . Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in  $\text{HCl}$  and in  $\text{HBr}$ . Insol. in cold alcohol; sl. sol. in boiling alcohol. (Thomas, C. R. **1899**, **128**, 1235.)

**Lead bromiodide**,  $\text{PbBrI} = \text{PbBr}_2$ ,  $\text{PbI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from a solution of  $\text{PbI}_2$  in  $\text{HBr}$ . (Grissom and Thorp, Am. Ch. J. **10**, 229.)

$3\text{PbBr}_2$ ,  $\text{PbI}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Thomas, C. R. **1899**, **128**, 1236.)

$6\text{PbBr}_2$ ,  $\text{PbI}_2$ . (G. and T.)

**Lead bromosulphide**,  $\text{PbBr}_2$ ,  $\text{PbS}$ .

Properties as chlorosulphide. (Parmentier.)

**Lead chloride**,  $\text{PbCl}_2$ .

Slowly sol. in 135 pts.  $\text{H}_2\text{O}$  at  $12.5^\circ$ , and in a much smaller quantity of hot  $\text{H}_2\text{O}$ . (Bischof.)

Sol. in 30 pts. cold, and 22 pts. hot  $\text{H}_2\text{O}$ . (Wittstein.)

Sol. in 30 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abl.)

100 pts.  $\text{H}_2\text{O}$  dissolve 4.59 pts.  $\text{PbCl}_2$  at  $15.5^\circ$ . (Ure's Diet.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.9712 pt.  $\text{PbCl}_2$  at  $20^\circ$ . (Formánek, C. C. **1887**, 270.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.946 pt.  $\text{PbCl}_2$  at  $17.7^\circ$ . (Bell, Chem. Soc. (2) **6**, 355.)

Sol. in 105.2 pts.  $\text{H}_2\text{O}$  at  $16.5^\circ$ . (Bell, C. N. **16**, 69.)

100 pts.  $\text{H}_2\text{O}$  dissolve 0.8 pt.  $\text{PbCl}_2$  at  $0^\circ$ ; 1.18 pts. at  $20^\circ$ ; 1.7 pts. at  $40^\circ$ ; 2.1 pts. at  $55^\circ$ ; 3.1 pts. at  $80^\circ$ . (Ditte, C. R. **92**, 718.)

1 l.  $\text{H}_2\text{O}$  dissolves 38.80 millimols.  $\text{PbCl}_2$  at  $25.2^\circ$ . (von Ende, Z. anorg. **1901**, **26**, 148.)

9.61 x  $10^{-1}$  gram are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Eöttger, Z. phys. ch. **1903**, **46**, 603.)

#### Solubility in $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{PbCl}_2$  at  $t^\circ$ .

$t^\circ$	G. $\text{PbCl}_2$
0	0.6728
15	0.9090
25	1.0842
35	1.3244
45	1.5673
55	1.8263
65	2.1265
80	2.6224
95	3.1654
* 100	3.3420

\* By extrapolation.

(Lichty, J. Am. Chem. Soc. **1903**, **25**, 474.)

33.6 millimols.  $\text{Pb}$  are dissolved in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. **1907**, **II**, 1056.)

1 l.  $\text{H}_2\text{O}$  dissolves 77.76 milliequivalents  $\text{PbCl}_2$  at  $25^\circ$ . Sp. gr. of the solution  $25^\circ/4^\circ = 1.0069$ . (Harkins and Winninghoff, J. Am. Chem. Soc. **1911**, **33**, 1816.)

0.0388 mol. mg.  $\text{PbCl}_2$  are sol. in 1 l.  $\text{H}_2\text{O}$ . (Kernot and Pomilio, Soc. R. Napoli, **1912**, (3), XVII, 353.)

A colloidal modification is sol. in hot water to give cryst. modification. (Van de Veide, Ch. Z. **1893**, **17**, 1908.)

Solubility in  $\text{H}_2\text{O}$  is not much increased by the addition of acids. (Fresenius.)

Sol. in conc.  $\text{HCl} + \text{Aq.}$  from which it is pptd. by  $\text{H}_2\text{O}$ , but less sol. in dil.  $\text{HCl} + \text{Aq.}$  than in  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in 1636 pts.  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Bischof.)

Sat. solution of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq.}$  of 1.116 sp. gr. contains 2.566%  $\text{PbCl}_2$  at  $16.5^\circ$ .

**Solubility in  $\text{HCl} + \text{Aq.}$**  100 pts. liquid containing pts.  $\text{HCl}$  of 1.1162 sp. gr. in 100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{PbCl}_2$  at  $17.7^\circ$ .

Pts. $\text{HCl}$	Pts. $\text{PbCl}_2$	Pts. $\text{HCl}$	Pts. $\text{PbCl}_2$	Pts. $\text{HCl}$	Pts. $\text{PbCl}_2$
1	0.347	8	0.099	50	0.356
2	0.201	9	0.096	60	0.559
3	0.165	10	0.093	70	0.933
4	0.145	15	0.090	80	1.498
5	0.131	20	0.111	90	2.117
6	0.107	30	0.151	100	2.900
7	0.100	40	0.216	..	...

(Bell, Chem. Soc. **21**, 350.)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl}$ .

Amt. $\text{HCl}$ in 100 pts. $\text{H}_2\text{O}$	Amount $\text{PbCl}_2$ dissolved in 1000 pts. of liquid				
	At 0°	At 20°	At 40°	At 55°	At 80°
0.0	8.0	11.8	17.0	21.0	31.0
5.6	2.8	3.0	4.6	6.5	12.4
10.0	1.2	1.4	3.2	5.5	12.0
18.0	2.4	4.8	7.2	9.8	19.8
21.9	4.7	6.2	10.4	12.9	23.8
31.5	11.9	14.1	19.0	24.0	38.0
46.0	29.8	30.0	....	....	....

(Ditte, C. R. 92. 718.)

Solubility in  $\text{HCl} + \text{Aq}$  at 0°.  $\frac{\text{PbCl}_2}{2} = \frac{1}{2}$  mols. $\text{PbCl}_2$  in mgs. in 10 cc. solution;  $\text{HCl} =$   
mols.  $\text{HCl}$  in ditto.

$\frac{\text{PbCl}_2}{2}$	$\text{HCl}$	$\frac{\text{PbCl}_2}{2}$	$\text{HCl}$
0.42	0.	0.072	5.8
0.22	0.35	0.088	11.7
0.135	0.675	0.100	29.5
0.11	1.125	0.209	46.7
0.105	1.6	0.95	73.5
0.099	2.3	1.5	89.0
0.090	3.4	1.9	96.0
0.08	4.5	3.01	111.5

It is seen that very little  $\text{HCl} + \text{Aq}$  is sufficient to diminish solubility very considerably, and, that on further addition of  $\text{HCl} + \text{Aq}$ , the solubility is nearly constant, and increases finally very much when large amts. of  $\text{HCl} + \text{Aq}$  are present. (Engel, A. ch. (6) 17. 359.)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq}$  at 25°.

G. $\text{HCl}$ per l.	G. $\text{PbCl}_2$ per l.	G. $\text{HCl}$ per l.	G. $\text{PbCl}_2$ per l.
0	10.79	3	5.0
0.5	9.0	6	3.1
1.	7.6	10	1.8
2.	6.0		

(Noyes, Z. phys. Ch. 1892, 9. 623.)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl} + \text{Aq}$  at 25.20°.  
 $S =$  solubility in millimols per litre.

$\text{HCl}$ normal	$S$	$\text{HCl}$ normal	$S$
0.0000	38.80	0.3714	6.35
0.0009	38.66	0.5142	5.37
0.0022	38.20	0.7386	4.73
0.0030	37.94	1.026	4.41
0.0045	37.35	1.538	4.61
0.0091	35.80	2.051	5.18
0.0114	34.99	2.564	6.25
0.0151	33.75	3.065	7.78
0.0226	31.46	3.718	8.16
0.0302	29.32	5.0	19.38
0.0452	25.46	7.5	65.86
0.0910	17.12	10.0	141.35
0.1850	10.12	12.05	164.3

(von Ende, Z. anorg. 1901, 26. 148.)

Solubility of  $\text{PbCl}_2$  in  $\text{HCl}$  at 18°.

$\text{HCl}$ Normality	G. $\text{PbCl}_2$ per l.
0	9.34
0.0001	9.305
0.0002	9.300
0.0005	9.243
0.00102	9.200
0.0102	8.504

(Pleissner, Arb. Kais. Gesundamt. 1907, 26. 384.)

Sol. in hot, insol. in cold conc.  $\text{H}_2\text{SO}_4$ . (Hayes.)Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , from which it is pptd. by  $\text{HCl} + \text{Aq}$ . (Gladstone.)Easily and completely decomp. by hot  $\text{HNO}_3 + \text{Aq}$ . (Wurtz.)Solubility of  $\text{PbCl}_2$  in  $\text{HNO}_3 + \text{Aq}$  at 25.2°. $S =$  solubility in millimols per litre.

$\text{HNO}_3$ normal	$S$
0.001	38.87
0.01	39.71
0.051	42.92
0.04 $\text{KNO}_3 +$	
0.01 $\text{HNO}_3$	43.36

(von Ende, Z. anorg. 1901, 26. 162.)

Solubility of  $\text{PbCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at 25.20°.  
 $S =$  solubility in millimols per litre.

$\text{NH}_4\text{Cl}$ normal	$S$
0.25	9.47
0.50	7.11
1.0	4.35

(von Ende, Z. anorg. 1901, 26. 152.)

Solubility of  $\text{PbCl}_2 + \text{NH}_4\text{Cl}$  at 22°.

G. equiv. per l. $\text{H}_2\text{O}$ $\text{NH}_4\text{Cl}$	G. equiv. per 100 cc. $\text{H}_2\text{O}$ $\text{PbCl}_2$	G. equiv. per l. $\text{H}_2\text{O}$ $\text{NH}_4\text{Cl}$	G. equiv. per 100 cc. $\text{H}_2\text{O}$ $\text{PbCl}_2$
0.0	$7.49 \times 10^{-4}$	1.0	$0.758 \times 10^{-4}$
0.1	3.10	1.2	0.707
0.2	1.916	1.5	0.671
0.3	1.508	2.0	0.695
0.4	1.348	2.5	0.812
0.5	1.263	3.0	0.968
0.55	1.189	4.0	1.502
0.6	1.092	5.0	2.338
0.65	1.012	6.0	3.580
0.7	0.956	7.0	5.628
0.8	0.837	7.29*	6.46
0.9	0.793		

\* Saturated.

(Brønsted, Cong. Appl. Chem. 1909, Sec. X, 110.)

Solubility in $\text{NH}_4\text{Cl} + \text{Aq}$ at $t^\circ$ .				Much more sol. in $\text{HgCl}_2 + \text{Aq}$ than in $\text{H}_2\text{O}$ .					
$t^\circ$	G. $\text{PbCl}_2$ in 100 g. of the solution	G. $\text{NH}_4\text{Cl}$ in 100 g. of the solution	Solid phase	Grammes $\text{HgCl}_2$ in 100 ccm.	Grammes $\text{PbCl}_2$ dissolved	After subtracting amt. dissolved by $\text{H}_2\text{O}$ alone	Calculated no. of grammes for 100 g. $\text{HgCl}_2$		
17°	0.89	0.0	$\text{PbCl}_2$	0	0.9712	.....	...		
	0.21	0.96		4	1.8972	0.9350	23.37		
	0.16	1.43		2	1.4874	0.5208	26.04		
	0.14	2.40		1	1.2272	0.2600	26.00		
	0.076	3.48	eutectic-pt.	0.5	1.0808	0.1134	22.68		
	0.078	4.23		0.25	1.0192	0.0500	20.00		
	0.078	4.93	$2\text{PbCl}_2, \text{NH}_4\text{Cl}$	0.125	0.9926	0.0226	18.08		
	0.008	12.36		(Formánek, C. C. 1887. 270.)					
	0.34	22.33	eutectic-pt.	Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 20°.					
	0.64	26.49		G. equiv. per l.					
	0.52	26.68	$\text{NH}_4\text{Cl}$	$\text{Pb}(\text{NO}_3)_2$		$\text{PbCl}_2$			
	0.33	26.91		0.0		0.0777			
	0.30	27.03		0.2		0.0832			
	0.0	27.14		(Noyes, Z. phys. Ch. 1892, 9. 623.)					
50°	1.69	0.0	$\text{PbCl}_2$	Solubility in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°.					
	1.08	0.51		C = concentration of $\text{Pb}(\text{NO}_3)_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ expressed in milliequivalents per l.					
	0.67	1.45		$d_1$ = Sp. gr. of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°.					
	0.58	2.45		S = Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ expressed in milliequivalents per l.					
	0.48	4.86	eutectic pt.	$d_2$ = Sp. gr. 25°/4° of $\text{PbCl}_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$ .					
	0.49	12.45		C	$d_1$	S	$d_2$		
	0.71	19.42	$2\text{PbCl}_2, \text{NH}_4\text{Cl}$	20.020	1.0008	76.75	1.0095		
	1.76	27.16		50.063	1.0045	76.64	1.0139		
	3.31	31.90	eutectic pt.	99.660	1.0119	77.98	1.0210		
	3.96	33.56		(Harkins and Winnigohof, J. Am. Chem. Soc. 1911, 33. 1816.)					
	2.65	33.62	$\text{NH}_4\text{Cl}$	Solubility of $\text{PbCl}_2$ in $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ at 25°.					
	1.62	33.88		G. $\text{Pb}(\text{NO}_3)_2$ per l.		% $\text{PbCl}_2$			
	0.32	34.14		0		1.09			
	0.0	34.25		3.31		1.10			
100°	3.10	0.0	$\text{PbCl}_2$	6.62		1.05			
	2.02	1.32		33.12		1.11			
	1.85	5.33		82.80		1.29			
	1.80	6.01		(Armstrong and Eyre, Proc. Roy. Soc. 1913, (A) 88. 234.)					
	1.76	8.59	eutectic pt.	Solubility of $\text{PbCl}_2$ in $\text{KCl} + \text{Aq}$ at 25.20°.					
	1.98	13.19		S = Solubility in millimols per litre.					
	4.54	26.08	$2\text{PbCl}_2, \text{NH}_4\text{Cl}$	KCl normal	S	KCl normal	S		
	8.32	32.64		0.0000	38.80	0.0999	16.90		
	11.40	36.29	eutectic pt.	0.001	38.32	0.5006	7.40		
	12.67	37.62		0.0025	37.85	0.7018	7.38		
	12.50	38.14	$\text{PbCl}_2, 2\text{NH}_4\text{Cl}$	0.0049	37.02	0.9991	4.90		
	11.60	38.32		0.0049	37.02	0.9991	4.90		
	10.70	38.66	eutectic pt.	0.0099	35.28	1.5018	4.83		
	9.88	40.22		0.0200	32.16	2.0024	5.56		
	9.26	41.90	$\text{NH}_4\text{Cl}$	0.0599	22.62	3.0036	9.74		
	4.21	42.91		(von Ende, Z. anorg. 1901, 28. 151.)					
	3.06	43.20							
	1.61	43.42							
	0.0	43.51							

These results show that the double salt  $\text{PbCl}_2, 2\text{NH}_4\text{Cl}$  can only exist in aqueous solution at temperature above 70°.

(Demassieux, C. R. 1913, 156. 894.)

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(Demassieux, C. R. 1913, 156. 894.)

Solubility of  $\text{PbCl}_2 + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $20^\circ$ .  
Values = g. equivalents.

In 1000 g. solution		In 1000 g. $\text{H}_2\text{O}$		Solid phase
$\text{PbCl}_2$	$\text{KCl}$	$\text{PbCl}_2$	$\text{KCl}$	
...	...	28.0	4.57	$\text{PbCl}_2, \text{KCl}, \frac{1}{2}\text{H}_2\text{O} + \text{KCl}$
17.80	3.18	23.42	4.18	$\text{PbCl}_2, \text{KCl}, \frac{1}{2}\text{H}_2\text{O}$
16.56	3.05	21.50	3.96	
15.50	2.91	19.85	3.73	
14.76	2.77	18.66	3.50	
13.96	2.66	17.48	3.33	
13.16	2.47	16.17	3.03	
13.08	2.45	16.06	3.01	
12.94	2.40	15.80	2.93	
12.96	2.36	14.92	2.87	
12.86	2.35	15.63	2.86	
12.44	2.30	15.03	2.78	$2\text{PbCl}_2, \text{KCl}$
11.84	2.29	14.30	2.77	
11.38	2.24	13.70	2.70	
10.60	2.20	12.72	2.64	
11.98	2.29	14.35	2.62	
10.46	2.14	12.47	2.55	
10.22	2.10	12.13	2.49	
9.82	2.04	11.60	2.41	
9.34	1.965	10.96	2.31	
8.94	1.884	10.42	2.20	
7.86	1.575	8.92	1.79	$\text{PbCl}_2$
7.72	1.526	8.72	1.744	
7.66	1.404	8.56	1.570	
7.46	1.324	8.29	1.472	
7.36	1.274	8.11	1.348	
7.38	1.223	8.13	1.347	
7.30	1.127	7.98	1.231	
7.34	1.122	8.01	1.225	
7.36	1.059	8.00	1.152	
7.48	1.022	8.10	1.107	
7.52	0.988	8.13	1.068	$\text{PbCl}_2$
7.70	0.930	8.28	1.000	
7.82	0.880	8.38	0.943	
8.24	0.821	8.79	0.875	
8.42	0.783	8.96	0.833	
8.84	0.719	9.36	0.761	
9.54	0.639	10.03	0.672	
10.68	0.575	11.18	0.602	
12.32	0.523	12.85	0.545	
12.38	0.503	12.88	0.523	$\text{PbCl}_2$
12.36	0.483	12.85	0.502	
12.56	0.475	13.04	0.497	
12.48	0.458	12.95	0.475	
12.24	0.375	13.65	0.387	
14.52	0.299	14.88	0.306	
19.00	0.195	19.33	0.199	

(Brønsted, Z. phys. Ch. 1912, 80. 208.)

$\text{PbCl}_2$  is sol. in 120 pts. pure  $\text{H}_2\text{O}$ , but on adding 5%  $\text{NaCl}$  437 pts. are required to effect solution. When  $\text{PbCl}_2$  is digested with conc.  $\text{NaCl} + \text{Aq}$ , 1 pt. dissolves in 129 pts. of the liquid.

A study of the equilibrium between lead chloride and sodium chloride in aqueous solution at  $13^\circ$ ,  $50^\circ$  and  $100^\circ$  shows that at none of these temp. do these chlorides form a double salt. (Demassieux, C. R. 1914, 158. 702.)

Solubility in salts + Aq at  $25^\circ$ .

Salt used	Concentration of the salt. Equivalents per liter	Solubility of $\text{PbCl}_2$ Equivalents per liter
None	0	0.07770
$\text{HCl}$	0.05	0.04786
"	0.1	0.03243
"	0.2	0.01927
$\text{KCl}$	0.05	0.0482
"	0.1	0.0341
"	0.2	0.0219
$\text{MgCl}_2$	0.05	0.0503
"	0.1	0.0350
$\text{CaCl}_2$	0.05	0.0503
"	0.1	0.0355
"	0.2	0.0219
$\text{MnCl}_2$	0.05	0.0501
"	0.1	0.0349
"	0.2	0.0217
$\text{ZnCl}_2$	0.2	0.0220
$\text{CdCl}_2$	0.05	0.0601
"	0.1	0.0481
"	0.2	0.0355

(Noyes, Z. phys. Ch. 1892, 9. 623.)

Sol. in  $\text{KOH} + \text{Aq}$ . (Rose.)

Less sol. in dil. salt solutions than in  $\text{H}_2\text{O}$ , especially  $\text{CaCl}_2 + \text{Aq}$ ; sol. in 534 pts.  $\text{H}_2\text{O}$  containing  $\text{CaCl}_2$ . (Bischof.)

More sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ , but not as sol. as  $\text{AgCl}$ . (Herschell, 1819.)

More sol. in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Anthon.)

Easily sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in conc. alcohol. (Wittstein.) Insol. in 94% alcohol; very al. sol. in cold or hot 76% alcohol.

Solubility in alcohol at  $25^\circ$ .

Alcohol = g. mol. alcohol in 1 l. of solvent.

$\text{PbCl}_2$  = g. mol.  $\text{PbCl}_2$  in 1 l. of solution.

Alcohol 4 2 1  $\frac{1}{2}$   $\frac{1}{1}$   
 $\text{PbCl}_2$  0.0172 0.0257 0.0298 0.0330 0.0338

Alcohol  $\frac{1}{2}$  0  
 $\text{PbCl}_2$  0.0367 0.0388

(Kernot and Pomilio, Soc. R. Napoli, (3) 17. 353.)

Insol. in benzene. (Franchimont, B. 16. 387.)

Insol. in  $\text{CS}_2$ . (Arcowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate (Naumann, B.

1909, **42**, 3790); ethyl acetate. (Naumann, B. 1910, **43**, 314.)

Insol. in methylal. (Eidmann, C. C. 1899, II, 1014.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)

Glycerine dissolves 1.995%  $\text{PbCl}_2$ .

1 pt. glycerine + 1 pt.  $\text{H}_2\text{O}$  dissolves 1.32%  $\text{PbCl}_2$ .

1 pt. glycerine + 3 pts.  $\text{H}_2\text{O}$  dissolves 1.0365%  $\text{PbCl}_2$ .

Glycerine containing 87.5%  $\text{H}_2\text{O}$  dissolves 0.91%  $\text{PbCl}_2$ . (Piesse, B. 7, 599.)

Solubility of  $\text{PbCl}_2$  in mannite + Aq at 25°.

Mannite = g. mol. mannite in 1 l. of solvent.

$\text{PbCl}_2$  = g. mol.  $\text{PbCl}_2$  in 1 l. of solution.

Mannite  $\frac{1}{2}$      $\frac{1}{4}$      $\frac{1}{8}$      $\frac{1}{16}$      $\frac{1}{32}$   
 $\text{PbCl}_2$     0.0408 0.0403 0.0394 0.0384 0.0385

Mannite  $\frac{1}{64}$     0

$\text{PbCl}_2$     0.0377 0.0388

(Kernot and Pomilio, Soc. R. Napoli, (3) 17, 353.)

Min. *Cotunnite*.

Lead tetrachloride,  $\text{PbCl}_4$ .

Sol. in  $\text{H}_2\text{O}$  with subsequent decomp. (Rivot, Beudant, and Daguin, Ann. Min. (5) 4, 239.)

Obtained in a pure state by Friedrich. Sol. in a little cold  $\text{H}_2\text{O}$ , but is decomp. by warming or diluting. Miscible with conc.  $\text{HCl}$  + Aq; not attacked by conc.  $\text{H}_2\text{SO}_4$ , even on warming. (Friedrich, W. A. B. 102, 2b, 534.)

Lead tetrachloride with  $\text{MCl}$ .

See Chloroplumbate, M.

Lead magnesium chloride,  $\text{PbCl}_2, 2\text{MgCl}_2 + 13\text{H}_2\text{O}$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Otto and Drewes, Arch. Pharm. 223, 495.)

Lead potassium chloride (potassium chloroplumbite),  $\text{PbCl}_2, \text{KCl}$ .

(Remsen and Herty, Am. Ch. J. 14, 125.)

Contains  $\frac{1}{2}$   $\text{H}_2\text{O}$ . (Wells, Sill. Am. J. 145, 130.)

See also Demassieux,  $\text{PbCl}_2 + \text{KCl}$  under  $\text{PbCl}_2$ .

2 $\text{PbCl}_2, \text{KCl}$ . (Wells.)

See also Demassieux as above.

Lead rhodium chloride.

See Chlororhodite, lead.

Lead rubidium chloride,  $\text{PbCl}_2, 2\text{RbCl} + \frac{1}{2}\text{H}_2\text{O}$ .

(Wells, Sill. Am. J. 146, 34.)

2  $\text{PbCl}_2, \text{RbCl}$ . (Wells.)

Lead sodium chloride.

Decomp. by  $\text{H}_2\text{O}$ .

Lead sodium tetrachloride,  $2\text{PbCl}_4, 9\text{NaCl}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Sobrero and Salmi, A. ch. (3) 29, 185.)

See also Chloroplumbate, lead.

Lead thallous chloride,  $\text{PbCl}_2, 3\text{TlCl}$ .

Sl. sol. in cold, more in hot  $\text{H}_2\text{O}$ . (Noyes, Z. phys. Ch. 9, 622.)

$\text{PbCl}_2, \text{TlCl}$ . Ppt. (Ephraim, Z. anorg. 1909, 61, 245.)

Lead chloride ammonia,  $2\text{PbCl}_2, 3\text{NH}_3$ .

(Rose, Pogg. 20, 157.)

Lead tetrachloride ammonia,  $\text{PbCl}_4, 4\text{NH}_3$ .

Pptd. from chloroform solution. (Matthews, J. Am. Chem. Soc. 1898, 20, 825.)

$\text{PbCl}_2, 2\text{NH}_3$ . Fumes in the air. Decomp. by  $\text{H}_2\text{O}$ . (Matthews.)

Lead chloride arsenate,  $3\text{Pb}_2(\text{AsO}_4)_3, \text{PbCl}_2$ .

See Arsenate chloride, lead.

Lead chloride borate,  $\text{Pb}(\text{BO}_3)_2, \text{PbCl}_2 + \text{H}_2\text{O}$ .

See Borate chloride, lead.

Lead chloride carbonate.

See Carbonate chloride, lead.

Lead chloride chlorite.

See Chlorite chloride, lead.

Lead chloride with fluoride and iodide.

See Lead chlorofluoride and Lead chloroiodide.

Lead chloride phosphate.

See Phosphate chloride, lead.

Lead chloride phosphite,  $\text{PbCl}_2, \text{Pb}_2\text{P}_2\text{O}_5(?)$ .

Ppt. (Berzelius.)

Does not exist. (Rose.)

Lead chloride sulphate.

See Sulphate chloride, lead.

Lead chloride sulphide,  $\text{PbCl}_2, 3\text{PbS}$ .

See Lead chlorosulphide.

Lead chlorofluoride,  $\text{PbClF}$ .

Sl. sol. in  $\text{H}_2\text{O}$  without decomp. Easily sol. in  $\text{HNO}_3$  + Aq. (Berzelius.)

Solubility in  $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve 0.0211 g.  $\text{PbClF}$  at 0°; 0.0370 g. at 25°; 0.1081 g. at 100°. (Starck, Z. anorg. Ch. 1911, 70, 174.)

Solubility in  $\text{HCl}$  + Aq at 25°.

Solution of  $\text{PbClF}$  in  $\text{HCl}$  + Aq containing 0.0535 g. equiv. per l. contains 0.0758 g.  $\text{PbClF}$  in 100 cc. of solvent.

Solution of  $\text{PbClF}$  in  $\text{HCl}$  + Aq containing

0.1069 g. equiv. per l. contains 0.1006 g. PbClF in 100 cc. of solvent. (Starck.)

Solubility in acetic acid at 25°.

Solution of PbClF in  $\text{HC}_2\text{H}_3\text{O}_2$  containing 0.0518 g. equiv. per l. contains 0.05129 g. PbClF in 100 cc. of solvent.

Solution of PbClF in  $\text{HC}_2\text{H}_3\text{O}_2$  containing 0.1055 g. equiv. per l. contains 0.0561 g. PbClF in 100 cc. of solvent. (Starck.)

#### Solubility in $\text{PbCl}_2 + \text{Aq.}$

t°	G. equiv. per l. $\text{PbCl}_2$	G. PbClF in 100 cc. of solvent
18°	0.0100	0.0020
"	0.0195	0.0016
"	0.0495	0.0002
25°	0.00996	0.0030
"	0.0196	0.0008
"	0.0392	0.0005

(Starck.)

**Lead chloriodide,  $2\text{PbCl}_2, \text{PbI}_2$ .**

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Poggiale, J. pr. 35. 329.)

$\text{PbCl}_2, \text{PbI}_2$ . Sol. in hot  $\text{HCl} + \text{Aq.}$  (Engelhardt.)

Sol. in  $\text{H}_2\text{O}$ . (Thomas, C. R. 1898, 126. 1351.)

**Lead chloroselenide.**

Decomp. by boiling  $\text{H}_2\text{O}$  and by conc.  $\text{KOH} + \text{Aq.}$  (Fonze-Diacon, C. R. 1900, 130. 1133.)

**Lead chlorosulphide,  $\text{PbCl}_2, 3\text{PbS}$ .**

Partially decomp. by hot  $\text{H}_2\text{O}$ . Not attacked by dil., but decomp. by conc.  $\text{HCl} + \text{Aq.}$  (Hünefeld, J. pr. 7. 27.)

$\text{PbS}, \text{PbCl}_2$ . Decomp. by  $\text{H}_2\text{O}$ , acids, or alkalies. (Parmentier, C. R. 114. 298.)

$\text{ClPbS}, \text{PbS}, \text{PbS}, \text{PbCl}$ . Ppt. (Hofmann, B. 1904, 37. 250.)

**Lead fluoride,  $\text{PbF}_2$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ , and not more in  $\text{HF} + \text{Aq.}$  (Berzelius, Pogg. 1. 31.)

5.5 millimols are sol. in 1000 cc.  $\text{H}_2\text{O}$ . (Jaeger, Z. anorg. 1901, 27. 38.)

1 l.  $\text{H}_2\text{O}$  dissolves 640 mg. at 18°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

641 mg. in 1 l. of sat. solution at 18°. (Kohlrausch, Z. phys. Ch. 1906, 64. 168.)

More sol. in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq.}$  Sl. sol. in  $\text{KF} + \text{Aq.}$  (Herty, Am. Ch. J. 14. 107.)

Sl. sol. in dil.  $\text{HF} + \text{Aq.}$ ; insol. in strong  $\text{HF} + \text{Aq.}$

0.01302 g. atoms Pb are sol. in 1000 cc.  $\text{HF}$ . (Jaeger, Z. anorg. 1901, 27. 37.)

Insol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1906, 46. 2.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. J. Ch. 1898, 20. 828.)

Insol. in ethylacetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Lead potassium fluoride,  $3\text{KF}, \text{HF}, \text{PbF}_4$ .**

Decomp.  $\text{H}_2\text{O}$ , stable in dry air. (Brauner, Z. anorg. 1894, 7. 7.)

**Lead silicon fluoride.**

See Fluosilicate, lead.

**Lead tantalum fluoride.**

See Fluotantalate, lead.

**Lead titanium fluoride.**

See Fluotitanate, lead.

**Lead fluoride sulphate.**

See Sulphate fluoride, lead.

**Lead hydroxide,  $\text{PbO}_2\text{H}_2$ .**

Not appreciably sol. in  $\text{H}_2\text{O}$ . (Jaeger, Z. anorg. 1901, 27. 38.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.155 g.  $\text{PbO}_2\text{H}_2$  at 20° and 100°. (Sehnal, C. R. 1909, 148. 1396.)

#### Solubility in $\text{NaOH} + \text{Aq.}$

G. Na in 20 cc.	G. Pb in 20 cc.
0.2024	0.1012
0.3196	0.1736
0.5866	0.3532
0.9476	0.4071
1.7802	0.5170

(Rubenbauer, Z. anorg. 1902, 30. 336.)

**Solubility of  $\text{PbO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$  at 25°.**

G. mol. per l.		Solid Phase
Na	Pb	
0.274	0.0181	$\text{PbO}_2\text{H}_2$
0.431	0.287	"
0.476	0.319	"
0.745	0.489	"
1.132	0.711	"
1.519	0.101	"

(Wood, Chem. Soc. 1910, 97. 884.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$2\text{PbO}, \text{PbO}_2\text{H}_2 = 3\text{PbO}, \text{H}_2\text{O}$ . Sol. in 10,000 to 12,000 pts.  $\text{H}_2\text{O}$ . (Yorke.) Sol. in 7000 pts.  $\text{H}_2\text{O}$ . (v. Bonsdorff, Pogg. 41. 307.)

0.45 millimol. Pb are sol. in 1 liter  $\text{H}_2\text{O}$  at 18°. (Pleissner, C. C. 1907, II. 1056.)

Sol. in acids. Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq.}$  Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq.}$  and reprecip. by  $\text{NH}_4\text{OH} + \text{Aq.}$

Solubility in  $\text{KOH} + \text{Aq.}$  according to Ditte (C. R. 94. 130). When  $\text{KOH} + \text{Aq}$  is gradu-



ally added to lead hydroxide suspended in  $H_2O$ , the lead hydroxide is at first dissolved proportional to the amount of KOH, until the strength reaches 200 g. KOH to 1 litre  $H_2O$ . The solubility then diminishes and increases again until 400 g. KOH are dissolved in 1 litre  $H_2O$ . The amorphous lead hydroxide is then converted into crystalline  $2PbO(PbO_2 \cdot H_2O)$ . By further addition of KOH the solubility is suddenly decreased, and then increases again. (Ditte.)

Sol. in triethyl toluenyl ammonium hydrate + Aq.

Sol. in sorbine + Aq. (Pelouze.)

Sol. in acetates + Aq. (Mercer.)

Sol. in Ca, Ba, Sr, K, or Na succrate + Aq.

Not pptd. in presence of Na citrate + Aq. (Spiller.)

See also under Lead, and Lead oxide.

Lead perhydroxide,  $PbO_2$ ,  $H_2O$ .

See Lead peroxide.

Lead imide,  $PbNH$ .

Decomp. by  $H_2O$  and dilute acids. (Franklin, Z. anorg. 1905, 46. 27.)

Lead iodide,  $PbI_2$ .

Sol. in 187 pts. boiling  $H_2O$ . (Berthelot.)  
Sol. in 1235 pts.  $H_2O$  at ord. temp., and 194 pts. at  $100^\circ$ . (Denot, J. pr. 1. 425.)

Sol. in 2400 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)

Sat.  $PbI_2$  + Aq at  $20^\circ$  contains 0.0017 pt.; at  $27^\circ$ , 0.002 pt.; at  $100^\circ$ , 0.0039 pt.  $PbI_2$ . (Lassaigne, J. chim. med. 7. 364.)

1 l.  $H_2O$  dissolves 0.6 g.  $PbI_2$  at  $10^\circ$ . (Ditte, C. R. 92. 718.)

1 l.  $H_2O$  dissolves 1.58 millimols  $PbI_2$  at  $25.2^\circ$ . (Von Ende, Z. anorg. 1901, 26. 159.)

$0.47 \times 10^{-1}$  gram are dissolved in 1 litre of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

Solubility in 100 g.  $H_2O$  at  $t^\circ$ .

$t^\circ$	G. $PbI_2$ .
0	0.0442
15	0.0613
25	0.0764
35	0.1042
45	0.1453
55	0.1755
65	0.2183
80	0.3023
95	0.3960
* 100	0.4360

\* By extrapolation.

(Lighty, J. Am. Chem. Soc. 1903, 25. 474.)

0.0013 g. mol.  $PbI_2$  are dissolved in 1 l.  $H_2O$  at  $20^\circ$ . (Fedotieff, Z. anorg. 1911, 73. 178.)

Not more sol. in  $HC_2H_3O_2$  + Aq than in  $H_2O$ , contrary to Henry. (Denot, l. c.)

Pptd. from aqueous solution by little HI + Aq, but redissolved by the addition of more. (Ditte, C. R. 92. 718.)

Insol. in cold, sol. in hot HCl + Aq with decomp.

Solubility of  $PbI_2$  in  $HNO_3$  + Aq at  $25.2^\circ$ .

S = Solubility in millimols. per litre.

$HNO_3$ normal	S
0.001	38.87
0.01	39.06
0.051	39.45
0.04 $KNO_3$ +	
0.01 $HNO_3$	39.45

(von Ende, Z. anorg. 1901, 26. 162.)

Sol. in KOH + Aq.

Sol. in conc. KI, NaI, BaI, SrI, CaI, and  $MgI_2$  + Aq, from which it is pptd. by  $H_2O$ . (Berthelot.)

Very sol. in KI + Aq, 2 mols.  $PbI_2$  being dissolved for 1 mol. KI. (Boullay.)

Sol. in  $NH_4I$  + Aq. Easily sol. in  $Na_2S_2O_3$  + Aq. (Werner, C. N. 53. 51.)

Not pptd. in presence of Na citrate. (Spiller.)

Solubility in sat.  $I_2$  + Aq at  $20^\circ = 0.00216$  g. mol. per l. Solid phase  $PbI_2 + I_2$ . (Fedotieff, Z. anorg. 1911, 73. 178.)

Very easily sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sl. sol. in alcohol. (Henry.) Decomp. by boiling ether. (Vogel.)

100 g. formic acid dissolve 0.25 g. at  $19.8^\circ$ . (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in  $CS_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

0.02 pts. are sol. in 100 pts. acetone at  $59^\circ$ .

0.02 pts. are sol. in 100 pts. amyl alcohol at  $133.5^\circ$ .

0.50 pts. are sol. in 100 pts. aniline at  $13^\circ$ .

1.10 pts. are sol. in 100 pts. aniline at  $184^\circ$ . (Laszcynski, B. 1894, 27. 2287.)

Solubility of  $\text{PbI}_2$  in pyridine at  $t^\circ$ .

$t^\circ$	G. $\text{PbI}_2$ per 100 g. pyridine	Solid phase
-37	0.166	$\text{PbI}_2, \text{C}_5\text{H}_5\text{N}$
-20	0.175	"
-9	0.186	"
0	0.200	"
+3	0.215	"
6	0.225	$\text{PbI}_2, \text{C}_5\text{H}_5\text{N} + \text{PbI}_2, 2\text{C}_5\text{H}_5\text{N}$
15	0.208	$\text{PbI}_2, 2\text{C}_5\text{H}_5\text{N}$
35	0.188	"
57	0.190	"
77	0.228	"
92	0.290	"
98	0.340	"
105	0.370	"
108	0.410	"
112	0.445	"

(Heise, J. phys. Ch. 1912, 16, 273.)

**Lead hydrogen iodide,  $\text{PbH}_2\text{I}_2 = \text{PbI}_2, 2\text{HI}$ .**

Cold  $\text{H}_2\text{O}$  dissolves out  $\text{HI}$ . Sol. in hot  $\text{H}_2\text{O}$ , from which crystallises  $\text{PbI}_2$ . (Guyot, J. chim. med. 12, 247.)

+  $10\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Berthelot, C. R. 91, 1024.)

**Lead lithium iodide,  $\text{PbI}_2, \text{LiI} + 5\text{H}_2\text{O}$ .**

Loses 1 mol.  $\text{H}_2\text{O}$  at  $95^\circ$  and loses another mol.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Bogorodski, C. C. 1894, II, 515.)

$\text{PbI}_2, 2\text{LiI} + 6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Mosnier, C. R. 1895, 120, 446.)

**Lead magnesium iodide,  $\text{PbI}_2, 2\text{MgI}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and by alcohol. (Mosnier, A. ch. 1897, (7) 12, 402.)

+  $16\text{H}_2\text{O}$ . Very hygroscopic. Decomp. immediately by  $\text{H}_2\text{O}$ . (Otto and Drewes, Arch. Pharm. 229, 180.)

**Lead nickel iodide,  $\text{PbNi}_2\text{I}_4 + 3\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Mosnier, A. ch. 1897, (7) 12, 411.)

**Lead potassium iodide (Potassium iodoplumbite),  $\text{PbI}_2, \text{KI}$ .**

Permanent. Completely decomp. by  $\text{H}_2\text{O}$ . Unacted upon by cold, but completely decomp. by hot alcohol. (Boullay, A. ch. (2) 34, 366.)

+  $2\text{H}_2\text{O}$ . The only salt that could be obtained by Remsen and Herty (Am. Ch. J. 14, 110.)

$\text{PbI}_2, 2\text{KI}$ . Sl. sol. in boiling chloroform; easily sol. in strong  $\text{KI} + \text{Aq}$ , insol. in alcohol. (Brooks, C. N. 1898, 77, 191.)

+  $2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Berthelot, A. ch. (5) 29, 289.)

Does not exist. (R. and H.)

+  $4\text{H}_2\text{O}$ . (Ditte, C. R. 92, 134.) Does not exist. (R. and H.)

$\text{PbI}_2, 4\text{KI}$ . Decomp. by  $\text{H}_2\text{O}$ ; insol. in alcohol. (Boullay.) Does not exist. (R. and H.)

$3\text{PbI}_2, 4\text{KI} + 6\text{H}_2\text{O}$ . (Berthelot, l. c.) Does not exist. (R. and H.)

**Lead potassium periodide,  $\text{K}_2\text{Pb}_2\text{I}_8 + 4\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Wells, Z. anorg. 4, 346.)

**Lead rubidium iodide,  $\text{PbI}_2, \text{RbI} + 2\text{H}_2\text{O}$ .**

(Wells, Sill. Am. J. 146, 34.)

**Lead silver iodide,  $\text{PbI}_2, 2\text{AgI}$ .**

(Ruff and Geisel, B. 1905, 38, 2663.)

**Lead silver iodide ammonia,  $\text{PbI}_2, 2\text{AgI}, 5\text{NH}_3$ .**

(Ruff and Geisel, B. 1905, 38, 2663.)

**Lead sodium iodide,  $\text{PbI}_2, \text{NaI}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Poggiale, C. R. 20, 1180.)

+  $\text{zH}_2\text{O}$ . (Remsen and Herty, Am. Ch. J. 14, 124.)

$\text{PbI}_2, 2\text{NaI} + 6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .

(Moisanier, C. R. 1895, 120, 445.)

**Lead iodide ammonia,  $\text{PbI}_2, 2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 48, 166.)

**Lead iodide carbonate.**

See Carbonate iodide, lead.

**Lead iodosulphide,  $\text{PbS}, 4\text{PbI}_2$ .**

Decomp. by light, heat, acids and alkalies. (Lenher, J. Am. Chem. Soc. 1895, 17, 512.)

Sol. in conc.  $\text{HI}$ ; insol. in dil.  $\text{HI} + \text{Aq}$ . (Lenher, J. Am. Chem. Soc. 1901, 23, 681.)

$\text{IPbS}_2\text{PbS}_2\text{PbI}$ . Ppt. (Hofmann, B. 1904, 37, 251.)

**Lead suboxide,  $\text{Pb}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{PbO}, \text{H}_2\text{O}$ .

Decomp. by dil.  $\text{H}_2\text{SO}_4, \text{HCl}, \text{HNO}_3, \text{HCl}, \text{H}_2\text{O}_2 + \text{Aq}$ , or alkalies, into  $\text{PbO}$ , which dissolves, and  $\text{Pb}$ , which dissolves or not, according to the reagent. Sol. in dil.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ .

**Lead monoxide (Litharge),  $\text{PbO}$ .**

Sol. in 7000 pts.  $\text{H}_2\text{O}$ . (Horsford.)

Pure  $\text{PbO}$  is insol. in  $\text{H}_2\text{O}$ . (Brandecke, Repert. 53, 155; Siebold, Repert. 53, 174; Herbergen, Repert. 55, 55.) Sl. sol. in  $\text{H}_2\text{O}$ . (Yorke, Phil. Mag. (3) 5, 82.)

0.31 millimoles  $\text{Pb}$  are dissolved in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II, 1056.)

$1.71 \times 10^{-2}$  g. are dissolved in 1 litre of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46, 603.)

Easily sol. in acids.

Sol. in KOH, or NaOH+Aq; also in  $\text{CaO}_2\text{H}_2$ +Aq.

Sol. in boiling  $\text{Cu}(\text{NO}_3)_2$ +Aq with pptn. of Aq.

Sol. in  $\text{CaCl}_2$ , and  $\text{SrCl}_2$ +Aq. (André, C. R. 104. 359.)

Sol. in  $\text{MgCl}_2$ +Aq. (Voigt, Ch. Ztg. 13. 695.)

Sol. in boiling  $\text{Cu}(\text{NO}_3)_2$ +Aq with pptn. of  $\text{CuO}$ .

Partially sol. in  $\text{Cd}(\text{NO}_3)_2$ , and  $\text{Mn}(\text{NO}_3)_2$ +Aq with pptn. of  $\text{CdO}$  and  $\text{MnO}$  respectively.

Not acted upon by Mg, Ag, Co, Ni, or Ce nitrates + Aq. (Persoz.)

Very sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ +Aq. (Rochleder.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

When finely pulverised, sol. in cane sugar +Aq, but less than  $\text{Pb}_2\text{O}_3$ . (Peschier.)

Sl. sol. in glycerine. Readily sol. in glucose +Aq. (Persoz.)

Sol. in volatile oils. (Schweitzer.)

*Yellow modification.*

Solubility in  $\text{H}_2\text{O}$  at 22°.

	Solubility in g.-equiv. per litre
1. Yellow $\text{PbO}$ , obtained by boiling lead hydroxide with 10% NaOH	$1.03 \times 10^{-4}$
2. Yellow $\text{PbO}$ , obtained by heating 1 at 630°	$1.05 \times 10^{-4}$
3. Yellow $\text{PbO}$ , obtained by heating at 740° red $\text{PbO}$ , formed by boiling lead hydroxide with conc. NaOH	$1.00 \times 10^{-4}$
4. Yellow $\text{PbO}$ obtained by heating pure, commercial, yellow-brown $\text{PbO}$ at 620°.	$1.09 \times 10^{-4}$

(Ruer, Z. anorg. 1906, 50. 273.)

*Red modification.* Obtained by boiling lead hydroxide with conc. NaOH+Aq.

Solubility in  $\text{H}_2\text{O}$  at 22° =  $0.56 \times 10^{-4}$  g. equiv. per l. (Ruer, Z. anorg. 1906, 50. 273.)

*Yellow-brown modification.* Solubility in  $\text{H}_2\text{O}$  at 22° =  $1.10 \times 10^{-4}$  g. equiv. per litre. (Ruer, Z. anorg. 1906, 50. 273.)

*See also Lead.*

*Min. Massicol.*

**Lead oxide (Red lead),  $\text{Pb}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$ .

Converted by acids into  $\text{PbO}_2$  and salts of monoxide.

Sol. in a large amt. of glacial acetic acid. (Berzelius.) Insol. in acetic acid. (Schonbein, J. pr. 74. 325.)

Solution in  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq may decompose or not according to concentration of acid. When treated with an excess of  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq of 8° B,  $\text{Pb}_2\text{O}_3$  is quickly dissolved, but the solution soon deposits  $\text{PbO}_2$ ; this decomposition is facilitated by dilution. But if  $\text{Pb}_2\text{O}_3$  is treated with a large excess of glacial  $\text{HC}_2\text{H}_3\text{O}_2$ , it dissolves, and the solution is permanent if atmospheric air is excluded, and temp. does not rise above 40°. (Jacquelin, J. pr. 53. 152.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37. 4329.)

Easily sol. in cane sugar+Aq. (Peschier.) *Min. Minium.*

**Lead sesquioxide,  $\text{Pb}_2\text{O}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or in KOH+Aq.

Decomp. by strong acids into  $\text{PbO}_2$  and corresponding salt of monoxide.

**Lead peroxide,  $\text{PbO}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids, also in conc. alkali hydroxides+Aq. The solutions in acids are very unstable, except when concentrated and kept at a low temperature.

Decomp. by cold HCl, HCN, HBr, and HI+Aq. Not attacked by other acids when cold, but decomp. thereby when hot. Insol. in moderately conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq.

There are two forms of  $\text{PbO}_2$ , the amorphous and the crystalline.

1 l. of very conc.  $\text{H}_2\text{SO}_4$  dissolves 10 millimols. crystalline  $\text{PbO}_2$ .

**Solubility of amorphous  $\text{PbO}_2$  in  $\text{H}_2\text{SO}_4$ +Aq at 22°.**

99.5 millimols.  $\text{PbO}_2$  are dissolved in 1 l. of acid containing 1720 g.  $\text{H}_2\text{SO}_4$ .

4 millimols.  $\text{PbO}_2$  are dissolved in 1 l. of acid containing 1097 g.  $\text{H}_2\text{SO}_4$ .

v = moles  $\text{H}_2\text{SO}_4$  per mole of  $\text{H}_2\text{O}$ .

c = millimols.  $\text{PbO}_2$  dissolved in 1 litre.

v	c	v	c
0.32	0.82	0.20	$8.10^{-4}$
0.30	0.4	0.15	$5.10^{-4}$
0.25	$7.10^{-2}$	0.10	$1.10^{-4}$

(Dolezalek and Finckli, Z. anorg. 1906, 51. 323-5.)

Decomp. by  $\text{NH}_4\text{OH}$ +Aq. Sol. in conc. KOH, or NaOH+Aq.

Sol. with decomp. in  $\text{Hg}_2(\text{NO}_3)_2$ +Aq. (Levol.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, 37. 2943.)

*Min. Plattnerite.*

**Lead manganese peroxide,  $\text{PbO}_2 \cdot 4\text{MnO}_2$ .**

Ppt. (Gibbs and Parkmann, Sill. Am. J. (2) 39. 58.)

**Lead oxybromide, PbBr<sub>2</sub>, PbO.**Insol. in H<sub>2</sub>O.+1, 1½, and 3H<sub>2</sub>O. (André, C. R. 96. 1502.)6PbO, PbBr<sub>2</sub>+2H<sub>2</sub>O. Ppt. (Strömholm, Z. anorg. 1904, 33. 436.)**Lead oxychloride, 2PbCl<sub>2</sub>, PbO+2H<sub>2</sub>O.**

(André, C. R. 96. 435.)

PbCl<sub>2</sub>, PbO. Absolutely insol. in hot or cold H<sub>2</sub>O. (André, A. ch. (6) 3. 108.)Min. *Mallockite*.+H<sub>2</sub>O. Sol. in hot NaOH+Aq. (André.)0.38 millimols. Pb are dissolved in 1 litre H<sub>2</sub>O at 18°. (Pleissner, C. C. 1907, II. 1055.)PbCl<sub>2</sub>, 2PbO. Insol. in H<sub>2</sub>O. Sol. in dil. KOH+Aq (about 110 g. in 1 l.) (Ditte, C. R. 94. 1180.)Min. *Mendipite*. Easily sol. in HNO<sub>3</sub>+Aq.+2H<sub>2</sub>O. (André, A. ch. (6) 3. 111.)PbCl<sub>2</sub>, 3PbO. Insol. in H<sub>2</sub>O. (Döbereiner.)+½H<sub>2</sub>O. Ppt. (Strömholm, Z. anorg. 1904, 33. 435.)+2H<sub>2</sub>O. 0.10 millimols. Pb are dissolved in 1 litre H<sub>2</sub>O at 18°. (Pleissner, C. C. 1907, II. 1056.)+3H<sub>2</sub>O. Ppt. (André, C. R. 104. 359.)+4H<sub>2</sub>O. Nearly insol. in H<sub>2</sub>O. Sl. sol. in NaOH+Aq. (Vauquelin.)PbCl<sub>2</sub>, 5PbO. (Döbereiner.)6PbO, PbCl<sub>2</sub>+2H<sub>2</sub>O. Ppt. (Strömholm, Z. anorg. 1904, 33. 434.)PbCl<sub>2</sub>, 7PbO. *Cassel-yellow*.**Lead strontium oxychloride, 2PbO, SrCl<sub>2</sub>+5H<sub>2</sub>O.**

(André, C. R. 104. 359.)

**Lead oxychloride, iodide, PbCl<sub>2</sub>, PbI<sub>2</sub>, 4PbO.**Min. *Schwartzenbergite*. Sol. in dil. HNO<sub>3</sub>+Aq.**Lead oxyiodide, PbI<sub>2</sub>, PbO.**Insol. in boiling H<sub>2</sub>O or KI+Aq. (Brandes, A. 10. 269.)+½H<sub>2</sub>O. (Ditte, C. R. 92. 145.)+H<sub>2</sub>O.PbI<sub>2</sub>, 2PbO. Insol. in H<sub>2</sub>O. (Denot, J. Pharm. 20. 1.)+H<sub>2</sub>O.PbI<sub>2</sub>, 3PbO+2H<sub>2</sub>O. Ppt. (Kühn, C. C. 1847. 593.)PbI<sub>2</sub>, 5PbO. Insol. in H<sub>2</sub>O. (Denot.)+7H<sub>2</sub>O. (Ditte, C. R. 92. 145.)6PbO, PbI<sub>2</sub>+2H<sub>2</sub>O. Ppt. (Strömholm, Z. anorg. 1904, 33. 437.)9PbO, PbI<sub>2</sub>+2H<sub>2</sub>O. (Strömholm, Z. anorg. 1904, 33. 437.)**Lead oxyperiodide, PbO, PbI<sub>2</sub>I<sub>2</sub>.**Decomp. by boiling H<sub>2</sub>O. Sol. in dil. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. (Gröger, W. A. B. 100, 2b. 415.)**Lead phosphide, PbP<sub>2</sub>.**Decomp. by H<sub>2</sub>O and dil. acids. (Bossuet, C. R. 1913, 157. 721.)**Lead phosphoselenide, PbSe, P<sub>2</sub>Se.**Insol. in H<sub>2</sub>O or HCl+Aq. Sol. in HNO<sub>3</sub>+Aq.

Insol. in cold, slowly decomp. by hot alkalies+Aq. (Hahn, J. pr. (2) 93. 436.)

2PbSe, P<sub>2</sub>Se<sub>3</sub>. Insol. in H<sub>2</sub>O, HCl, or HNO<sub>3</sub>+Aq. Slowly sol. in red fuming HNO<sub>3</sub>. (Hahn.)2PbSe, P<sub>2</sub>Se<sub>3</sub>. Decomp. by fuming HNO<sub>3</sub>. (Hahn.)**Lead selenide, PbSe.**Cold HNO<sub>3</sub>+Aq dissolves Pb with separation of Se, which dissolves on warming. (Little, A. 112. 212.)Min. *Clausthalite*. Sol. in HNO<sub>3</sub>+Aq with separation of Se, when warmed.**Lead mercury selenide, (Pb, Hg)Se.**Min. *Lehrbachite*.**Lead sulphide, PbS.**Very sl. sol. in H<sub>2</sub>O.1 l. H<sub>2</sub>O dissolves 3.6×10<sup>-3</sup> moles. PbS at 18°. (Weigel, Z. phys. Ch. 1907, 53. 294.)1 l. H<sub>2</sub>O dissolves 3×10<sup>-4</sup> g. PbS at 25°. (Hevesy, Z. anorg. 1913, 82. 323.)Insol. in dilute acids; alkalies, and alkali sulphides+Aq. Decomp. with solution in moderately dil. HNO<sub>3</sub>+Aq. With conc. HNO<sub>3</sub> or aqua regia, PbSO<sub>4</sub> is formed. Sol. in hot conc. HCl+Aq.1 l. H<sub>2</sub>O sat. with H<sub>2</sub>S dissolves 1.5×10<sup>-4</sup> g. PbS at 25°. (Hevesy, Z. anorg. 1913, 82. 323.)Insol. in NH<sub>4</sub>Cl, or NH<sub>4</sub>NO<sub>3</sub>+Aq. (Brett.)Somewhat sol. in H<sub>2</sub>S+Aq when heated therewith in a sealed tube. (Senarmont, A. ch. (3) 32. 168.)

Insol. in potassium thiocarbonate +Aq. (Rosenblatt, Z. anal. 26. 15.)

Sol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+Aq. (Waller, J. Anal. Ch. 5. 646.)Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 823.)Min. *Galena*, *Galenite*.**Lead polysulphide, PbS<sub>2</sub>.**Ppt.; insol. in alkali sulphides; decomp. by conc. HNO<sub>3</sub>. (Bodroux, C. R. 1900, 130. 1398.)**Lead platinum sulphide.**See *Sulphoplatinate*, lead.**Lead sulphide mercuric chloride, 3PbS, 4HgCl<sub>2</sub>.**Decomp. by H<sub>2</sub>O. (Levallois, C. R. 96. 1666.)

**Lead sulphobromide, chloride, or iodide.**

See Lead bromosulphide, etc.

**Lead disulphodithiimide,  $PbN_2S_2$ ,  $NH_3$ .**

Ppt.

Very stable in the air or in a vacuum.  
Sol. in no solvent without decomp.

When rapidly heated it explodes very violently at  $140^\circ$ . (Ruff, B. 1904, 37. 1581.)

**Lead telluride,  $PbTe$ .**

Insol. in  $H_2O$ . Sol. in cold  $HNO_3$  + Aq.  
(Rose, Pogg. 18. 68.)

Min. *Alaite*. Easily sol. in  $HNO_3$  + Aq.

**"Leucone."**

Wöhler (A. 127. 268) gives this substance the formula  $H_{10}Si_2O_{10}$ , but it is identical with silicoformic anhydride,  $Si_2H_2O_3$ , which see.

**Lime.**

*Quicklime*,  $CaO$ . See Calcium oxide.

*Slaked lime*,  $CaO \cdot H_2O$ . See Calcium hydroxide.

**Lithium, Li.**

Decomposes  $H_2O$ .

Easily sol. in dil. acids. Slowly attacked by conc.  $H_2SO_4$ , rapidly by conc.  $HNO_3$  + Aq.  
Insol. in hydrocarbons. Sol. in liquid  $NH_3$ , but not so easily as K.

Sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 820.)

1 gram atom dissolves:

at	$0^\circ$	in 3.93 mol. liquid $NH_3$ .
"	$-25^\circ$	" 3.93 " " "
"	$-50^\circ$	" 3.93 " " "
"	$-80^\circ$	" 3.93 " " "

(Ruff, B. 1906, 39. 840.)

Sol. in ethylamine. Insol. in propylamine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, 29. 1561.)

**Lithium amalgam,  $LiHg$ .**

$LiHg$  is obtained at all temp. up to  $100^\circ$ . Can be cryst. from Hg without decomp. at any temp. below  $100^\circ$ . (Kerp, Z. anorg. 1900, 26. 68.)

**Lithium amide,  $LiNH_2$ .**

(Ruff, B. 1911, 44. 505.)

Decomp. slowly in the air.

Slowly decomp. by cold, rapidly by hot  $H_2O$ .

Slowly decomp. by HCl.

Slowly decomp. by cold, rapidly by hot abs. alcohol. (Titherley, Chem. Soc. 1894, 65. 518.)

**Trilithium amide,  $Li_3NH_2$ .**

Hydroscopic; decomp. by  $H_2O$ . (Dafert, M. 1910, 31. 994.)

**Lithium ammonia,  $Li, NH_3$ .**

Decomp. by  $H_2O$  at ordinary temp.; sol. in liquid  $NH_3$ . (Moissan, C. R. 1898, 127. 689.)

$Li, 3NH_3$ . (Moissan, C. R. 1901, 133. 716.)

**Trilithium ammonium,  $Li_3NH_4$ .**

Very hygroscopic, decomp. by  $H_2O$ . (Dafert, M. 1910, 31. 992.)

**Lithium antimonide,  $Li_3Sb$ .**

Decomp. by  $H_2O$  with evolution of  $H_2$ . Sol. in liquid  $NH_3$ . (Lebeau, C. R. 1902, 134. 285.)

**Lithium arsenide,  $Li_3As$ .**

Decomp. by  $H_2O$ ; decomp. violently by fuming  $HNO_3$ . (Lebeau, C. R. 1899, 129. 50.)

**Lithium azoimide,  $LiN_3$ .**

Deliquescent. Stable in aq. solution.

36.12	pts.	are sol. in 100 pts. $H_2O$ at $10^\circ$ .
62.07	"	" " " " " " $H_2O$ " $15.5^\circ$ .
66.41	"	" " " " " " $H_2O$ " $16^\circ$ .
20.26	"	" " " " " " abs. alcohol at $16^\circ$ .

Insol. in ether. (Curtius, J. pr. 1898, (2) 58. 277.)

+  $H_2O$ . Very hygroscopic; decomp. in the air. Very sol. in  $H_2O$  and alcohol. (Dennis, Z. anorg. 1898, 17. 18.)

**Lithium bromide,  $LiBr$ .**

Deliquescent.

100 pts.  $H_2O$  dissolve at:

$0^\circ$	34°	59°	82°	103°
143	196	222	244	270

pts.  $LiBr$ .

Sp. gr. of  $LiBr$  + Aq at  $19.5^\circ$  containing:

0	10	15	20	25	30%
1.035	1.072	1.113	1.156	1.204	1.254

35	40	45	50	55%
1.309	1.368	1.432	1.500	1.580

(Kremers, Pogg. 108. 65; 104. 133; Gerlach, Z. anal. 8. 285.)

Temp. of maximum g.-mol.  $LiBr$  dissolved density of  $LiBr$  + Aq. in 1000 g.  $H_2O$ .

1.921°	0.2941
0.881°	0.4383

(de Coppet, C. R. 1900, 131. 178.)

Moderately sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Solubility in glycol at  $14.7^\circ$  = 37.5%. (de Coninck, Belg. Acad. Bull. 1905, 359.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II. 1014.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3789); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Difficultly sol. in ethyl acetate. (Nau-  
mann, B. 1910, 43. 314.)

+H<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 209 g. LiBr  
at 44°. (Bogorodski, C. C. 1894, II. 514.)

+2H<sub>2</sub>O. (Bogorodski.)

+3H<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 80 g. LiBr  
at -30°, and 122 g. at -10°. (Bogorodski.)

Lithium molybdenyl bromide, LiBr, MoOBr<sub>5</sub>,  
+4H<sub>2</sub>O.

Very hygroscopic. (Weinland and Knöll,  
Z. anorg. 1905, 44. 111.)

Lithium bromide ammonia.

LiBr, NH<sub>3</sub>. Sol. in H<sub>2</sub>O with decomp.

LiBr, 2NH<sub>3</sub>. " " " " "

LiBr, 3NH<sub>3</sub>. " " " " "

LiBr, 4NH<sub>3</sub>. " " " " "

(Bonnet, C. R. 1900, 130. 1395.)

Lithium carbide, Li<sub>2</sub>C<sub>2</sub>.

Insol. in conc. acids.

Sol. in fused oxidizing agents; decomp. H<sub>2</sub>O  
in the cold. (Moissan, C. R. 1896, 122. 363.)

Lithium subchloride, Li<sub>2</sub>Cl.

Decomp. by H<sub>2</sub>O. (Guntz, C. R. 1895,  
121. 945.)

Lithium chloride, LiCl.

Very deliquescent. Most deliquescent salt  
known to Berzelius. Very sol. in H<sub>2</sub>O. Sol.  
in 1.315 pts. H<sub>2</sub>O at 15°. (Gerlach.)

100 pts. H<sub>2</sub>O dissolve at:

0° 20° 65° 80° 69° 140° 160°  
63.7 80.7 104.2 115 129 139 145 pts. LiCl.

(Gerlach, Z. anal. 8. 281.)

Sp. gr. of LiCl+Aq at 15° containing:

1	5	10	15	20% LiCl,
1.006	1.030	1.058	1.086	1.117

25 30 35 40% LiCl.

1.148 1.182 1.219 1.256

(Gerlach, Z. anal. 8. 281.)

Sp. gr. of LiCl+Aq at 18° containing:

5	10	20	30	40% LiCl.
1.0274	1.0563	1.115	1.181	1.255

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of LiCl+Aq at 25°.

Concentration of LiCl+Aq.	Sp. gr.
1-normal	1.0243
1/2 " "	1.0129
1/3 " "	1.0062
1/4 " "	1.0030

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of LiCl+Aq.

g. LiCl in 1000 g. of solution	Sp. gr. 18°/18°
0	1.000000
2.3923	1.001405
6.2360	1.003647
10.1093	1.005921

(Dijken, Z. phys. Ch. 1897, 24. 109.)

Sp. gr. of LiCl+Aq at 0°.

% LiCl 4.26 12.18 22.2 32.5 41.4 43.2

Sp. gr. 1.026 1.073 1.133 1.203 1.267 1.282

(Lemoine, C. R. 1897, 125. 603.)

Sp. gr. of LiCl+Aq at 20°.

Normality of LiCl+Aq	% LiCl	Sp. gr.
10.35	35.97	1.2230
7.17	26.40	1.1550
5.57	21.10	1.1215
2.98	11.83	1.0691
1.06	4.37	1.0232

(Forchheimer, Z. phys. Ch. 1900, 34. 25.)

Sp. gr. 20°/4° of a normal solution of LiCl =  
1.022375. (Haigh, J. Am. Chem. Soc. 1912,  
34. 1151.)

Sp. gr. of dil. LiCl+Aq at 20.004°.

Conc. = g. equiv. LiCl per l. at 20.004°.

Sp. gr. compared with H<sub>2</sub>O at 20.004 = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,002,5
0.0002	1.000,005,0
0.0005	1.000,012,6
0.0010	1.000,025,8
0.0020	1.000,050,5
0.0050	1.000,125,8
0.0100	1.000,251,0

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35.  
1688.)

B.-pt. of LiCl+Aq.

% LiCl	B.-pt.	% LiCl	B.-pt.
3.38	101°	16.66	107°
6.54	102	19.35	109
13.04	105	21.8	111

(Skinner, Chem. Soc. 61. 341.)

Sat. LiCl + Aq boils at 171°. (Kremers.)

B.-pt. of LiCl + Aq. P = pts. LiCl to 100 pts. H<sub>2</sub>O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	3.5	124°	48.5	147°	87.5
102	7	125	50	148	90
103	10	126	51.5	149	92.5
104	12.5	127	53	150	95
105	15	128	54.5	151	97.5
106	17.5	129	56	152	100
107	20	130	57.5	153	102.5
108	22	131	59	154	105
109	24	132	60.5	155	107.5
110	26	133	62	156	110.5
111	28	134	63.5	157	113.5
112	30	135	65	158	116.5
113	32	136	66.5	158.5	117.96
114	33.5	137	68	159	119.5
115	35	138	69.75	160	122.5
116	36.5	139	71.5	161	125.5
117	38	140	73.25	162	128.5
118	39.5	141	75	163	131.5
119	41	142	77	164	135
120	42.5	143	79	165	138.5
121	44	144	81	166	142.5
122	45.5	145	83	167	146.5
123	47	146	85	168	151

(Gerlach, Z. anal. 26. 437.)

Solubility of LiCl in HCl + Aq at 0°.

Mg. mol. per 10 cc. of solution		G. per 10 cc. of solution		Sp. gr. of solution
LiCl	HCl	LiCl	HCl	
120	0.0	51.0	0.0	1.255
97.5	22.5	41.4	8.2	1.243
67.0	66.0	28.5	24.1	1.249
58.0	81.0	24.6	29.5	1.251

(Engel, A. ch. (6) 13. 385.)

See also LiCl + H<sub>2</sub>O.

Sl. sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in absolute alcohol, ether, and alcohol-ether.

B.-pt. of alcoholic solution of LiCl.

% LiCl	B.-pt.	% LiCl	B.-pt.
2.4	78.43° + 0.70°	9.93	78.43° + 5.55°
5.39	" + 2.15	15.94	" + 11.75
8.01	" + 4.18	...	....

(Skinner.)

Solubility in alcohol + Aq decreases to 40% alcohol + 60% H<sub>2</sub>O. Curve shows minimum at 30% H<sub>2</sub>O to 70% alcohol. The sat. pure H<sub>2</sub>O and pure alcohol solutions cooled to 0° deposit LiCl, H<sub>2</sub>O and LiCl, 4C<sub>2</sub>H<sub>5</sub>O respectively. (Pina de Rubies, C. A. 1914. 743, 3006.)

Solubility in ethyl alcohol.

Temp. 1.06° 5.07° 13.0° 25.0° 40.6° 62.6°  
% LiCl 14 14 13 14 15 18  
(Lemoine, C. R. 1897, 125. 605.)

100 g. ethyl alcohol dissolve at:

0° 5° 10° 15° 17°  
14.42 15.04 16.77 18.79 20.31 g. LiCl.  
The solid phase from 0°–17° is LiCl, 4C<sub>2</sub>H<sub>5</sub>O

20° 30° 40° 50° 60°  
24.28 25.10 25.38 24.40 23.46 g. LiCl.

The solid phase from 20°–60° is LiCl.  
(Turner and Bissett, Chem. Soc. 1913, 103 1907.)

Solubility in ethyl alcohol + Aq at 25°.

100 g. of the solution contain

G. C <sub>2</sub> H <sub>5</sub> OH	G. H <sub>2</sub> O	G. LiCl
0	55.10	44.90
5.96	51.52	42.52
11.07	48.73	40.20
17.46	43.90	38.64
18.56	43.70	37.74
22.16	41.17	36.67
26.29	39.51	34.70
28.97	37.42	33.61
29.27	36.89	33.84
30.10	36.64	33.28
30.51	35.67	33.82
32.79	34.95	32.26
38.40	31.58	30.02
49.27	24.67	26.06
50.32	24.04	25.64
53.50	20.94	25.56
58.15	18.47	23.38
59.78	17.46	22.76
63.09	14.83	22.08
70.24	8.66	21.10
70.70	8.26	21.04
70.74	7.78	21.48
79.26	0	20.74

The solid phase in the mixtures which are richest in alcohol is LiCl; in the other mixtures the solid phase is LiCl + H<sub>2</sub>O.

(Pina de Rubies, C. C. 1915, I. 521.)

Sp. gr. of LiCl in ethyl alcohol (LiCl, 2C<sub>2</sub>H<sub>5</sub>O).

% salt	Sp. gr. at 14°	Sp. gr. at 0°
0	0.797	0.809
5.2	0.839	0.851
10.1	0.871	0.881
14.6	0.903	0.903

(Lemoine, C. R. 1897, 125. 605.)

## Solubility in methyl alcohol at t°.

t°	% LiCl in sat. solution
1	26
23	27
50	30

(Lemoine, C. R. 1897, 125. 604.)

Sp. gr. of LiCl in methyl alcohol (LiCl, 3CH<sub>3</sub>O).

% salt	5.2	14.5	22.1
Sp. gr. at 21.5°	0.836	0.910	0.974
Sp. gr. " 0°	0.854	0.926	0.988

(Lemoine, C. R. 1897, 125. 604.)

15.86 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Sol. in 15 pts. fusel oil. (Gooch, Am. Ch. J. 9. 33.)

100 g. methyl alcohol dissolve 42.36 g. LiCl at 25°.

100 g. ethyl alcohol dissolve 25.83 g. LiCl at 25°.

100 g. propyl alcohol dissolve 16.22 g. LiCl at 25°.

100 g. isoamyl alcohol dissolve 9.03 g. LiCl at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

## Solubility of fused LiCl in alcohols at 25°.

Solvent	% LiCl
Water	45.0
Ethyl alcohol	2.475
Propyl alcohol	3.720
Butyl alcohol	9.56
Amyl alcohol	8.26
Allyl alcohol	4.20
Glycerine	4.14
Phenol (at 53°C)	1.89

(Patten and Mott, J. phys. Chem. 1904, 8. 158.)

100 pts. pyridine dissolve 7.78 pts. LiCl at 15°; 14.26 pts. LiCl at 100°. (Lassczynski, B. 1894, 27. 2288.)

Soluble in anhydrous pyridine, 97% pyridine+Aq, 95% pyridine+Aq, and 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Difficultly sol. in methyl acetate (Naumann, B. 1909, 42. 3789); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Solubility in glycol at 15°=11%. (de Coninck, Belg. Acad. Bull. 1905, 359.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

## Solubility of LiCl in acetone.

Pts. sol. in 100 pts. acetone	t°
4.60	0
4.40	12
4.11	25
3.76	46
3.12	53
2.14	58

(Lassczynski, B. 1894, 27. 2287.)

+H<sub>2</sub>O. 13.536 millimols. are contained in 1 l. sat. solution at 25°. (Hers, Z. anorg. 1912, 73. 274.)

## Solubility in HCl+Aq at 25°.

Millimols HCl in 10 ccm.	Millimols LiCl in 10 ccm.
...	135.36
6.30	134.14
10.53	126.52
17.64	122.58

(Hers, Z. anorg. 1912, 73. 274.)

+2H<sub>2</sub>O. Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)+3H<sub>2</sub>O. (Bogorodski, C. C. 1894, II. 514.)

## Lithium gold chloride.

See Chloraurate, lithium.

Lithium manganous chloride, LiCl, MnCl<sub>2</sub>+3H<sub>2</sub>O.Decomp. by H<sub>2</sub>O; stable only in excess of LiCl. (Chassevant, A. ch. (6) 30. 10.)Lithium mercuric chloride, 2LiCl, HgCl<sub>2</sub>.Very deliquescent and sol. in H<sub>2</sub>O. (Harth, Z. anorg. 1897, 14. 323.)Lithium nickel chloride, LiCl, NiCl<sub>2</sub>+3H<sub>2</sub>O.Deliquescent. Sol. in H<sub>2</sub>O and alcohol. (Chassevant.)Lithium thallic chloride, 3LiCl, TlCl<sub>3</sub>+8H<sub>2</sub>O.Very deliquescent. Sol. in H<sub>2</sub>O. (Pratt, Am. J. Sci. 1895, (3) 49. 404.)

## Lithium stannic chloride.

See Chlorostannate, lithium.

Lithium uranous chloride, Li<sub>2</sub>UCl<sub>6</sub>.

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

Lithium uranium chloride, UCl<sub>4</sub>, 2LiCl.Very hygroscopic; sol. in H<sub>2</sub>O with decomp. Sol. in acetic acid. Decomp. by alcohol. (Aloy, Bull. Soc. 1899, (3) 21. 264.)



**Lithium zinc chloride,  $\text{LiCl}, \text{ZnCl}_2 + 3\text{H}_2\text{O}$ .**

Extremely deliquescent. (Ephraim, Z. anorg. 1908, 59, 68.)

$3\text{LiCl}, \text{ZnCl}_2 + 10\text{H}_2\text{O}$  (?). Not obtained in solid state. (Ephraim, Z. anorg. 1908, 59, 69.)

**Lithium chloride ammonia.**

$\text{LiCl}, \text{NH}_3$ .

$\text{LiCl}, 2\text{NH}_3$ .

$\text{LiCl}, 3\text{NH}_3$ .

$\text{LiCl}, 4\text{NH}_3$ .

Above salts are all decomp. by  $\text{H}_2\text{O}$ . (Bonnefoi, C. R. 1898, 127, 367-369.)

**Lithium chloriodide,  $\text{LiCl}_4\text{I} + 4\text{H}_2\text{O}$ .**

Deliquescent. (Wells and Wheeler, Sill. Am. J. 144, 42.)

**Lithium fluoride,  $\text{LiF}$ .**

Very difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 1, 17.)

Two crystalline forms. Only very sl. sol. in  $\text{H}_2\text{O}$ . Very sl. decomp. by  $\text{H}_2\text{O}$  at red heat. (Poulenc, Bull. Soc. 1894, (3) 11, 17.)

Sp. gr. of solution sat. at  $18^\circ = 1.003$  and contains 0.27%  $\text{LiF}$ . (Mylius, B. 1897, 30, 1718.)

Sol. in 800 pts.  $\text{H}_2\text{O}$ , and the presence of  $\text{NH}_4\text{F}$  and  $\text{NH}_3$  decreases solubility to 1:3500. (Carnot, Bull. Soc. 1889, (3) 1, 250.)

Two crystalline forms are very sl. sol. in  $\text{HCl}$ ; easily sol. in  $\text{HNO}_3$ . (Poulenc, Bull. Soc. 1894, (3) 11, 17.)

Two crystalline forms are insol. in 95% alcohol. (Poulenc.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

**Lithium hydrogen fluoride,  $\text{LiHF}_2$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ , but more easily than  $\text{LiF}$ . (Berzelius.)

**Lithium silicon fluoride.**

See Fluosilicate, lithium.

**Lithium stannic fluoride.**

See Fluostannate, lithium.

**Lithium tantalum fluoride.**

See Fluotantalate, lithium.

**Lithium uranyl fluoride,  $\text{UO}_2\text{F}_2, 4\text{LiF}$ .**

(Ditte.)

**Lithium zirconium fluoride.**

See Fluozirconate, lithium.

**Lithium hydride,  $\text{LiH}$ .**

Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Guntz, C. R. 1896, 123, 997.)

**Lithium hydrosulphide,  $\text{LiSH}$  (?).**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius, Pogg. 6, 439.)

**Lithium hydroxide,  $\text{LiOH}$ .**

Not so deliquescent as  $\text{NaOH}$ , and apparently not more sol. in hot than cold  $\text{H}_2\text{O}$ . (Gmelin, Gilb. 62, 399.)

Not deliquescent. (Arfvedson, A. ch. 10, 82.)

The solubility of  $\text{LiOH}$  in  $\text{H}_2\text{O}$  can be expressed by  $y = 6.6750 + 0.00346t + 0.0003t^2$ , where  $y$  = the percentage of  $\text{Li}_2\text{O}$  in a saturated solution. (Dittmar, Jour. Soc. Chem. Ind. 7, 730.)

Solubility of  $\text{LiOH}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. per 100 g. Solution		G. $\text{LiOH}$ per 100 g. $\text{H}_2\text{O}$
	$\text{Li}_2\text{O}$	$\text{LiOH}$	
0	6.67	10.64	12.7
10	6.74	10.80	12.7
20	6.86	10.99	12.8
25	6.95	11.14	12.9
30	7.05	11.27	12.9
40	7.29	11.68	13.0
50	7.56	12.12	13.3
60	7.96	12.76	13.8
80	8.87	14.21	15.3
100	10.02	16.05	17.5

(Seidl's Solubilities, 1st Ed. 174.)

A sat. aq. solution contains 7.09%  $\text{LiOH}$ . (Schreinemakers, C. C. 1905, II, 1486.)

Sp. gr. of  $\text{LiOH} + \text{Aq}$  at  $18^\circ$  containing:

1.25    2.5    5    7.5%  $\text{LiOH}$ .

1.0132   1.0276   1.0547   1.0804

(Kohlrausch, W. Ann. 1879, 1.)

Solubility in  $\text{Li}_2\text{SbS}_4 + \text{Aq}$  at  $30^\circ$ .

% $\text{LiOH}$	% $\text{Li}_2\text{SbS}_4$	Solid Phase
11.4	0	$\text{LiOH}, \text{H}_2\text{O}$
9.1	8.3	"
2.3	29.9	"
2.1	48.3	"
2.1	52.1	$\text{LiOH}, \text{H}_2\text{O} + \text{Li}_2\text{SbS}_4, 10\text{H}_2\text{O}$
1.4	51.8	$\text{Li}_2\text{SbS}_4, 10\text{H}_2\text{O}$
0	51.3	"

(Donk, Chem. Weekbl. 1908, 5, 529, 629, 767.)

Sl. sol. in alcohol; insol. in alcohol-ether. (Mayer.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37, 3601.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II. 1014.)

Cryst. also with  $H_2O$ , and  $\frac{1}{2}H_2O$ . (Göttig, B. 20, 2912.)

**Lithium imide,  $Li_2NH$ .**

Decomp. at high temp. Insol. in toluene, benzene, ether and ethyl acetate. Decomp.  $CHCl_3$ . (Ruff, B. 1911, 44, 506.)

**Lithium iodide,  $LiI$ .**

Deliquescent.

Solubility in 100 pts.  $H_2O$  at:

0° 19° 40° 59° 75° 80° 99° 120°  
151 164 179 200 263 435 476 588 pts.  $LiI$ .

Sp. gr. of  $LiI + Aq$  at 19.5° containing:

5 10 15 20 25 30%  $LiI$ ,  
1.038 1.079 1.124 1.172 1.224 1.280

35 40 45 50 55 60%  $LiI$ .  
1.344 1.414 1.489 1.575 1.670 1.777

(Kremers, Pogg. 104, 133; 111, 60: Gerlach, Z. anal. 8, 295.)

Sp. gr. of  $LiI + Aq$  at 18° containing:

5 10 15 20 25%  $LiI$ .  
1.0361 1.0756 1.1180 1.1643 1.2138

(Kohlrausch, W. Ann. 1879, 1.)

Temp. of maximum g.-mol.  $LiI$  dissolved  
density of  $LiI + Aq$  in 1000 g.  $H_2O$ .

2.516° 0.1795

0.039° 0.4666

(de Coppet, C. R. 1900, 131, 178.)

Very sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

100 g. methyl alcohol dissolve 343.4 g.  $LiI$  at 25°.

100 g. ethyl alcohol dissolve 250.8 g.  $LiI$  at 25°.

100 g. propyl alcohol dissolve 47.52 g.  $LiI$  at 25°.

100 g. isoamyl alcohol dissolve 112.50 g.  $LiI$  at 25°.

In the case of propyl alcohol the solid phase at 25° is  $LiI$ ,  $4C_3H_7O$ . (Turner and Bissett, Chem. Soc. 1913, 103, 1909.)

Solubility in organic solvents at t°.

C = pts. by wt. of  $LiI$  in 100 ccm. of the sat. solution.

L = no. of liters which at the saturation temp. hold in solution 1 mol.  $LiI$ .

Solvent	t°	C	L
Furfural	25°	45.86	0.292
Nitromethane	25°	2.519	5.32
"	0°	1.219	10.98

(Walden, Z. phys. Ch. 1906, 55, 718.)

Solubility in glycol at 15.3° = 28%. (de Coninck, Belg. Acad. Bull. 1906, 359.)

Sol. in benzonitrile. (Naumann, B. 1914, 47, 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42, 3789.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43, 314.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37, 4328.)

+ $H_2O$ . Mpt. below 200°. (Bogorodsky, C. C. 1897, II. 175.)

+2 $H_2O$ . Mpt. 86–88°. (Bogorodsky.)

+3 $H_2O$ . Mpt. 75°. (Bogorodsky.)

Sol. in absolute alcohol without decomp. (Thirsoff, Chem. Soc. 1894, 66, (2) 234.)

The composition of the hydrates formed by  $LiI$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $LiI$  and of the conductivity and sp. gr. of  $LiI + Aq$ . (Jones, Am. Ch. J. 1905, 34, 301.)

**Lithium mercuric iodide,  $2LiI, HgI_2 + 6H_2O$ .**

Very deliquescent. Decomp. by  $H_2O$ . Very sol. without decomp. in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, ethyl oxalate, etc. Less sol. in nitrobenzene. Insol. in benzene and methyl iodide. (Duboin, C. R. 1906, 141, 1017.)

+8 $H_2O$ . Decomp. by  $H_2O$ . Very sol. in alcohols, glycerine, acetone, fuming formic acid, acetic acid, ethyl acetate, etc. without decomp. Sl. sol. in nitrobenzene. Insol. in benzene and methyl iodide. (Duboin, l. c.)

+9 $H_2O$ . Hygroscopic. Sol. in alcohol and acetone without decomp. (Dobroserdoff, C. C. 1901, I. 664.)

**Lithium nitride,  $Li_3N$ .**

Sol. in  $H_2O$  with decomp. (Ouvrard, C. R. 114, 120.)

Very hygroscopic. (Dafert, M. 1910, 31, 987.)

**Lithium oxide,  $Li_2O$ .**

Slowly sol. in  $H_2O$  to form  $LiOH$ .

See Lithium hydroxide.

**Lithium peroxide,  $Li_2O_2$ .**

(de Forcrand, C. R. 1900, 130, 1467.)

**Lithium hydrogen peroxide,  $Li_2O_2, H_2O_2 + 3H_2O$ .**

Sol. in  $H_2O$ . Insol. in alcohol. (de Forcrand, C. R. 1900, 130, 1466.)

**Lithium selenide,  $Li_2Se$ .**

Sol. in  $H_2O$ . (Fabre, C. R. 103, 269.)

+9 $H_2O$ . Sol. in  $H_2O$ . (Fabre.)

**Lithium silicide,  $Li_3Si$ .**

Decomp. by  $H_2O$  and by dil. acids. Decomp. by aqueous solutions of alkalis with evolution of  $H_2$ . (Moissan, C. R. 1902, 134, 1083.)

**Lithium monosulphide,  $\text{Li}_2\text{S}$ .**

More sol. in  $\text{H}_2\text{O}$  or alcohol than  $\text{LiOH}$ .

**Luteochromium bromide,  $\text{Cr}(\text{NH}_3)_3\text{Br}_3$ .**

Less sol. in  $\text{H}_2\text{O}$  than the chloride. (Jörgensen, J. pr. (2) 30. 1.)

— **bromoplatinate**,  $[\text{Cr}(\text{NH}_3)_3]_2(\text{PtBr}_6)_2 + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Jörgensen.)

— **chloride**,  $\text{Cr}(\text{NH}_3)_3\text{Cl}_3 + \text{H}_2\text{O}$ .

Efflorescent, and very sol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

— **chloroplatinate**.

(a)  $[\text{Cr}(\text{NH}_3)_3]_2(\text{PtCl}_6)_2 + 6\text{H}_2\text{O}$ . Nearly completely insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

(b)  $\text{Cr}(\text{NH}_3)_3\text{Cl}(\text{PtCl}_6) + 2\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into above; insol. in alcohol. (Jörgensen.)

(c)  $[\text{Cr}(\text{NH}_3)_3]_2\text{Cl}_4(\text{PtCl}_6) + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into (a). (Jörgensen.)

— **mercuric chloride**,  $\text{Cr}(\text{NH}_3)_3\text{Cl}_3, \text{HgCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ ; al. sol. in dil.  $\text{HCl} + \text{Aq}$ ; insol. in alcohol.

$\text{Cr}(\text{NH}_3)_3\text{Cl}_3, 3\text{HgCl}_2 + 2\text{H}_2\text{O}$ . Decomp. by dil.  $\text{HCl} + \text{Aq}$  into above salt. (Jörgensen.)

— **chromicyanide**,  $\text{Cr}(\text{NH}_3)_3\text{Cr}(\text{CN})_6$ .

Precipitate.

— **cobalticyanide**,  $\text{Cr}(\text{NH}_3)_3\text{Co}(\text{CN})_6$ .

Nearly insol. in  $\text{H}_2\text{O}$  or in conc.  $\text{HCl} + \text{Aq}$ . (Jörgensen.)

— **ferrocyanide**,  $\text{Cr}(\text{NH}_3)_3\text{Fe}(\text{CN})_6$ .

Very al. sol. in cold  $\text{H}_2\text{O}$  or dil. acids. (Jörgensen.)

— **iodide**,  $\text{Cr}(\text{NH}_3)_3\text{I}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Jörgensen, l. c.)

— **iodosulphate**,  $\text{Cr}(\text{NH}_3)_3\text{SO}_4\text{I}$ .

Sol. in  $\text{H}_2\text{O}$ ; nearly insol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  or alcohol. (Jörgensen.)

— **nitrate**,  $\text{Cr}(\text{NH}_3)_3(\text{NO}_3)_3$ .

Sol. in 35–40 pts.  $\text{H}_2\text{O}$ . Insol. in cold dil.  $\text{HNO}_3 + \text{Aq}$  or alcohol. Can be crystallised out of  $\text{H}_2\text{O}$  containing a little  $\text{HNO}_3$ . (Jörgensen, J. pr. (2) 30. 1.)

— **nitrate chloroplatinate**,  
 $\text{Cr}(\text{NH}_3)_3(\text{NO}_3)_2\text{PtCl}_6 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Jörgensen.)

— **nitratosulphate**,  $\text{Cr}(\text{NH}_3)_3(\text{NO}_3)\text{SO}_4$ .

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Jörgensen.)

**Luteochromium oxalate**,  $[\text{Cr}(\text{NH}_3)_3]_2(\text{C}_2\text{O}_4)_2 + 4\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Jörgensen.)

— **orthophosphate**,  $\text{Cr}(\text{NH}_3)_3\text{PO}_4 + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Jörgensen.)

— **sodium pyrophosphate**,  
 $\text{Cr}(\text{NH}_3)_3(\text{Na}_2\text{P}_2\text{O}_7) + 11\frac{1}{2}\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ ; wholly insol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jörgensen.)

— **sulphate**,  $[\text{Cr}(\text{NH}_3)_3]_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}$ .

Quite sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Jörgensen.)

— **sulphate chloroplatinate**,

$[\text{Cr}(\text{NH}_3)_3(\text{SO}_4)]_2\text{PtCl}_6$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

**Luteocobalt diamine chromium sulphocyanide.**

See Diamine chromium luteocobalt sulphocyanide.

**Luteocobaltic bromide,  $\text{Co}(\text{NH}_3)_3\text{Br}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . Precipitated from saturated  $\text{H}_2\text{O}$  solution by dil.  $\text{HBr} + \text{Aq}$ . (Jörgensen, J. pr. (2) 35. 417.)

— **bromopermanganate**,

$\text{Co}(\text{NH}_3)_3\text{Br}_3(\text{MnO}_4)$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Klobb, A. ch. (6) 12. 5.)

— **bromoplatinate**,  $\text{Co}(\text{NH}_3)_3\text{Br}_3, \text{PtBr}_6 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; can be recrystallised from hot  $\text{H}_2\text{O}$  containing  $\text{HBr}$ . (Jörgensen.)

— **bromosulphate**,  $\text{Co}(\text{NH}_3)_3\text{Br}(\text{SO}_4)$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Very al. sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jörgensen.)

— **carbonate**,  $[\text{Co}(\text{NH}_3)_3]_2(\text{CO}_3)_2 + 7\text{H}_2\text{O}$ .

Efflorescent; easily sol. in  $\text{H}_2\text{O}$ .

$[\text{Co}(\text{NH}_3)_3]_2(\text{CO}_3)_2, \text{H}_2\text{CO}_3 + 5\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than the neutral salt. (Gibbs and Genth.)

— **chloride**,  $\text{Co}(\text{NH}_3)_3\text{Cl}_3$ .

Sol. in 17.09 pts.  $\text{H}_2\text{O}$  at  $10.5^\circ$ ; 16.81 pts. at  $11.4^\circ$ ; 16.48 pts. at  $12^\circ$ ; and more easily in hot  $\text{H}_2\text{O}$ . (F. Rose.)

100 pts.  $\text{H}_2\text{O}$  dissolve 4.26 pts. at  $0^\circ$ , and 12.74 pts. at  $46.6^\circ$ . (Kurnakoff, J. russ. Soc. 24. 629.)

Not appreciably sol. in conc.  $\text{HCl} + \text{Aq}$ . (Jörgensen.)

Insol. in alcohol or solutions of the alkali chlorides. (Gibbs and Genth.)

Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Aqueous solution is pptd. by alcohol, mineral acids, or alkali chlorides.

**Lutecobaltic mercuric chloride**,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $\text{HgCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Krok, 1870.)

By recrystallizing from hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  is converted into—

$\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $3\text{HgCl}_2 + \text{H}_2\text{O}$ . Very sl. sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

$\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $2\text{HgCl}_2 + \frac{1}{2}\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{O}$ , from which it crystallizes on cooling. Insol. in cold conc.  $\text{HCl} + \text{Aq}$ , and is pptd. from  $\text{H}_2\text{O}$  solution by  $\text{HCl}$  or alcohol. (Carstanjen.)

Does not exist. (Jørgensen.)

$+3\text{H}_2\text{O}$ . More easily sol. in cold  $\text{H}_2\text{O}$  and other solvents than the preceding comp. (Carstanjen, Berlin, 1861.)

Does not exist. (Jørgensen.)

— **stannous chloride**,  $2\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,

$3\text{SnCl}_2 + 10\text{H}_2\text{O}$ .

$+8\text{H}_2\text{O}$ .

— **chlaurate**,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $\text{AuCl}_3$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Gibbs and Genth, Sill. Am. J. (2) 23. 330.)

— **chloriodate**,  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]_2\text{I}_4\text{O}_{11} + \text{H}_2\text{O}$ .

— **chloriridite**,  $\text{Co}(\text{NH}_3)_4$ ,  $\text{IrCl}_3$ .

Insol. in boiling  $\text{H}_2\text{O}$  or dil.  $\text{HCl} + \text{Aq}$ . (Gibbs.)

— **chloriridate**,  $2\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $3\text{IrCl}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— **chlorochromate**,  $\text{Co}(\text{NH}_3)_4\text{CrO}_4\text{Cl} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1027.)

— **chlorofluoride**,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2\text{F}$ .

(Bohm, Z. anorg. 1905, 43. 339.)

— **chloropalladite**,  $2\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $3\text{PdCl}_2$ .

Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . (Gibbs, Sill. Am. J. (2) 37. 58.)

— **chloroperchlorate**,  $\text{Co}(\text{NH}_3)_4\text{Cl}(\text{ClO}_4)_2$ .

(Millosevich, Gazz. ch. it. 1901, 31. (2) 285.)

— **chloropermanganate**,

$\text{Co}(\text{NH}_3)_4\text{Cl}_2(\text{MnO}_4)$ .

Can be recrystallized from  $\text{H}_2\text{O}$ . (Klobb, C. R. 103. 384.)

— **chloropermanganate ammonium chloride**,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2(\text{MnO}_4)$ ,  $\text{NH}_4\text{Cl}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Klobb.)

**Lutecobaltic chloropermanganate potassium chloride**,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2(\text{MnO}_4)$ ,  $\text{KCl}$ .

Very easily sol. in  $\text{H}_2\text{O}$ , with decomp. into constituents; sol. in  $\text{KCl} + \text{Aq}$ . (Klobb.)

— **chloropermanganate sodium chloride**,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2(\text{MnO}_4)$ ,  $\text{NaCl}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Klobb.)

— **chloroplatinate**,  $2\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ .

Can be recrystallized from much hot  $\text{H}_2\text{O}$ . (Gibbs and Genth.)

$+21\text{H}_2\text{O}$ . (Gibbs and Genth.)

$\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $\text{PtCl}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Very sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$  into—

$2\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$ . By recrystallizing from hot  $\text{H}_2\text{O}$  containing  $\text{HCl}$  this salt is converted into the above salt. (Jørgensen.)

— **chlororhodite**.

Nearly insol. in boiling  $\text{H}_2\text{O}$  or dil. acids. Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Gibbs, Sill. Am. J. (2) 37. 57.)

— **chlororuthenate**,  $2\text{Co}(\text{NH}_3)_4\text{Cl}_2$ ,  $3\text{RuCl}_3$ .

Sol. in dil. acids. (Gibbs.)

— **chloroselenate**,  $\text{Co}(\text{NH}_3)_4\text{ClSeO}_4 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1029.)

— **chlorosulphate**,  $\text{Co}(\text{NH}_3)_4\text{Cl}(\text{SO}_4)$ .

Sol. in  $\text{H}_2\text{O}$ .

$+3\text{H}_2\text{O}$ . Only sl. sol. in cold  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1025.)

— **ammonium chlorosulphate**,

$[\text{Co}(\text{NH}_3)_4\text{Cl}_2(\text{SO}_4)]_2$ ,  $3(\text{NH}_4)_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Klobb, Bull. Soc. 1901, (3) 25. 1027.)

— **chlorosulphate chloroplatinate**,

$2\text{Co}(\text{NH}_3)_4\text{Cl}(\text{SO}_4)$ ,  $\text{PtCl}_4$ .

Very sl. sol. in cold pure  $\text{H}_2\text{O}$ . Can be recrystallized out of  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Krok.)

— **chlorosulphate mercuric chloride**,

$\text{Co}(\text{NH}_3)_4\text{Cl}(\text{SO}_4)$ ,  $\text{HgCl}_2$ .

Scarcely sol. in pure  $\text{H}_2\text{O}$ , but can be crystallized from warm acidified  $\text{H}_2\text{O}$ . (Krok.)

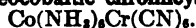
— **chlorosulphite**,  $\text{Co}(\text{NH}_3)_4(\text{SO}_3)\text{Cl} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Magdeburg, B. 22. 2637.)

— **chromate**,  $[\text{Co}(\text{NH}_3)_4]_2(\text{CrO}_4)_3 + 5\text{H}_2\text{O}$ .

Ppt. Sol. in hot  $\text{H}_2\text{O}$ .

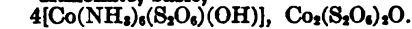
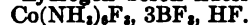
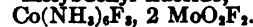
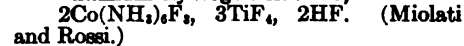
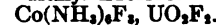
$[\text{Co}(\text{NH}_3)_4]_2(\text{Cr}_2\text{O}_7)_3 + 5\text{H}_2\text{O}$ . Moderately sol. in hot  $\text{H}_2\text{O}$ .

**Luteocobaltic chromicyanide,**

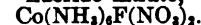
Ppt. (Braun.)

**— cobalticyanide,  $\text{Co}(\text{NH}_3)_5\text{Co}(\text{CN})_6$ .**

Ppt.

**— dithionate, basic,**Sol. in  $\text{H}_2\text{O}$  and dil. alcohol.**— ferricyanide,  $\text{Co}(\text{NH}_3)_5\text{Fe}(\text{CN})_6 + \frac{1}{2}\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . (Braun.)**— fluoride,  $\text{Co}(\text{NH}_3)_5\text{F}_3$ .**Sl. sol. in cold  $\text{H}_2\text{O}$ . Nearly insol. in acids. (Böhm, Z. anorg. 1905, 43. 340.)**— hydrogen fluoride,  $\text{Co}(\text{NH}_3)_5\text{H}_2\text{F}_3$ .**Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati and Rossi, Real. Ac. Linc. 1896, (5) 5. II, 185.)**— hydrogen boron fluoride,**Cryst. from  $\text{H}_2\text{O}$  acidified with HF. (Miolati and Rossi.)**— molybdenyl fluoride,**Cryst. from  $\text{H}_2\text{O}$  containing HF. (Miolati and Rossi.)**— silicon fluoride,****— titanium hydrogen fluoride,****— tungstyl fluoride,****— uranyl fluoride.**Can be cryst. from  $\text{H}_2\text{O}$  containing HF. (Miolati and Rossi.)**— vanadyl fluoride,**

Ppt. (Miolati and Rossi.)

**— fluoride nitrate,**

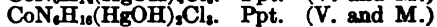
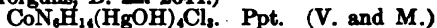
(Bohm, Z. anorg. 1905, 43. 336.)

**— hydroxide,  $\text{Co}(\text{NH}_3)_5(\text{OH})_2$ .**

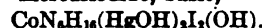
Known only in aqueous solution.

**Luteocobaltic mercuric hydroxychloride,**

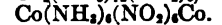
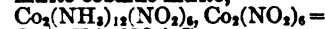
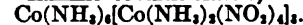
Ppt. Easily decomp. (Vortmann and Morgulis, B. 22. 2644.)

**— iodide,  $\text{Co}(\text{NH}_3)_5\text{I}_3$ .**Insol. in cold, but moderately sol. in hot  $\text{H}_2\text{O}$ .According to Jörgensen, contains  $\text{HNO}_3$  and has the formula  $\text{Co}_2(\text{NH}_3)_{12}\text{I}_4(\text{NO}_3)_2$ .**— iodosulphate,  $\text{Co}(\text{NH}_3)_5\text{I}(\text{SO}_4)$ .**Can be recrystallised from hot  $\text{H}_2\text{O}$ . Sl. sol. in warm, nearly insol. in cold  $\text{H}_2\text{O}$ . (Krok, B. 4. 711.)**— mercuriodide,  $\text{Co}_2\text{N}_{12}\text{H}_{24}(\text{HgI})_2\text{I}_4$ .**

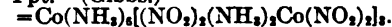
Ppt. (Vortmann and Borsbach.)

**— mercuriodide, basic,**Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Vortmann and Borsbach, B. 23. 2804.)**— nitrate,  $\text{Co}(\text{NH}_3)_5(\text{NO}_3)_2$ .**Sol. in  $\text{H}_2\text{O}$ . Can be recrystallised from boiling  $\text{H}_2\text{O}$ . Sol. in about 60 pts.  $\text{H}_2\text{O}$ . Insol. in conc.  $\text{HNO}_3 + \text{Aq}$ . (Jörgensen, J. pr. (2), 35. 417.)

Almost insol. in acids. (Rogojski, A. ch. (3), 41. 454.)

Insol. in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ ; decomp. by  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Gibbs and Genth.) $\text{Co}(\text{NH}_3)_5(\text{NO}_3)_2, \text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or dil. alcohol. (Jörgensen, J. pr. (2), 44. 63.)**— nitrate chloroplatinate,**Not decomp. by  $\text{H}_2\text{O}$ . (Jörgensen.)**— nitratosulphate,  $\text{Co}(\text{NH}_3)_5(\text{NO}_3)(\text{SO}_4)$ .**Sol. in  $\text{H}_2\text{O}$ . (Jörgensen.)**— nitrite cobaltic nitrite,**Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)Much less sol. in  $\text{H}_2\text{O}$  than the corresponding roseo salt. (Gibbs.)**— diamine cobaltic nitrite,**

Ppt. (Gibbs.)

Nearly insol. in cold, sl. sol. in boiling  $\text{H}_2\text{O}$ . (Jörgensen, Z. anorg. 5. 179.)**— oxalate,  $[\text{Co}(\text{NH}_3)_5]_2(\text{C}_2\text{O}_4)_2 + 4\text{H}_2\text{O}$ .**Insol. in hot or cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ .

**Lutecobaltic oxalate chloraurate,**  
 $2\text{Co}(\text{NH}_3)_6(\text{C}_2\text{O}_4)_2\text{Cl}, \text{AuCl}_3 + 4\text{H}_2\text{O}.$

Easily sol. in hot  $\text{H}_2\text{O}$ . (Gibbs.)

— **perchlorate,**  $\text{Co}(\text{NH}_3)_6(\text{ClO}_4)_2.$

(Millosevich, *Gazz. ch. it.* 1901, **31**, (2) 285.)

— **permanganate,**  $[\text{Co}(\text{NH}_3)_6](\text{MnO}_4)_2.$

Nearly insol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve only 0.072 pt. salt. Moderately sol. in hot  $\text{H}_2\text{O}$ . (Klobb, *A. ch.* (6) **12**, 5.)

— **persulphate sulphate,**  
 $[\text{Co}(\text{NH}_3)_6]_2\text{S}_2\text{O}_8(\text{SO}_4)_2.$

Much less sol. in  $\text{H}_2\text{O}$  than the sulphate. Sol. in 641 pts.  $\text{H}_2\text{O}$  at  $18.8^\circ$  and in 632 pts. at  $20^\circ$ . Not easily sol. even in boiling  $\text{H}_2\text{O}$ . (Jørgensen, *Z. anorg.* 1898, **17**, 459.)

— **orthophosphate,**  $\text{Co}(\text{NH}_3)_6(\text{PO}_4) + 4\text{H}_2\text{O}.$

Sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Jørgensen.)

$[\text{Co}(\text{NH}_3)_6]_2(\text{PO}_4)(\text{PO}_4\text{H})_2 + 5\frac{1}{2}\text{H}_2\text{O}$  (?). Ppt. (Braun.)

$[\text{Co}(\text{NH}_3)_6]_2(\text{PO}_4\text{H})_2 + 4\text{H}_2\text{O}$ . Ppt. Easily sol. in very dil.  $\text{HCl} + \text{Aq}$ . (Jørgensen.)

— **metaphosphate.**

Ppt.

— **pyrophosphate,**  $[\text{Co}(\text{NH}_3)_6]_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}.$

(Gibbs, *Am. Acad. Proc.* **11**, 29); or  $\text{Co}_2(\text{NH}_3)_{12}\text{P}_2\text{O}_7(\text{ONa})_2$  (Vortmann, *B.* **11**, 2181); or  $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{Na}) + 11\frac{1}{2}\text{H}_2\text{O}$ . (Jørgensen, *J. pr.* (2) **35**, 438.)

Very nearly insol. in  $\text{H}_2\text{O}$ . With  $\text{H}_2\text{O}$  at  $80^\circ$  it is decomp. into—

$[\text{Co}(\text{NH}_3)_6]_2(\text{P}_2\text{O}_7) + 20\text{H}_2\text{O}$ . Less easily sol. than the preceding salt.

— **pyrophosphate, acid,**  $\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{H})_2.$

Wholly insol. in  $\text{H}_2\text{O}$ . Somewhat sol. in dil.  $\text{HCl} + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$  (Jørgensen.)

— **sodium pyrophosphate,**

$\text{Co}(\text{NH}_3)_6(\text{P}_2\text{O}_7\text{Na}) + 11\frac{1}{2}\text{H}_2\text{O}.$

Ppt. Not wholly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Less sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Jørgensen.)

$[\text{Co}(\text{NH}_3)_6]_2(\text{P}_2\text{O}_7)_2 + 2\text{Co}(\text{NH}_3)_6(\text{NaP}_2\text{O}_7) + 39\text{H}_2\text{O}$ . As above. (Jørgensen.)

— **selenate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2 + 5\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$ . (Klobb, *Bull. Soc.* 1901, (3) **25**, 1028.)

— **hydrogen selenate,**

$[\text{Co}(\text{NH}_3)_6]_2\text{H}(\text{SeO}_4)_2 + 2\frac{1}{2}\text{H}_2\text{O}.$

Not decomp. by  $\text{H}_2\text{O}$ . (Klobb.)

**Lutecobaltic ammonium selenate,**  
 $[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2, (\text{NH}_4)_2\text{SeO}_4 + 4\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$ .

$[\text{Co}(\text{NH}_3)_6]_2(\text{SeO}_4)_2, (\text{NH}_4)_2\text{SeO}_4 + 8\text{H}_2\text{O}.$   
 Very sol. in  $\text{H}_2\text{O}$ . (Klobb.)

— **sulphocyanide,**  $\text{Co}(\text{NH}_3)_6(\text{SCN})_2.$

Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati, *Z. anorg.* 1900, **23**, 241.)

— **mercuric sulphocyanide,**

$\text{Co}(\text{NH}_3)_6(\text{SCN})_2, 2\text{Hg}(\text{SCN})_2.$

Decomp. by  $\text{H}_2\text{O}$ .

Cryst. from dil.  $\text{NH}_4\text{SCN} + \text{Aq}$ . (Miolati.)

— **platinum sulphocyanide,**

$[\text{Pt}(\text{SCN})_4]_2[\text{Co}(\text{NH}_3)_6(\text{SCN})_2]_2.$

Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati.)

— **silver sulphocyanide,**

$\text{Co}(\text{NH}_3)_6(\text{SCN})_2, 2\text{AgSCN}.$

Decomp. by hot  $\text{H}_2\text{O}$ . (Miolati.)

— **sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}.$

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .  
 $+ 6\text{H}_2\text{O}$ . (Krok, *B.* **4**, 711.)

— **hydrogen sulphate,**

$\text{Co}(\text{NH}_3)_6\text{H}(\text{SO}_4)_2.$

Decomp. by alcohol to sulphate. (Jørgensen, *Z. anorg.* 1898, **17**, 458.)

$4[(\text{Co}_6\text{NH}_3)_2(\text{SO}_4)_2], 5\text{H}_2\text{SO}_4 + 10\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$  with decomp. into the normal sulphate.

When pulverized it seems to dissociate slowly in contact with abs. alcohol. (Klobb, *Bull. Soc.* 1901, (3) **25**, 1025.)

— **ammonium sulphate,**

$[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2, (\text{NH}_4)_2\text{SO}_4 + 8\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$  with decomp. (Klobb.)

— **cerium sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2,$   
 $\text{Ce}_2(\text{SO}_4)_2 + 1\frac{1}{2}\text{H}_2\text{O}.$

Very sl. sol. in cold, and practically insol. in boiling  $\text{H}_2\text{O}$ . Sol. in acids. (Gibbs, *Am. Ch. J.* **15**, 560.)

$[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2, 3\text{Ce}(\text{SO}_4)_2 + \text{H}_2\text{O}$ . As above. (Wing, *Sill. Am. J.* (2) **49**, 363.)

— **lanthanum sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2,$   
 $\text{La}_2(\text{SO}_4)_2 + \text{H}_2\text{O}.$

Sl. sol. in  $\text{H}_2\text{O}$ . (Wing.)

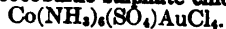
— **thallic sulphate,**  $[\text{Co}(\text{NH}_3)_6]_2(\text{SO}_4)_2,$   
 $\text{Tl}_2\text{O}(\text{SO}_4)_2 + 5\text{H}_2\text{O}.$

Decomp. by cold  $\text{H}_2\text{O}$ . (Gibbs.)

— **sulphate bromaurate,**

$\text{Co}(\text{NH}_3)_6(\text{SO}_4)(\text{AuBr}_4).$

Very sl. sol. in  $\text{H}_2\text{O}$  with apparent decomp. Insol. in alcohol. (Jørgensen.)

**Luteocobaltic sulphate chloraurate,**Sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **cobaltic sulphite**,  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_2$ ,  
 $\text{Co}_2(\text{SO}_3)_2 + \text{H}_2\text{O} = \text{dichrocobaltic sulphite}$ ,  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_2 + 2\text{H}_2\text{O}$ , which see.

$[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_2$ ,  $2\text{Co}_2(\text{SO}_3)_2 + 15\text{H}_2\text{O} =$   
**diamine cobaltic sulphite**,  $[\text{Co}(\text{NH}_3)_2]_2(\text{SO}_3)_2 + 5\text{H}_2\text{O}$ , which see.

**Luteorhodium bromide,  $\text{Rh}(\text{NH}_3)_4\text{Br}_2$ .**Less sol. in  $\text{H}_2\text{O}$  than the chloride. (Jørgensen, J. pr. (2) 44. 51.)— **chloride**,  $\text{Rh}(\text{NH}_3)_4\text{Cl}_2$ .Sol. in 7 to 8 pts.  $\text{H}_2\text{O}$  at  $8^\circ$ . (J.)+  $\text{H}_2\text{O}$ . Extremely efflorescent. (J.)— **rhodium chloride**,  $\text{Rh}(\text{NH}_3)_4\text{Cl}_2$ ,  $\text{RhCl}_3$ .Sol. in  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. 5. 174.)— **chloroplatinate**,  $2\text{Rh}(\text{NH}_3)_4\text{Cl}_2$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in warm  $\text{HCl} + \text{Aq}$ . (J.)  
 $\text{Rh}(\text{NH}_3)_4\text{Cl}_2$ ,  $\text{PtCl}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into chloride and above salt. (J.)

— **nitrate**,  $\text{Rh}(\text{NH}_3)_4(\text{NO}_3)_2$ .

Sol. in 48 to 49 pts.  $\text{H}_2\text{O}$  at ord. temp.  
 $\text{HNO}_3 + \text{Aq}$  diluted with 5 vols.  $\text{H}_2\text{O}$  ppts. the salt completely from aqueous solution. (Jørgensen, J. pr. (2) 44. 51.)

$\text{Rh}(\text{NH}_3)_4(\text{NO}_3)_2$ ,  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or dil. alcohol. (Jørgensen, J. pr. (2), 44. 63.)

— **orthophosphate**,  $\text{Rh}(\text{NH}_3)_4\text{PO}_4 + 4\text{H}_2\text{O}$ .Sl. sol. in cold  $\text{H}_2\text{O}$ . (J.)— **sodium pyrophosphate**,  
 $[\text{Rh}(\text{NH}_3)_4]_2(\text{P}_2\text{O}_7)_2 \cdot \text{Na}_2 + 23\text{H}_2\text{O}$ .

Nearly wholly insol. in  $\text{H}_2\text{O}$ . Wholly insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (J.)

— **sulphate**,  $[\text{Rh}(\text{NH}_3)_4]_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}$ .Sol. in 43 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (J.)**Magnesium, Mg.**

Does not decomp.  $\text{H}_2\text{O}$  at ord. temp., but decomp. slowly at  $100^\circ$ .  $\text{H}_2\text{O}$  containing acids dissolves Mg easily. Sol. in cold dil.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ . Difficultly sol. in cold  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Bunsen.) Cold nitrosulphuric acid does not attack. (Bunsen.) Cold  $\text{NH}_4\text{OH} + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ , or  $\text{NaOH} + \text{Aq}$  do not attack. (Maak, Phipps.) Sol. in  $\text{NH}_4\text{Cl}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Wöhler.)

Very rapidly sol. in  $\text{K}_2\text{S}_2\text{O}_8 + \text{Aq}$  and  $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{Aq}$  with violent evolution of gas. (Levi, Gazz. ch. it. 1908, 38. (1), 583.)

Attacked by aqueous solution of  $\text{KCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{NaCl}$ ,  $\text{LiCl}$ ,  $\text{CuCl}$ ,  $\text{CdCl}_2$ ,  $\text{CoCl}_2$ ,  $\text{PbCl}_2$ ,  $\text{HgCl}_2$ ,  $\text{FeCl}_3$ ,  $\text{CrCl}_3$ ,  $\text{PtCl}_4$ ,  $\text{AuCl}_3$ ,  $\text{CuSO}_4$ ,  $\text{ZnSO}_4$ ,  $\text{FeSO}_4$  and  $\text{MnSO}_4$ .

Sl. attacked by hot 30%  $\text{CaCl}_2 + \text{Aq}$ , not by 30%  $\text{MgCl}_2 + \text{Aq}$ ,  $\text{BaCl}_2 + \text{Aq}$  and  $\text{SrCl}_2 + \text{Aq}$ . (Tommasi, Bull. Soc. 1899, (3), 21. 886.)

Not attacked by  $\text{NH}_4\text{F} + \text{Aq}$ , very slowly by solutions of  $\text{BaCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{KCl}$ ,  $\text{K}_2\text{Fe}(\text{CN})_6$ ,  $\text{NaNO}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_8$  and  $\text{Na}_2\text{HPO}_4$ . Solutions of  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$ ,  $\text{Na}_2\text{B}_4\text{O}_7$ , alum and chrome alum attack vigorously. Solutions of  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $(\text{NH}_4)_2\text{C}_2\text{O}_4$ ,  $(\text{NH}_4)_2\text{S}$  and  $\text{Na}_2\text{CO}_3$  attack even more vigorously. (Moursaur, C. R. 1900, 130. 140.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Insol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46. 2.)

Somewhat sol. in liquid  $\text{NH}_3$ , if a clean metallic surface is in contact with the pure solvent. (Kraus, J. Am. Chem. Soc. 1907, 29. 1561.)

$\frac{1}{2}$ ccm. oleic acid dissolves 0.0104 g. Mg in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

**Magnesium arsenide,  $\text{Mg}_3\text{As}_2$ .**

Decomp. on air. (Parkinson, Chem. Soc. 5. 127.)

**Magnesium azoimide,  $\text{Mg}(\text{N}_2)_2$ .**Decomp. by hot  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2) 68. 292.)**Magnesium boride,  $\text{Mg}_3\text{B}_2$ .**Sol. in  $\text{HCl} + \text{Aq}$ . (Winkler, B. 23. 774.)**Magnesium bromide,  $\text{MgBr}_2$ .**Deliquescent. Very sol. in  $\text{H}_2\text{O}$  with evolution of heat.Sat.  $\text{MgBr}_2 + \text{Aq}$  contains at:

$-18^\circ$	$+17^\circ$	$48^\circ$	$62^\circ$	$97^\circ$
52	58	60.9	62.5	65.8% $\text{MgBr}_2$ .

(Étard, A. ch. 1894, (7), 2. 541.)

See also  $\text{MgBr}_2 + 6\text{H}_2\text{O}$ .Sp. gr. of  $\text{MgBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5	10	15	20	25 % $\text{MgBr}_2$
1.043	1.087	1.137	1.191	1.247

30	35	40	45	50 % $\text{MgBr}_2$
1.31	1.377	1.451	1.535	1.625

(Kremers, Pogg. 108. 118, calculated by Gerlach, Z. anal. 8. 285.)

 $\text{MgBr}_2 + \text{Aq}$  is sl. decomp. by evaporation.

Solubility of  $\text{MgBr}_2$  in alcohols.

$\text{MgBr}_2$  forms with methyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{CH}_3\text{OH}$
0	42.6	130	63.6
20	44.6	140	66.8
40	46.7	150	70.2
60	48.9	160	74.0
80	51.4	170	78.5
100	55.5	180	84.5
110	58.0	185	88.0
120	60.7	190 mpt.	100

(Menschutkin, Z. anorg. 1907, 52, 11.)

$\text{MgBr}_2$  forms with ethyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$
0	17.2	80	73.8
10	24.9	85	76.2
20	32.7	90	78.7
30	40.3	95	82.3
40	47.8	100	86.7
50	55.1	103	90.0
60	62.2	106	94.4
70	68.8	108.5 mpt.	100
75	71.4		

(Menschutkin.)

$\text{MgBr}_2$  forms with propyl alcohol a complex,  $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$  in  $\text{C}_3\text{H}_7\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_3\text{H}_7\text{OH}$
0	77.9	43	93.0
10	81.5	46	94.3
20	85.1	48	95.8
30	89.5	50	97.8
40	92.0	52 mpt.	100

(Menschutkin.)

$\text{MgBr}_2$  forms with isobutylalcohol a complex,  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$  in  $\text{C}_4\text{H}_9\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_4\text{H}_9\text{OH}$
0	55.8	60	82.4
10	60.5	65	84.2
20	65.2	71	88.0
30	69.8	75	92.0
40	74.3	77	94.6
50	78.5	80 mpt.	100

(Menschutkin.)

$\text{MgBr}_2$  forms with isoamylalcohol a complex,  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$  in  $\text{C}_5\text{H}_{11}\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6(\text{iso})\text{C}_5\text{H}_{11}\text{OH}$
0	70.2	38	88.7
10	75.6	40	90.0
20	80.2	42	92.0
30	84.5	44	94.2
35	86.7	46 mpt.	100

(Menschutkin.)

Solubility in ether at  $t^\circ$ .

$t^\circ$	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$
-8	0.6	1.08
0	0.8	1.44
+10	1.27	2.3
14	1.64	2.95
16	1.93	3.48
18	2.3	4.14
20	2.7	4.86
22 mpt.	3.22	5.80

(Menschutkin, Z. anorg. 1906, 49, 36.)

Solubility of  $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$  in ether at  $t^\circ$ .

"Lower solution" = the melted  $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$  which does not mix with the ether above.

$t^\circ$	Composition of lower solution		Composition of the upper layer	
	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$	% $\text{MgBr}_2$	% $\text{MgBr}_2 \cdot 2\text{C}_2\text{H}_5\text{O}$
-10	42.0	75.7	1.8	3.2
0	41.0	73.9	2.3	4.1
+10	40.1	72.2	2.8	5.0
20	39.3	70.8	3.3	5.9
30	38.7	69.8	3.8	6.8
40	38.2	68.8	4.3	7.7
50	37.8	68.0	4.7	8.5
60	37.6	67.7	5.1	9.2
70	37.6	67.7	5.4	9.7
80	37.8	68.0	5.6	10.0
90	38.1	68.6	5.7	10.2

(Menschutkin.)



Solubility of  $\text{MgBr}_2$  in formic acid.  
 $\text{MgBr}_2$  forms with formic acid a complex,  
 $\text{MgBr}_2 \cdot 6\text{HCOOH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{HCOOH}$  in  $\text{HCOOH}$   
 at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{HCOOH}$
0	49.8
20	57.5
40	65.1
60	73.1
70	78.1
80	86.0
86	95.0
88 mpt.	100

(Menschutkin, Z. anorg. 1907, 54. 90.)

Solubility of  $\text{MgBr}_2$  in acetic acid.  
 $\text{MgBr}_2$  forms with acetic acid a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$  in  
 $\text{CH}_3\text{COOH}$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{CH}_3\text{COOH}$
17	0.3
30	1.5
50	4.5
60	7.9
70	16.2
80	38.5
85	49.5
90	57.7
100	71.8
105	80.0
110	89.5
112 mpt.	100.0

(Menschutkin.)

Solubility of  $\text{MgBr}_2$  in acetic anhydride.  
 $\text{MgBr}_2$  forms with acetic anhydride a complex,  
 $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$ .

Solubility of  $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$  in  
 $(\text{CH}_3\text{CO})_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6(\text{CH}_3\text{CO})_2\text{O}$
0	26.4
30	30.0
60	37.7
90	44.5
120	57.8
130	69.8
135	85.0
136-137 mpt.	100

(Menschutkin, Z. anorg. 1909, 61. 112.)

Solubility of  $\text{MgBr}_2$  in acetone.  
 $\text{MgBr}_2$  forms with acetone a complex,  
 $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$ .

Solubility of  $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$  in  
 $\text{CH}_3\text{COCH}_3$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 3\text{CH}_3\text{COCH}_3$
0	0.2
30	0.8
60	1.45
70	2.0
72	3.7
73	5.5
74	14.0
75	50.0
76	71.6
80	83.3
84	89.8
88	95.2
92 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 30.)

Solubility of  $\text{MgBr}_2$  in acetamide.  
 $\text{MgBr}_2$  forms with acetamide a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$  in  
 $\text{CH}_3\text{CONH}_2$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONH}_2$
50.5	56.0
70	57.8
90	60.5
110	65.0
130	71.5
150	80.0
160	85.5
165	90.0
169 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61. 106.)

Solubility of  $\text{MgBr}_2$  in acetanilide.  
 $\text{MgBr}_2$  forms with acetanilide a complex,  
 $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$  in  
 $\text{CH}_3\text{CONHC}_6\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{CH}_3\text{CONHC}_6\text{H}_5$
107.5	9.0
140	19.3
170	29.6
185	39.0
195	49.0
200	59.5
205	73.2
209 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61. 109.)

Solubility of  $\text{MgBr}_2$  in aniline.

$\text{MgBr}_2$  forms with aniline three complexes;  
 $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$ ;  $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$ ;  
 $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$ .

Solubility of these complexes in aniline.

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NH}_2$
10	3.2
30	3.9
50	5.1
70	7.5
90	12.8
100	18.5
103.5	27.5

Solubility of  $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4\text{C}_6\text{H}_5\text{NH}_2$
103	24.0
120	24.3
140	24.9
160	26.0
180	28.3
200	33.5
220	45.0
230	55.0
237	76.3

Solubility of  $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$  in  $\text{C}_6\text{H}_5\text{NH}_2$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$
237	76.3
250	77.3
260	78.1
270	79.0

(Menschutkin, Z. anorg. 1907, 52. 159.)

Solubility of  $\text{MgBr}_2$  in benzaldehyde.

$\text{MgBr}_2$  forms with benzaldehyde a complex,  $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$ .

Solubility of  $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$  in  $\text{C}_6\text{H}_5\text{CHO}$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$	$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 3\text{C}_6\text{H}_5\text{CHO}$
0	0.7	140	17.8
30	1.3	145	37.5
60	1.9	146	65.0
80	2.5	148	84.5
100	3.4	153	93.2
120	6.0	159 mpt.	100
130	9.5		

(Menschutkin, Z. anorg. 1907, 53. 26.)

Solubility of  $\text{MgBr}_2$  in methylal.

$\text{MgBr}_2$  forms with methylal a complex,  $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$ .

Solubility of  $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$  in  $\text{CH}_2(\text{OCH}_3)_2$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 2\text{CH}_2(\text{OCH}_3)_2$
20	0.3
40	0.45
60	0.6
80	0.75
100	0.9
106	1.1
106	86.2
108	90.8
110	95.4
112 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 32.)

Solubility of  $\text{MgBr}_2$  in dimethylcarbinol.

$\text{MgBr}_2$  forms with dimethylcarbinol a complex,  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$ .

Solubility of  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$  in  $(\text{CH}_3)_2\text{CHOH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_2\text{CHOH}$
0	40.0	110	62.5
20	42.2	120	67.3
40	45.0	130	74.0
60	48.5	136	83.6
80	53.3	138	90.00
100	59.0	139 mpt.	100

(Menschutkin.)

Solubility of  $\text{MgBr}_2$  in trimethylcarbinol.

$\text{MgBr}_2$  forms with trimethylcarbinol a complex,  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$ .

Solubility of  $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$  in  $(\text{CH}_3)_3\text{COH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$	$t^\circ$	% by weight of $\text{MgBr}_2 \cdot 4(\text{CH}_3)_3\text{COH}$
24.4	0.06	65	50.5
25	1.0	70	62.5
35	9.5	75	77.0
45	19.1	77.5	85.0
55	32.2	79	91.5
60	40.5	80 mpt.	100

(Menschutkin.)

Solubility of  $\text{MgBr}_2$  in phenylhydrazine.

$\text{MgBr}_2$  forms with  $\text{C}_6\text{H}_5\text{NHNH}_2$  a complex,  $\text{MgBr}_2 \cdot 6\text{C}_6\text{H}_5\text{NHNH}_2$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{NHNH}_2$  in  $\text{C}_2\text{H}_5\text{NHNH}_2$  at  $t^\circ$ .

$t^\circ$	% by wt. of $\text{MgBr}_2 \cdot 6\text{C}_2\text{H}_5\text{NHNH}_2$
20	3.0
40	7.0
60	16.4
80	33.0
99	54.8
100	54.8
140	60.8
180	68.4
200	73.4

(Menschutkin, Z. anorg. 1907, 52. 162.)

Solubility of  $\text{MgBr}_2$  in urea.

$\text{MgBr}_2$  forms with urea a complex,  $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$  in urea at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$
108.5	24.2
115	29.8
120	35.0
125	41.6
127	45.5
130	60.0

(Menschutkin, Z. anorg. 1909, 61. 116.)

$\text{MgBr}_2 \cdot 6\text{CO}(\text{NH}_2)_2$  decomposes at  $130^\circ$  giving  $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$ .

Solubility of  $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$  in urea at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 4\text{CO}(\text{NH}_2)_2$
130	58.0
145	60.7
160	67.2
165	71.4
170	83.7
171	96.0

(Menschutkin, Z. anorg. 1909, 61. 116.)

Solubility of  $\text{MgBr}_2$  in urethane.

$\text{MgBr}_2$  forms with urethane a complex,  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$
35	43.3
50	45.6
70	51.3
80	56.2
85	59.8
90	66.5
*91.5	75.5

\* Mpt. of  $\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$ .

(Menschutkin, Z. anorg. 1909, 61. 113.)

$\text{MgBr}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$  decomposes at  $90.5\text{--}91^\circ$  forming  $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$ .

Solubility of  $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgBr}_2 \cdot 4\text{NH}_2\text{COOC}_2\text{H}_5$
91	69.4
100	73.8
110	80.0
115	84.1
120	90.0
123 mpt.	100.0

(Menschutkin.)

+ $6\text{H}_2\text{O}$ .

Solubility of  $\text{MgBr}_2 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgBr}_2 + 6\text{H}_2\text{O}$	$t^\circ$	% by weight of $\text{MgBr}_2 + 6\text{H}_2\text{O}$
0	76.0	120	89.0
20	78.1	140	92.0
40	80.2	150	94.9
60	82.3	160	98.0
80	84.4	164 mpt.	100
100	86.6		

(Menschutkin, Z. anorg. 1907, 52. 153.)

Sp. gr. of solution sat. at  $18^\circ = 1.655$ , and contains 50.8%  $\text{MgBr}_2$ . (Mylus and Funk, B. 1897, 30. 1718.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in alcohol. Sol. in acetone. (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II. 1014.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

+ $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Panfiloff, Chem. Soc. 26. 234.)

**Magnesium manganous bromide,  $\text{MgBr}_2 \cdot 2\text{MnBr}_2 + 12\text{H}_2\text{O}$ .**

Deliquescent. (Saunders, Am. Ch. J. 14. 150.)

**Magnesium mercuric bromide,  $\text{MgBr}_2 \cdot \text{HgBr}_2$ .**

Deliquescent.

$\text{MgBr}_2 \cdot 2\text{HgBr}_2$ . Not deliquescent.

**Magnesium molybdenyl bromide,  $\text{MgBr}_2 \cdot \text{MoOBr}_2 + 7\text{H}_2\text{O}$ .**

(Weinland and Knoll, Z. anorg. 1905, 44. 112.)

**Magnesium potassium bromide,  $\text{MgBr}_2 \cdot 2\text{KBr} + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , from which  $\text{KBr}$  crystallises at  $75$  to  $87^\circ$ . Alcohol dissolves out  $\text{MgBr}_2$ . (Löwig, Repert. 29. 261.)

Formula is  $MgBr_2 \cdot KBr \cdot 6H_2O$ . Deliquescent. (Lerch, J. pr. (2) 28. 338.)

### Magnesium stannic bromide.

See Bromostannate, magnesium.

### Magnesium chloride, $MgCl_2$ .

Deliquescent. Very sol. in  $H_2O$  with evolution of heat. The solution decomposes on evaporation losing  $HCl$ , when less than 6 mols.  $H_2O$  are present to 1 mol.  $MgCl_2$ . (Casaseca, C. R. 37. 350.)

Anhydrous. Sol. in 1.857 pts.  $H_2O$  at  $15^\circ$ . (Gerlach.)

Sol. in 1 pt. cold  $H_2O$ . (Fourcroy.)

Sat.  $MgCl_2$  + Aq at  $12.5^\circ$  contains 64.8%  $MgCl_2$ . (Hassensfratz.)

100 pts.  $H_2O$  at  $15.5^\circ$  dissolve 200 pts.  $MgCl_2$ . (Ure's Dict.)

100 pts.  $H_2O$  dissolve 52.2 pts.  $MgCl_2$  at  $0^\circ$  and sp. gr. of sat. solution = 1.3619 at  $15^\circ$ . (Engel, Bull. Soc. (2) 47. 318.)

1000 mols.  $H_2O$  dissolve 108 mols.  $MgCl_2$  at  $25^\circ C$ . (Löwenherz, Z. phys. Ch. 1894, 13. 479.)

100 mols.  $MgCl_2$  + Aq contain at  $t^\circ$ :

$t^\circ$  67.5 68.5 68.7 79.5 79.95  
Mol.  $MgCl_2$  11.58 11.92 11.71 12.28 12.39

$t^\circ$  116.67 152.6 181-2 186  
Mol.  $MgCl_2$  16.2 18.24 23.8 24.1-24.4  
(Vant Hoff and Meyerhoffer, B. A. B. 1897, 73.)

Solubility of  $MgCl_2$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $MgCl_2$	Solid phase
-10	11.4	Ice
-20	16.	"
-30	19.4	"
-33.6	20.6	Ice + $MgCl_2 \cdot 12H_2O$
-20	26.7	$MgCl_2 \cdot 12H_2O$
-16.4	30.5	"
-16.8	31.6	$MgCl_2 \cdot 12H_2O$ + $MgCl_2 \cdot 8H_2O$
-3.4	34.3	$MgCl_2 \cdot 8H_2O$ + $MgCl_2$ , $6H_2O$
0	34.6	$MgCl_2 \cdot 6H_2O$
10	34.9	"
20	35.3	"
22	35.6	"
40	36.5	"
60	37.9	"
80	39.8	"
100	42.2	"
116.7	46.1	$MgCl_2 \cdot 6H_2O$ + $MgCl_2$ , $4H_2O$
152.6	49.1	$MgCl_2 \cdot 4H_2O$
181.5	55.8	$MgCl_2 \cdot 4H_2O$ + $MgCl_2$ , $2H_2O$
186	56.1	$MgCl_2 \cdot 2H_2O$

(Landolt-Börnstein, Tab. 5th Ed. 1912. 480.)

See also  $MgCl_2 \cdot 6H_2O$ .

Sp. gr. of  $MgCl_2$  + Aq at  $15^\circ$ .

% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.
1	1.0084	13	1.1130	25	1.2274
2	1.0169	14	1.1220	26	1.2378
3	1.0253	15	1.1311	27	1.2482
4	1.0338	16	1.1404	28	1.2586
5	1.0422	17	1.1498	29	1.2690
6	1.0510	18	1.1592	30	1.2794
7	1.0597	19	1.1686	31	1.2903
8	1.0684	20	1.1780	32	1.3012
9	1.0772	21	1.1879	33	1.3121
10	1.0859	22	1.1977	34	1.3230
11	1.0949	23	1.2076	35	1.3340
12	1.1040	24	1.2175	..	...

(Gerlach, Z. anal. 8. 281.)

Sp. gr. of  $MgCl_2$  + Aq at  $18^\circ$ .

% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.	% $MgCl_2$	Sp. gr.
5	1.0416	20	1.1764	34	1.3210
10	1.0859	30	1.2779	..	....

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $MgCl_2$  + Aq at  $0^\circ$ . S = pts. salt in 100 pts. of solution;  $S_1$  = mols. salt in 100 mols. solution.

S	$S_1$	Sp. gr.
29.2056	7.230	1.2788
20.9293	4.762	1.1927
15.7989	3.423	1.1427
11.3249	2.355	1.1007
6.2008	1.233	1.0545

(Charpy, A. ch. (6) 29. 23.)

Sp. gr. of  $MgCl_2$  + Aq at  $19.5^\circ$ .

Pts. $MgCl_2$ in 100 pts. $H_2O$	Sp. gr.	Pts. $MgCl_2$ in 100 pts. $H_2O$	Sp. gr.
10.7	1.0826	35.3	1.2388
22.0	1.1592	51.5	1.3235

(Kremers, Pogg. 104. 155.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $14^\circ$ .

$\frac{\text{MgCl}_2}{\text{+6H}_2\text{O}}$	Sp. gr.	$\frac{\text{MgCl}_2}{\text{+6H}_2\text{O}}$	Sp. gr.	$\frac{\text{MgCl}_2}{\text{+6H}_2\text{O}}$	Sp. gr.
0	0.9993	17	1.0682	34	1.1407
1	1.0033	18	1.0724	35	1.1451
2	1.0073	19	1.0765	36	1.1495
3	1.0113	20	1.0807	37	1.1540
4	1.0154	21	1.0849	38	1.1584
5	1.0194	22	1.0891	39	1.1628
6	1.0234	23	1.0933	40	1.1673
7	1.0274	24	1.0976	41	1.1718
8	1.0314	25	1.1018	42	1.1763
9	1.0355	26	1.1061	43	1.1809
10	1.0395	27	1.1103	44	1.1855
11	1.0435	28	1.1146	45	1.1901
12	1.0476	29	1.1189	46	1.1948
13	1.0517	30	1.1232	47	1.1995
14	1.0558	31	1.1275	48	1.2042
15	1.0599	32	1.1319	..	....
16	1.0641	33	1.1363	..	....

(Oudemans, Z. anal. 7. 420.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $24^\circ$ .

$\frac{\text{MgCl}_2}{\text{+6H}_2\text{O}}$	Sp. gr.	$\frac{\text{MgCl}_2}{\text{+6H}_2\text{O}}$	Sp. gr.	$\frac{\text{MgCl}_2}{\text{+6H}_2\text{O}}$	Sp. gr.
2	1.0069	30	1.1062	58	1.2167
4	1.0138	32	1.1137	60	1.2252
6	1.0207	34	1.1212	62	1.2338
8	1.0276	36	1.1288	64	1.2425
10	1.0345	38	1.1364	66	1.2513
12	1.0415	40	1.1441	68	1.2602
14	1.0485	42	1.1519	70	1.2692
16	1.0556	44	1.1598	72	1.2783
18	1.0627	46	1.1677	74	1.2875
20	1.0698	48	1.1756	76	1.2968
22	1.0770	50	1.1836	78	1.3063
24	1.0842	52	1.1918	80	1.3159
26	1.0915	54	1.2000	..	....
28	1.0988	56	1.2083	..	....

(Gerlach, Z. anal. 8. 283. Calculated from Schiff.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{MnCl}_2 + \text{Aq}$ .	Sp. gr.
1-normal	1.1375
$\frac{1}{2}$ " "	1.0188
$\frac{1}{4}$ " "	1.0091
$\frac{1}{8}$ " "	1.0043

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$ .

$\frac{1}{2}$ $\text{MgCl}_2$ g. in 1000 g. of solution	Sp. gr. $16^\circ/16^\circ$
0	1.000000
0.4400	1.000372
0.8801	1.000741
1.7780	1.001458
3.4533	1.002888
7.4691	1.006219
14.7187	1.012235
29.6307	1.024647

(Dijken, Z. phys. Ch. 1897, 24. 108.)

Sp. gr. of  $\text{MgCl}_2$  at  $20.1^\circ$ .

p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc.  $\left(\frac{\text{pd}}{100} = \text{w}\right)$

p	d	w
28.83	1.2569	0.36237
25.59	1.2241	0.31327
20.31	1.1735	0.23842
15.79	1.1324	0.17877
10.185	1.0833	0.11033
8.058	1.0650	0.08583
5.919	1.0473	0.06198
3.913	1.0304	0.04022
3.903	1.0240	0.03210
1.743	1.0126	0.01765

(Barnes, J. Phys. Chem. 1898, 2. 546.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Concentration of $\text{MgCl}_2 + \text{Aq}$	Sp. gr.
23	1 pt. $\text{MgCl}_2$ in 8.1874 pts. $\text{H}_2\text{O}$	1.0906
24	1 pt. " " 102.1 " "	1.0065

(Hittorf, Z. phys. Ch. 1902, 39. 628.)

Sp. gr. of  $\text{MgCl}_2$  at  $0^\circ$ .

G.  $\text{MgCl}_2$  in 100 ccm. of solution 6.7158 9.9506  
Sp. gr. 1.0591 1.0645

G.  $\text{MgCl}_2$  in 100 ccm. of sol. 13.8111 20.004  
Sp. gr. 1.1106 1.1605

(Bremer, C. C. 1903, I. 293.)

Sp. gr. of  $\text{MgCl}_2 + \text{Aq}$  at  $20^\circ$  containing M g. mols.  $\text{MgCl}_2$  per l.

M 0.00493 0.007327 0.01 0.03104  
Sp. gr. 1.000344 1.000524 1.000842 1.002756

M 0.05108 0.07171 0.10 0.25  
Sp. gr. 1.004224 1.006036 1.008505 1.020966

M 0.50 0.75 0.9415  
Sp. gr. 1.038496 1.056905 1.069617  
(Jones and Pearce, Am. Ch. J. 1907, 33. 699.)

$\text{MgCl}_2 + \text{Aq}$  containing 10%  $\text{MgCl}_2$  boils at  $101.6^\circ$ ; containing 20%  $\text{MgCl}_2$  boils at  $106.2^\circ$ ; containing 30%  $\text{MgCl}_2$  boils at  $115.6^\circ$ . (Gerlach.)

Sat.  $\text{MgCl}_2 + \text{Aq}$  forms a crust at  $122.5^\circ$ , and contains 52.9 pts.  $\text{MgCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ . (Gerlach, Z. anal. 26. 426.)

B.-pt. of  $\text{MgCl}_2 + \text{Aq}$ . P = pts.  $\text{MgCl}_2$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	4.9	111°	34.6	121°	50.8
102	9.2	112	36.6	122	52.2
103	13.2	113	38.4	123	53.6
104	16.7	114	40.2	124	55.0
105	19.9	115	41.8	125	56.4
106	22.5	116	43.4	126	57.7
107	25.0	117	44.9	127	59.0
108	27.5	118	46.4	128	60.3
109	29.9	119	47.9	129	61.6
110	32.3	120	49.4	130	62.9

(Gerlach, Z. anal. 26. 440.)

B.-pt. of  $\text{MgCl}_2 + \text{Aq}$  containing %  $\text{MgCl}_2$ .

% $\text{MgCl}_2$	B.-pt.	% $\text{MgCl}_2$	B.-pt.
4.6	101°	11.6	103°
8.4	102	14.3	104

(Skinner, Chem. Soc. 61. 341.)

Sol. in  $\text{KCl} + \text{Aq}$  at  $50^\circ$ . (Uhlig, C. C. 1913, II. 749.)

Sol. in 7 pts. alcohol at  $15^\circ$ . (Bergmann.)  
moderate heat. (B.)

100 pts. alcohol of given sp. gr. dissolve pts.  $\text{MgCl}_2$ :

Sp. gr.	Pts. $\text{MgCl}_2$	Sp. gr.	Pts. $\text{MgCl}_2$
0.900	21.25	0.834	36.25
0.848	23.75	0.817	50.00

(Kirwan.)

$\text{MgCl}_2 + 6\text{H}_2\text{O}$  is sol. in 5 pts. alcohol of 0.90 sp. gr. and in 2 pts. alcohol of 0.817 sp. gr.

Sol. in 0.1828 pt. strong alcohol at  $82.5^\circ$ . (Wensel.)

B.-pt. of an alcoholic solution of  $\text{MgCl}_2$ .

% $\text{MgCl}_2$	B.-pt.
5.56	$78.43^\circ + 0.73^\circ$
8.53	" +1.34
9.62	" +1.77
13.84	" +3.54

(Skinner, Chem. Soc. 61. 341.)

Even more sol. in acetic ether than  $\text{CaCl}_2$ . (Cann, C. R. 102. 363.)

Sol. in boiling amyl alcohol. (Riggs, Sill. Am. J. 144. 103.)

Sl. sol. in anhydrous pyridine. Sol. in 97%, 95% and 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Insol. in  $\text{CS}_2$ . (Arcetowski, Z. anorg. 1894, 6. 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $2\text{H}_2\text{O}$ . Very deliquescent. (Ditte, A. ch. 1881, (5) 22. 560.)

+  $4\text{H}_2\text{O}$ . (van't Hoff and Meyerhoffer.)

+  $6\text{H}_2\text{O}$ . Deliquescent. Sol. in 0.6 pt. cold, and 0.273 pt. hot  $\text{H}_2\text{O}$ . (Casaseca, l. c.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	1000 mols $\text{H}_2\text{O}$ dissolve mols $\text{MgCl}_2$	100 g. $\text{H}_2\text{O}$ dis- solve g. $\text{MgCl}_2$
3.5	99.6	52.65
25.0	104.5	55.28
50.0	110.6	58.86

(Biltz and Marcus, Z. anorg. 1911, 71. 169.)

Solubility in  $\text{KCl} + \text{NH}_4\text{Cl} + \text{Aq}$  at  $25^\circ$  has been studied. (Biltz and Marcus, Z. anorg. 1911, 71. 178.)

When the solid phases are  $\text{MgSO}_4 + 6\text{H}_2\text{O}$  and  $\text{MgCl}_2 + 6\text{H}_2\text{O}$ , 1000 mols.  $\text{H}_2\text{O}$  dissolve 104 mols.  $\text{MgCl}_2$  and 14 mols.  $\text{MgSO}_4$  at  $25^\circ$ . (Löwenherz, Z. phys. Ch. 1894, 13. 480.)

Solubility of  $\text{MgCl}_2 + 6\text{H}_2\text{O}$  in  $(\text{NH}_4)\text{MgCl}_2 + 6\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Per 1000 mols $\text{H}_2\text{O}$	
	Mols $\text{NH}_4\text{Cl}$	Mols $\text{MgCl}_2$
3.5	0.5	99.5
25.0	0.5	103.8
50.0	0.8	111.2

(Biltz and Marcus, Z. anorg. 1911, 71. 170.)

Solubility data of  $\text{MgCl}_2 + \text{KCl} + \text{MgKCl}_2$  are given by van't Hoff and Meyerhoffer. (Z. phys. Ch. 1899, 30. 64.)

+  $8\text{H}_2\text{O}$ . Pptd. from an aqueous solution which contains about 10 mols.  $\text{H}_2\text{O}$  to 1 mol.  $\text{MgCl}_2$ .

+  $12\text{H}_2\text{O}$ . Pptd. from an aq. solution which contains 1 mol.  $\text{MgCl}_2$  in about 12.06 mols. of  $\text{H}_2\text{O}$ . (Bogorodaky, C. C. 1899, I. 246.)

**Magnesium manganous chloride,  $\text{MgCl}_2$ ,  $2\text{MnCl}_2 + 12\text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Saunders, Am. Ch. J. 14. 148.)

$2\text{MgCl}_2$ ,  $\text{MnCl}_2 + 12\text{H}_2\text{O}$ . Ppt. Deliquesces in the air. (Gossner, C. C. 1904, I. 707.)

**Magnesium mercuric chloride,  $\text{MgCl}_2$ ,  $\text{HgCl}_2 + 6\text{H}_2\text{O}$ .**

Very deliquescent. More sol. than the following salt. (v. Bonsdorff, Pogg. 17. 133.)

$\text{MgCl}_2$ ,  $3\text{HgCl}_2 + 5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with-

out decomp. Easily sol. in alcohol. (v. Bonsdorff.)

**Magnesium phosphoryl chloride,  $\text{MgCl}_2, \text{POCl}_3$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat and decomposition. Very sl. sol. in warm  $\text{POCl}_3$ . (Casselmann, A. 98. 223.)

**Magnesium potassium chloride,  $\text{MgCl}_2, 2\text{KCl} + 6\text{H}_2\text{O}$ .**

Deliquescent, forming a solution of  $\text{MgCl}_2$ , while  $\text{KCl}$  remains undissolved. 100 pts.  $\text{H}_2\text{O}$  dissolve 64.5 pts. at  $18.75^\circ$ . 20 pts. salt dissolved in 80 pts.  $\text{H}_2\text{O}$  lower the temp.  $1.75^\circ$ . (Bischof.) Alcohol dissolves out  $\text{MgCl}_2$ . Decomp. into the two salts by solution in  $\text{H}_2\text{O}$ . (Maroet.)

A sat. solution in contact with solid  $\text{KCl}$  and  $\text{KCl}$ ,  $\text{MgCl}_2$ ,  $\text{H}_2\text{O}$  at  $50^\circ$  contains 79.5 mol.  $\text{MgCl}_2$  and 14.9 mol.  $\text{KCl}$  per 1000 mol.  $\text{H}_2\text{O}$ . A sat. solution in contact with solid  $\text{MgCl}_2$ ,  $6\text{H}_2\text{O}$  and  $\text{KCl}$ ,  $\text{MgCl}_2$ ,  $\text{H}_2\text{O}$  at  $50^\circ$  contains 111.9 mol.  $\text{MgCl}_2$  and 1.2 mol.  $\text{KCl}$  per 1000 mol.  $\text{H}_2\text{O}$ . (Uhlig, Chem. Soc. 1913, 104. (2) 775; C. B. Miner. 1913, 417.)

Min. *Carnallite*.

**Magnesium rubidium chloride,  $\text{MgCl}_2, \text{RbCl} + 6\text{H}_2\text{O}$ .**

Not decomp. by a small quantity of  $\text{H}_2\text{O}$ . (Feit and Kubiersky, Ch. Ztg. 16. 335.)

**Magnesium sodium chloride,  $\text{MgCl}_2, \text{NaCl} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Poggiale.)

**Magnesium thallic chloride,  $2\text{TlCl}_3, \text{MgCl}_2 + 6\text{H}_2\text{O}$ .**

Hydrosopic. Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A. 1909, 366. 224.)

**Magnesium stannic chloride.**

See Chlorostannate, magnesium.

**Magnesium vanadium chloride,  $\text{MgCl}_2, \text{VCl}_3 + \text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$  and alcohol. (Stähler, B. 1904, 37. 4412.)

**Magnesium zinc chloride,  $\text{MgCl}_2, \text{ZnCl}_2 + 6\text{H}_2\text{O}$ .**

Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Warner, C. N. 27. 271.)

**Magnesium chloride ammonia,  $\text{MgCl}_2, 4\text{NH}_3$ .**  
Easily decomp. (Clark, A. 78. 369.)

**Magnesium chloride hydroxylamine,  $\text{MgCl}_2, 2\text{NH}_2\text{OH} + 2\text{H}_2\text{O}$ .**

100 g. of solution in  $\text{H}_2\text{O}$  contain 44.4% at  $20^\circ$ . (Antonow, J. Russ. Phys. Chem. Soc. 1905, 37. 478.)

**Magnesium fluoride,  $\text{MgF}_2$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 76 mg.  $\text{MgF}_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 60. 356.)

87 mg. are dissolved in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1906, 64. 168.)

Scarcely sol. in acids. (Gay-Lussac and Thénard.) Insol. in excess of  $\text{HF}$ . When precipitated, is sol. in aqueous solution of ammonium and magnesium salts. Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , from which it is precipitated by alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Min. *Sellarite*.

**Magnesium potassium fluoride,  $\text{MgF}_2, \text{KF}$ .**

Decomp. by  $\text{H}_2\text{SO}_4$ . (Duboin, C. R. 1895, 120. 679.)

$\text{MgF}_2, 2\text{KF}$ . Decomp. by  $\text{H}_2\text{SO}_4$ . (Duboin.)

**Magnesium sodium fluoride,  $\text{MgF}_2, \text{NaF}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Geuther, J. B. 1865. 173.)

**Magnesium stannic fluoride.**

See Fluostannate, magnesium.

**Magnesium titanium fluoride.**

See Fluotitanate, magnesium.

**Magnesium zirconium fluoride.**

See Fluozirconate, magnesium.

**Magnesium hydrosulphide,  $\text{MgS}, \text{H}_2$ .**

Known only in aqueous solution, which decomposes on warming. Solution containing 16%  $\text{MgS}, \text{H}_2$  has sp. gr. 1.118 at  $12^\circ$ . (Divers and Shimidzu, Chem. Soc. 45. 699.)

**Magnesium hydroxide,  $\text{MgO}, \text{H}_2$ .**

$\text{MgO}$  is sol. in 55,368 pts.  $\text{H}_2\text{O}$  at ordinary temp., and also at  $100^\circ$ . (Fresenius, A. 59. 117.)

$\text{MgO}$  is sol. in 5142 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  (Fyfe); in 5800 pts. at  $15.8^\circ$  (Henry, J. Pharm. 12. 2); in 7900 pts. (Kirkman); in 16,000 pts. (Dalton); in 100,000-200,000 pts. cold  $\text{H}_2\text{O}$  (Bineau); in 36,000 pts. boiling  $\text{H}_2\text{O}$  (Fyfe, Ed. Phil. J. 5. 305.)

Calculated from electrical conductivity of  $\text{MgO}, \text{H}_2 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 9 mg.  $\text{MgO}, \text{H}_2$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Calculated from electrical conductivity, 1 l.  $\text{H}_2\text{O}$  dissolves 00.076 g.  $\text{MgO}, \text{H}_2$  at  $18^\circ$ . (Dupré and Brutus, Z. angew. Ch. 1903, 16. 55.)

Presence of  $\text{CaO}, \text{H}_2$  or  $\text{CaSO}_4$  does not decrease the solubility. (Henry.) Presence of the salts of the alkali metals, especially ammonium salts, increase the solubility. Insol. in conc.  $\text{Na}_2\text{SO}_4$ ,  $\text{NaNO}_3$ ,  $\text{NaCl}$  or  $\text{KNO}_3 + \text{Aq}$ . (Karsten.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , but insol. in  $\text{KOH} + \text{Aq}$ . (Odling.)

Easily sol. in acids. Sol. in an aqueous solution of sugar. Boiling alcohol dissolves traces.

Solubility of  $\text{MgO}_2\text{H}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $29^\circ$ .

Conc. of $\text{NH}_4\text{Cl} + \text{Aq}$ (Normal)	Acid required for liberated $\text{NH}_3$ in 25 cc. (Normal)	Normality of		G. per l.	
		$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{Cl}$	$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{Cl}$
0.7	0.09835	0.156	0.388	4.55	20.86
0.466	0.1108	0.108	0.250	3.15	13.39
0.35	0.09835	0.089	0.172	2.60	9.21
0.23	0.1108	0.0638	0.106	1.86	5.67
0.17	0.1108	0.049	0.0771	1.43	4.13

(Hers and Muhs, Z. anorg. 1909, 33. 140.)

Solubility of  $\text{MgO}_2\text{H}_2$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $29^\circ$ .

Conc. of $\text{NH}_4\text{NO}_3 + \text{Aq}$ (Normal)	Acid required for liberated $\text{NH}_3$ in 25 cc. (Normal)	Normality of		G. per l.	
		$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{NO}_3$	$\text{MgO}_2\text{H}_2$	$\text{NH}_4\text{NO}_3$
0.35	0.1108	0.0833	0.1834	2.43	14.69
0.175	0.1108	0.0495	0.076	1.45	6.09

(Hers and Muhs.)

Completely insol. in 16%  $\text{NaCl} + \text{Aq}$  in presence of 0.8 g.  $\text{NaOH}$ . (Maigret, Bull. Soc. (3) 33. 631.)

Solubility of  $\text{MgO}_2\text{H}_2$  in  $\text{NaCl} + \text{NaOH} + \text{Aq}$ .

G. $\text{NaCl}$ per l.	G. $\text{MgO}$ per l. of solution with added	
	0.8 g. $\text{NaOH}$ per l.	4.0 g. $\text{NaOH}$ per l.
125	0.07	0.03
140	0.045	...
160	None	None

(Maigret.)

Freshly pptd.  $\text{Mg}(\text{OH})_2$  is sol. in  $\text{Th}(\text{NO}_3)_4 + \text{Aq}$  forming a colloidal solution. (Halla, Z. anorg. 1912, 79. 262.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II, 1014.)

See also Magnesium oxide.

Min. *Brucite*. Sol. in cold citric acid +  $\text{Aq}$ . (Bolton, C. N. 37. 14.)

$2\text{MgO}$ ,  $3\text{H}_2\text{O}$ . (Bender, B. 3. 932.)

Magnesium iodide,  $\text{MgI}_2$ .

Very deliquescent.

Solubility in  $\text{H}_2\text{O}$ . See  $\text{MgI}_2 + 6$ , and  $8\text{H}_2\text{O}$ .Sp. gr. of  $\text{MgI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5 10 15 20 25 30%  $\text{MgI}_2$ ,  
1.043 1.068 1.139 1.194 1.254 1.32

35 40 45 50 55 60%  $\text{MgI}_2$ ,  
1.395 1.474 1.568 1.668 1.78 [1.915

(Kramers, Pogg. 111. 62, calculated by Gerlach, Z. anal. 8. 285.)

 $\text{MgI}_2 + \text{Aq}$  decomp. slightly on evaporation.

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in alcohol, ether, and wood-spirit.

Solubility of  $\text{MgI}_2$  in alcohols.

$\text{MgI}_2$  forms with methyl alcohol a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{OH}$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{OH}$  in  $\text{CH}_3\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6\text{CH}_3\text{OH}$	$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6\text{CH}_3\text{OH}$
0	49.6	120	66.2
20	52.6	140	69.5
40	55.3	160	73.2
60	58.0	180	77.1
80	60.6	200	81.5
100	63.3		

(Menschutkin, Z. anorg. 1907, 52. 15.)

$\text{MgI}_2$  forms with ethyl alcohol a complex,  $\text{MgI}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$	$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6\text{C}_2\text{H}_5\text{OH}$
0	21.9	120	82.7
20	33.2	130	87.2
40	44.4	135	90.0
60	55.3	140	93.3
80	65.5	143	96.0
100	74.7	145	98.0
110	78.8	146.5 mpt.	100

(Menschutkin.)

$\text{MgI}_2$  forms with dimethylcarbinol a complex,  $\text{MgI}_2 \cdot 6(\text{CH}_3)_2\text{CHOH}$ .

Solubility of  $\text{MgI}_2 \cdot 6(\text{CH}_3)_2\text{CHOH}$  in  $(\text{CH}_3)_2\text{CHOH}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6(\text{CH}_3)_2\text{CHOH}$	$t^\circ$	% by weight of $\text{MgI}_2 \cdot 6(\text{CH}_3)_2\text{CHOH}$
10	57.1	110	76.2
30	60.0	120	79.4
50	63.3	130	84.8
70	67.0	136	91.7
90	71.2	138 mpt.	100

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in ether at  $t^\circ$ .

$t^\circ$	% $\text{MgI}_2$	% $\text{MgI}_2 \cdot 2\text{C}_4\text{H}_{10}\text{O}$
5.4	1.45	2.2
11.8	2.43	3.7
15.6	3.46	5.3
18.1	5.4	8.3
20.4	7.55	11.6
22.2	11.28	17.3

(Menschutkin, Z. anorg. 1906, 49. 41.)



t°	% MgI <sub>2</sub>	% MgI <sub>2</sub> · 2C <sub>4</sub> H <sub>10</sub> O
	in lower layer	
14.8	35.5	54.4
17.6	35.5	54.4
20	35.8	54.8
28.4	35.5	54.4
33	35.7	54.7
35	35.3	54.1
in upper layer		
18.6	13.57	20.8
23.2	14.4	22.1
24.4	14.6	22.4
32.4	15.82	24.2
in solution when two layers mix		
37.3	19.4	29.3
38.5	22.45	34.4
38.5	26.07	39.9
38.5	29.8	45.7
38	32.8	50.3

(Menschutkin.)

Solubility of MgI<sub>2</sub> in acetic acid.MgI<sub>2</sub> forms with acetic acid a complex, MgI<sub>2</sub> · 6CH<sub>3</sub>COOH.Solubility of MgI<sub>2</sub> · 6CH<sub>3</sub>COOH in CH<sub>3</sub>COOH at t°.

t°	% by wt. MgI <sub>2</sub> · 6CH <sub>3</sub> COOH
20	0.6
40	2.0
60	5.0
70	9.5
75	13.0
80	18.5
85	27.1
95	42.0
105	54.5
115	65.0
125	73.8
135	85.0
140	94.0
142 mpt.	100.0

(Menschutkin, Z. anorg. 1907, 54. 93.)

Solubility of MgI<sub>2</sub> in acetone.MgI<sub>2</sub> forms with acetone a complex, MgI<sub>2</sub> · 6CH<sub>3</sub>COCH<sub>3</sub>.Solubility of MgI<sub>2</sub> · 6CH<sub>3</sub>COCH<sub>3</sub> in CH<sub>3</sub>COCH<sub>3</sub> at t°.

t°	% by wt. MgI <sub>2</sub> · 6CH <sub>3</sub> COCH <sub>3</sub>
0	4.9
30	6.7
50	8.3
60	10.2
70	15.2
80	28.6
85	40.0
90	59.2
95	80.0
100	92.5
105	98.5
106.5 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 30.)

Solubility of MgI<sub>2</sub> in acetal.MgI<sub>2</sub> forms with acetal a complex, MgI<sub>2</sub> · 2CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub>.Solubility of MgI<sub>2</sub> · 2CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub> in CH<sub>3</sub>CH(OC<sub>2</sub>H<sub>5</sub>)<sub>2</sub> at t°.

t°	% by wt. MgI <sub>2</sub> · 2CH <sub>3</sub> CH(OC <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>
20	0.15
60	0.45
77	0.6
77	92.0
79	93.7
81	95.5
83	97.3
86 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 33.)

Solubility of MgI<sub>2</sub> in acetamide.MgI<sub>2</sub> forms with acetamide a complex, MgI<sub>2</sub> · 6CH<sub>3</sub>CONH<sub>2</sub>.Solubility of MgI<sub>2</sub> · 6CH<sub>3</sub>CONH<sub>2</sub> in CH<sub>3</sub>CONH<sub>2</sub> at t°.

t°	% by wt. of MgI <sub>2</sub> · 6CH <sub>3</sub> CONH <sub>2</sub>
49	56.5
80	63.4
110	70.5
130	76.0
150	82.1
160	85.5
170	90.8
175	96.2
177 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61. 108.)

Solubility of  $\text{MgI}_2$  in acetonitrile.

$\text{MgI}_2$  forms with acetonitrile a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{CN}$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{CN}$  in  $\text{CH}_3\text{CN}$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2 \cdot 6\text{CH}_3\text{CN}$
0	37.2
30	49.8
50	58.2
70	67.9
80	76.5
89	91.3

(Menschutkin, Z. anorg. 1909, 61. 110.)

Solubility of  $\text{MgI}_2$  in benzaldehyde.

$\text{MgI}_2$  forms with benzaldehyde a complex,  $\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{CHO}$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{CHO}$  in  $\text{C}_6\text{H}_5\text{CHO}$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2 \cdot 6\text{C}_6\text{H}_5\text{CHO}$
0	3.2
20	3.8
40	5.3
60	7.7
80	11.0
100	18.5
110	26.5
120	40.0
125	53.0
130	74.5
133	86.0
136	94.2
139 mpt.	100

(Menschutkin, Z. anorg. 1907, 53. 28.)

Solubility of  $\text{MgI}_2$  in methyl acetate.

$\text{MgI}_2$  forms with methyl acetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOCH}_3$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOCH}_3$  in  $\text{CH}_3\text{COOCH}_3$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOCH}_3$
0	0.4
30	0.55
60	0.75
90	0.9
100	1.8
103	2.4
103	74.2
110	81.7
120	98.0
121 mpt.	100.0

(Menschutkin, Z. anorg. 1909, 61. 101.)

Solubility of  $\text{MgI}_2$  in methyl acetate.

$\text{MgI}_2$  forms with ethyl acetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_2\text{H}_5$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_2\text{H}_5$  in  $\text{CH}_3\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_2\text{H}_5$
0	3.2
20	4.8
40	8.6
50	13.7
55	21.5
60	38.0
65	63.5
70	90.5
75	97.7
78.5 mpt.	100.0

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in ethyl formate.

$\text{MgI}_2$  forms with ethyl formate a complex,  $\text{MgI}_2 \cdot 6\text{HCOOC}_2\text{H}_5$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{HCOOC}_2\text{H}_5$  in  $\text{HCOOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2 \cdot 6\text{HCOOC}_2\text{H}_5$
0	15.1
10	17.4
20	20.5
30	25
40	31.8
50	44
60	68
70.5 mpt.	100

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in isoamylacetate.

$\text{MgI}_2$  forms with isoamylacetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$ .

Solubility of  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$  in  $\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2 \cdot 6\text{CH}_3\text{COO(iso)C}_5\text{H}_{11}$
0	7.7
20	11.5
40	20.9
45	25.5
50	33.2
55	47.8
57.5	63.0
60 mpt.	100.0

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in isobutyl acetate.

$\text{MgI}_2$  forms with isobutylacetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_4\text{H}_9$ .

Solubility of  $\text{MgI}_2$ ,  $6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$  in  $\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$ .

$t^\circ$	% by wt. $\text{MgI}_2$ , $6\text{CH}_3\text{COO}(\text{iso})\text{C}_4\text{H}_9$
0	10.5
20	13.6
40	17.6
50	20.4
60	24.9
70	33.7
75	40.5
80	52.0
85	89.0
87.5 mpt.	100.0

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in propyl acetate.

$\text{MgI}_2$  forms with propyl acetate a complex,  $\text{MgI}_2 \cdot 6\text{CH}_3\text{COOC}_2\text{H}_5$ .

Solubility of  $\text{MgI}_2$ ,  $6\text{CH}_3\text{COOC}_2\text{H}_5$  in  $\text{CH}_3\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2$ , $6\text{CH}_3\text{COOC}_2\text{H}_5$
0	4.1
20	5.4
30	6.5
35	7.8
40	19.0
45	46.0
50	72.5
55	88.2
60	96.0
65 mpt.	100.0

(Menschutkin.)

Solubility of  $\text{MgI}_2$  in urethane.

$\text{MgI}_2$  forms with urethane a complex,  $\text{MgI}_2 \cdot 6\text{NH}_2\text{COOC}_2\text{H}_5$ .

Solubility of  $\text{MgI}_2$ ,  $6\text{NH}_2\text{COOC}_2\text{H}_5$  in  $\text{NH}_2\text{COOC}_2\text{H}_5$  at  $t^\circ$ .

$t^\circ$	% by wt. $\text{MgI}_2$ , $6\text{NH}_2\text{COOC}_2\text{H}_5$
32	51.8
50	59.4
70	70.7
80	78.8
84	85.0
87 mpt.	100.0

(Menschutkin.)

+ $6\text{H}_2\text{O}$ .

Solubility of  $\text{MgI}_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 + 6\text{H}_2\text{O}$	$t^\circ$	% by weight of $\text{MgI}_2 + 6\text{H}_2\text{O}$
43°	89.8	160°	91.7
80°	90.3	200°	93.4
120°	90.9	215°	94.3

(Menschutkin, Z. anorg. 1907, 52. 156.)

+ $8\text{H}_2\text{O}$ . Sp. gr. of solution of  $\text{MgI}_2 + 8\text{H}_2\text{O}$  sat. at  $18^\circ$  containing 59.7%  $\text{MgI}_2 = 1.909$ . (Mylius, B. 1897, 30. 1718.)

Solubility of  $\text{MgI}_2 + 8\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% by weight of $\text{MgI}_2 + 8\text{H}_2\text{O}$
0	76.0
20	81.0
40	88.0
43.5	90.8

(Menschutkin.)

+ $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Panfiloff, C. C. 1894, II. 610.)

**Magnesium mercuric iodide,  $\text{MgI}_2$ ,  $\text{HgI}_2$ .**

Known only in solution.

+ $9\text{H}_2\text{O}$ . Very deliquescent. (Duboin, C. R. 1906, 142. 1338.)

Very sol. in ethyl, methyl, propyl, butyl, isobutyl, amyl, isopropyl and allyl alcohols, ethyl, amyl, propyl and isobutyl acetates, ethyl cyanide and acetone. Sol. in benzyl alcohol. Decomp. by glycerine. Sl. sol. in ethyl benzoate, amyl benzoate, nitrobenzene. Decomp. by ethyl oxalate. Insol. in toluene, benzene, ethyl iodide,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethylene bromide, monochlor and monobrombenzene. (Duboin, A. ch. 1909, (8) 16. 276.)

$\text{MgI}_2$ ,  $2\text{HgI}_2$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{HgI}_2$  and above compound, which remains in solution. (Boullay.)

+ $7\text{H}_2\text{O}$ . Sat. solution in  $\text{H}_2\text{O}$  at  $17.8^\circ$  has the composition  $\text{MgI}_2$ , 1.29  $\text{HgI}_2$ , 11.06  $\text{H}_2\text{O}$ . (Duboin, C. R. 1906, 142. 1338.)

**Magnesium potassium iodide,  $\text{MgI}_2$ ,  $\text{KI} + 6\text{H}_2\text{O}$ .**

Deliquescent. (Lerch, J. pr. (2) 23. 338.)

Very hygroscopic. (de Schulten, Bull. Soc. 1900 (3) 23. 158.)

**Magnesium iodide ammonia,  $\text{MgI}_2$ ,  $6\text{NH}_3$ .**

Practically insol. in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1913, 35. 1459.)

**Magnesium nitride,  $\text{Mg}_3\text{N}_2$ .**

Decomp. by moist air or  $\text{H}_2\text{O}$ . Sol. in dil. or conc.  $\text{HCl} + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$ . Sol. in warm  $\text{H}_2\text{SO}_4$ . Insol. in alcohol, ethyl iodide, or phosphorus oxychloride. (Briegleb and Geuther, A. 123. 236.)

Decomp. by  $\text{H}_2\text{O}$ . (Smita, R. t. c. 1894, 12. 198.)

Easily decomp.  $\text{H}_2\text{O}$  when finely powdered. (Rossel, C. R. 1895, 121. 942.)

**Magnesium suboxide (?).**

Decomp.  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Beets, Pogg. 127. 45.)

**Magnesium oxide,  $\text{MgO}$ .**

Sol. in 50,000–100,000 pts.  $\text{H}_2\text{O}$  (Bineau, C. R. 41. 510); in 55,368 pts. cold or hot  $\text{H}_2\text{O}$  (Frobenius, A. 89. 123); in 100,000–200,000 pts.  $\text{H}_2\text{O}$  (Busenel); in 16,000 pts.  $\text{H}_2\text{O}$  at ord. temp. (Dalton); in 7900 pts.  $\text{H}_2\text{O}$  at ord. temp. (Kirwan); in 5760 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$ , and 36,000 pts. at  $100^\circ$  (Fyfe).

Calc. from electrical conductivity of  $\text{MgO} + \text{Aq}$ . 1 pt.  $\text{MgO}$  is sol. in 172,000 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Dupré, Zeit. angew. Ch. 1903, 16. 55.) "Heavy"  $\text{MgO}$  is more sol. in  $\text{H}_2\text{O}$  than "light"  $\text{MgO}$ . The temp. of preparation affects the rate of solution, the rate being diminished as the temp. of preparation is increased. (Anderson, Chem. Soc. 1905, 87. 265.)

Easily sol. in acids, even in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Solubility in  $\text{P}_2\text{O}_5 + \text{Aq}$  at  $25^\circ$ .

Composition of the solution		Sp. gr. $25^\circ/25^\circ$	Solid phase
G. $\text{MgO}$ per l.	G. $\text{P}_2\text{O}_5$ per l.		
0.207	0.486	...	$\text{MgHPO}_4 \cdot 3\text{H}_2\text{O}$
0.280	0.732	...	
0.553	1.917	...	
1.438	4.85	...	
2.23	7.35	1.006	
4.73	16.84	1.017	
11.19	38.59	1.042	
17.33	61.21	1.069	
26.09	93.09	1.109	
37.40	130.7	1.144	
75.5	281.8	1.285	
109.5	439.0	...	
122.6	498.4	1.470	
129.9	546.5	...	
140.0	584.0	...	
146.8	623.3	1.595	$\text{MgH}_4(\text{PO}_4)_3 \cdot x\text{H}_2\text{O}$
147.3	625.9	...	
150.3	645.8	...	
155.5	680.7	...	
87.1	779.6	1.626	
77.1	809.6	1.644	
70.6	835.1	1.654	

(Cameron, J. phys. Chem. 1907, 11. 364.)

Sol. in  $\text{NH}_4$  salts,  $\text{NaCl}$ , or  $\text{KCl} + \text{Aq}$ . (Fresenius.)

Solubility in  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$ .

% $\text{MgCl}_2$	% $\text{MgO}$ as $\text{Mg}(\text{OH})_2$
2.36	0.00008
4.47	0.00028
6.79	0.00048
9.02	0.00080
13.14	0.00115
15.15	0.00195
17.53	0.00240
18.52	0.00250
22.04	0.00245
23.78	0.00235
25.13	0.00230
26.88	0.00250
28.34	0.00230
29.80	0.00240
30.04	0.00250
34.22	0.0030

(Robinson, J. phys. Chem. 1909, 13. 676.)

More sol. in  $\text{K}_2\text{SO}_4$ , and  $\text{Na}_2\text{SO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Warrington.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in methyl alcohol to form a colloidal solution containing 1.6%  $\text{MgO}$ . (Neuberg and Rewald. Biochem. Z. 1908, 9. 547.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Solubility in (calcium succinate + sugar) +  $\text{Aq}$ .

1 l. solution containing 418.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 0.30 g.  $\text{MgO}$ ; containing 296.5 g. sugar and 24.2 g.  $\text{CaO}$  dissolves 0.24 g.  $\text{MgO}$ ; containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 0.22 g.  $\text{MgO}$ . (Bodenbender, J. B. 1865. 600.)

See also Magnesium hydroxide.

Min. Periclase.

Magnesium peroxide,  $\text{MgO}_2$ .

Sol. in 14,550 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Foregger and Philipp, J. Soc. Chem. Ind. 1906, 25. 298.)

$5\text{MgO}, 2\text{MgO}_2 + 3\text{H}_2\text{O}$ .

$3\text{MgO}, 2\text{MgO}_2 + 3\text{H}_2\text{O}$ .

$2\text{MgO}, 2\text{MgO}_2 + 3\text{H}_2\text{O}$ .

$4\text{MgO}, 2\text{MgO}_2 + 3\text{H}_2\text{O}$ .

Above salts are decomp. by  $\text{H}_2\text{O}$ .

(Carrasco, Gazz. ch. it. 1909, 39, (1) 47.)

Magnesium oxybromide,  $\text{MgBr}_2 \cdot 3\text{MgO} + 12\text{H}_2\text{O}$ .

Decomp. in the air and also by  $\text{H}_2\text{O}$ , alcohol and most reagents. (Tassilly, C. R. 1897, 125. 607.)

Magnesium oxychloride,  $\text{Mg}_2\text{OCl}_2 + 16\text{H}_2\text{O}$ .

Easily decomp. by  $\text{H}_2\text{O}$  and alcohol. (André, A. ch. (6) 3. 80.)

$+ 6\text{H}_2\text{O}$ . (André.)

$2\text{MgO}, \text{HCl}, 5\text{H}_2\text{O}$  or  $3\text{MgO}, \text{MgCl}_2 + 10\text{H}_2\text{O}$ . Solubility determinations show that this salt is the solid phase in equilibrium at  $25^\circ$  with solutions of  $\text{MgCl}_2$  and  $\text{MgO}$  containing from 10–15%  $\text{MgCl}_2$ . (Robinson, J. phys. Chem. 1909, 13. 677.)

$\text{Mg}_2\text{OCl}_2 + 6, 8, 14$ , or  $17\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ , which dissolves out  $\text{MgCl}_2$ . (Bender, B. 3. 932.)

$\text{Mg}_{11}\text{O}_{10}\text{Cl}_2 + 14$ , or  $18\text{H}_2\text{O}$ . (Krause, A. 165. 38.)

$\text{Mg}_{10}\text{OCl}_2 + 24\text{H}_2\text{O} = 9\text{MgO}, \text{MgCl}_2 + 24\text{H}_2\text{O}$ .  $\text{H}_2\text{O}$  removes all  $\text{MgCl}_2$  by long digesting. (Bender, A. 159. 341.)

$+ 10$ , and  $15\text{H}_2\text{O}$ . (Bender.)

Magnesium oxysulphide,  $\text{Mg}_2\text{OS}$ .

(Reichel, J. pr. (2) 12. 55.)

**Magnesium phosphide,  $Mg_3P_2$ .**

Decomp. by  $H_2O$ , dil.  $HCl$ +Aq, or  $HNO_3$ +Aq. (Parkinson, Chem. Soc. 5. (2) 125 and 309.)

Insol. in moderately dil. cold  $HCl$ +Aq, or boiling dil.  $H_2SO_4$ +Aq. Difficultly and slowly sol. in aqua regia. (Blunt, Chem. Soc. 3. (2) 106.)

Decomp. by  $H_2O$ ,  $HCl$ , conc.  $H_2SO_4$ , and by  $HNO_3$ . (Gautier, C. R. 1899, 128. 1169.)

**Magnesium silicide,  $Mg_2Si_3$ .**

Slowly decomp. by warm  $H_2O$ . Slowly decomp. by cold, rapidly by hot  $NH_4Cl$ +Aq. Decomp. by cold dil.  $HCl$ +Aq. (Geuther, J. pr. 95. 425.)

$Mg_2Si$ . Decomp. by  $HCl$ +Aq with residue of Si. (Wöhler, A. 107. 113.)

Slowly decomp. by  $H_2O$  at ord. temp. Violently decomp. by  $HCl$ . (Lebeau and Boesuet, C. R. 1908, 146. 284.)

**Magnesium sulphide,  $MgS$ .**

Decomp. by  $H_2O$ . (Reichel, J. pr. (2) 12. 55.)

Sl. sol. in  $H_2O$  with rapid decomp. (Fremy.)

Sol. in acids with decomp.

*Anhydrous. Crystalline.* Only very sl. sol. in cold  $H_2O$ . Sol. in  $HNO_3$  and  $H_2SO_4$  at ord. temp. Sol. in  $PCl_5$  and in chromyl chloride. (Mourlot, C. R. 1898, 127. 182.)

**Magnesium polysulphide,  $MgS_x$ .**

Known only in solution. (Reichel.)

**Magnus' green salt.**

See Platodiamine chloroplatinite.

**Manganese, Mn.**

Decomposes  $H_2O$  even in the cold, more rapidly when hot. (Regnault.)

Decomposes cold water violently. (Bunsen.)

Sol. in all dil. acids. Slowly sol. in cold  $H_2SO_4$ . (John.)

Insol. in cold, but rapidly sol. in hot  $H_2SO_4$ . Very easily sol. in dil.  $H_2SO_4$ , or  $HCl$ +Aq,  $HNO_3$ , or  $HC_2H_3O_2$ +Aq. (Brunner.)

Pure manganese is unaltered in dry air, even when finely powdered. Slowly attacked by cold, quickly by hot  $H_2O$ . Very sl. attacked by cold  $H_2SO_4$ , rapidly on warming; rapidly attacked by cold dil.  $H_2SO_4$ +Aq; violently by conc.  $HNO_3$ +Aq; and rapidly by dil.  $HNO_3$ ,  $HCl$ ,  $HC_2H_3O_2$ +Aq, and also  $NaOH$ +Aq. Sol. in  $NH_4Cl$ +Aq. (Prelinger, W. A. B. 102, 2b. 359.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0276 g. Mn in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

**Manganese antimonide,  $MnSb$ .**

Sol. in hot aqua regia. (Wedekind, B. 1907, 40. 1286.)

**Manganese azoimide, basic,  $Mn(OH)N_3$ .**

Only sl. sol. in  $H_2O$  with decomp. (Curtius, J. pr. 1898, (2) 58. 293.)

**Manganese bismuthide,  $MnBi$ .**

Very sensitive towards acids with the exception of conc.  $HCl$ . (Wedekind, B. 1911, 44. 2665.)

**Manganese boride,  $MnB$ .**

Attacked by cold  $H_2O$  and by acids. (Jassoneix, C. R. 1904, 139. 1210.)

Easily attacked by  $HCl$ ,  $H_2SO_4$ , and  $HF$  with evolution of  $BH_3$ . (Wedekind, B. 1905, 38. 1231.)

$MnB_2$ . Sol. in acids, with evolution of  $H_2$ . (Troost and Hautefeuille, A. ch. (5) 9. 65.)

Slowly decomp. by  $H_2O$ . Sol. in dil.  $HCl$  and other dil. acids with evolution of  $BH_3$ . (Wedekind, B. 1905, 38. 1229.)

**Manganous bromide,  $MnBr_2$ .**

*Anhydrous.* Very deliquescent.

Sat.  $MnBr_2$ +Aq contains at:

−21° +7° 11° 18° 38° 52°  
52.1 56.5 57.0 59.1 62.7 64.2%  $MnBr_2$ ,

64° 76° 89° 97° 105°  
68.2 70.1 69.7 69.2 70.2%  $MnBr_2$ .

(Étard, A. ch. 1894, (7) 2. 541.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

+ $H_2O$ . (Lescœur, A. ch. 1894, (7) 2. 104.)

+4 $H_2O$ . More deliquescent than  $MnCl_2$ . Melts in crystal water when heated. (Berthelot.)

+6 $H_2O$ . (Kusnetsoff, C. C. 1897, II. 329.)

**Manganous mercuric bromide.**

Deliquescent.

**Manganous palladium bromide.**

See Bromopalladite, manganous.

**Manganous stannic bromide.**

See Bromostannate, manganous.

**Manganese carbide,  $MnC$ .**

(Brown, J. pr. 17. 492.)

$MnC_2$ .

$MnC_3$ . (Troost and Hautefeuille, A. ch. (5) 9. 60.)

Decomp. by  $H_2O$  and by dil. acids. (Moissan, C. R. 1896, 122. 422.)

**Manganous chloride,  $MnCl_2$ .**

*Anhydrous.* Deliquescent.

100 pts. H<sub>2</sub>O at t° dissolve pts. MnCl<sub>2</sub>:

t°	Pts. MnCl <sub>2</sub>	t°	Pts. MnCl <sub>2</sub>
10	62.16	87.5	122.22
31.25	85.72	106.25	123.81
62.5	122.22	...	....

or, sat. MnCl<sub>2</sub>+Aq at t° contains:

t°	% MnCl <sub>2</sub>	t°	% MnCl <sub>2</sub>
10	38.33	87.5	55.0
31.25	46.15	106.25	55.32
62.5	55.0	...	...

(Brandes, Pogg. 22. 263.)

See also below under +2H<sub>2</sub>O, and +4H<sub>2</sub>O.Sp. gr. of MnCl<sub>2</sub>+Aq at 15°. a=sp. gr. if % is MnCl<sub>2</sub>; b=sp. gr. if % is MnCl<sub>2</sub>+4H<sub>2</sub>O.

%	a	b	%	a	b
5	1.045	1.0285	40	1.443	1.250
10	1.091	1.057	45	1.514	1.290
15	1.138	1.086	50	...	1.331
20	1.189	1.116	55	...	1.375
25	1.245	1.147	60	...	1.419
30	1.306	1.180	65	...	1.463
35	1.372	1.214	70	...	1.508

(Gerlach, Z. anal. 23. 476.)

Sp. gr. of MnCl<sub>2</sub>+Aq at room temp.

% MnCl <sub>2</sub>	Sp. gr.
8.007	1.0960
15.650	1.1963
30.330	1.3372
40.132	1.4530

(Wagner, W. Ann. 1883, 18. 273.)

Sp. gr. of MnCl<sub>2</sub>+Aq at t°.

t°	% MnCl <sub>2</sub>	Sp. gr.
14.5	5.0	1.0457
14.5	11.99	1.1076
14.0	14.98	1.1379
14.5	19.92	1.1891
14.0	23.10	1.2246
14.6	28.51	1.2888

(Long, W. Ann. 1880, 11. 38.)

Sp. gr. of MnCl<sub>2</sub>+Aq at 25°.

Concentration of MnCl <sub>2</sub> +Aq	Sp. gr.
1-normal	1.0513
1/2 " "	1.0259
1/3 " "	1.0125
1/4 " "	1.0063

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Solubility of MnCl<sub>2</sub>+KCl in H<sub>2</sub>O at t°.

t°	% MnCl <sub>2</sub>	% KCl	Solid phase
6	40.23 35.94 ...	... 9.41 23.06	MnCl <sub>2</sub> , 4H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O+KCl KCl
28.4	44.46 43.28 38.65 ...	... 8.66 13.79 26.91	MnCl <sub>2</sub> , 4H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O+KCl KCl
52.8	50.14	6.01	MnCl <sub>2</sub> , 4H <sub>2</sub> O+MnCl <sub>2</sub> , 2H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O
62.6	51.86 49.95 44.05 36.85 ...	... 6.67 12.49 18.77 31.57	MnCl <sub>2</sub> , 2H <sub>2</sub> O MnCl <sub>2</sub> , 2H <sub>2</sub> O+MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , KCl, 2H <sub>2</sub> O+MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O MnCl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O+MnCl <sub>2</sub> , 4KCl KCl

(Süss, Z. Kryst. Min. 1912, 51. 262.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)Solutions of MnCl<sub>2</sub> in 75% alcohol saturated at t° contain:

t°	% MnCl <sub>2</sub>	t°	% MnCl <sub>2</sub>
10	23.1	43.75	37.5
25	36.1	87.5	32.2
		(B-pt.)	

Solutions of  $\text{MnCl}_2$  in absolute alcohol saturated at  $t^\circ$  contain:

$t^\circ$	% $\text{MnCl}_2$	$t^\circ$	% $\text{MnCl}_2$
11.25	33.3	76.25	36.2
37.5	33.3	(B.-pt.)	

(Brandes, *l. c.*)

$\text{MnCl}_2$  crystallises from above solutions on standing.

When 15–20 vols. ether are added to 1 vol. absolute alcohol sat. with  $\text{MnCl}_2$ ,  $\text{MnCl}_2$  is completely pptd. (Döbereiner.)

Insol. in oil of turpentine.

Sol. in urethane. (Castoro, *Z. anorg.* 1899, 20. 61.)

Sl. sol. in benzonitrile. (Naumann, *B.* 1914, 47. 1369.)

Difficultly sol. in methyl acetate. (Naumann, *B.* 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, *B.* 1910, 43. 314.)

+ $\text{H}_2\text{O}$ . Solubility in  $\text{HCl}$ +Aq decreases with increasing amt. of  $\text{HCl}$ . It is greater when hot than cold, but is not inconsiderable even when  $\text{HCl}$  is conc. 1 l. conc.  $\text{HCl}$ +Aq sat. at  $12^\circ$  dissolves 190 g.  $\text{MnCl}_2$  from  $\text{MnCl}_2$ + $\text{H}_2\text{O}$ . (Ditte, *C. R.* 1881, 92. 243.)

+ $\frac{1}{2}\text{H}_2\text{O}$ .  $\text{MnCl}_2$ + $4\text{H}_2\text{O}$  effloresces to  $\text{MnCl}_2$ + $\frac{1}{2}\text{H}_2\text{O}$  in a dry atmosphere and under low pressure and not to  $\text{MnCl}_2$ + $2\text{H}_2\text{O}$ . (Sabatier, *Bull. Soc.* 1894, (3) 11. 547.)

+ $2\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnCl}_2$ per 100 pts. $\text{H}_2\text{O}$	Sp. gr. of sat. solution
60	108.6	1.6108
70	110.6	1.6134
80	112.7	....

(Dawson and Williams, *Z. phys. Ch.* 1899, 31. 63.)

Sat. aqueous solution of  $\text{MnCl}_2$ + $2\text{H}_2\text{O}$ . Contains 51.86%  $\text{MnCl}_2$  at  $62.6^\circ$ . (Süss, *Z. Krist.* 1912, 51. 262.)

+ $4\text{H}_2\text{O}$ . Deliquescent.

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve:

$t^\circ$	Pts. $\text{MnCl}_2$ + $4\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{MnCl}_2$ + $4\text{H}_2\text{O}$
8	151	87.5	641
31.25	265	106.25	656
62.5	641	....	...

(Brandes, *l. c.*)

Sol. in 0.8 pt.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abl.)

Pptd. from solution in 9.17 mols.  $\text{H}_2\text{O}$ . (Kuznetsoff, *C. C.* 1899, I. 246.)

Sat. aq. solution contains at:

$-22^\circ$	$-5^\circ$	$+7^\circ$	$17^\circ$	$19^\circ$
34.7	37.8	40.4	41.2	42.3% $\text{MnCl}_2$
35°	55°	57°	80°	100° 140°
44.4	48.2	50.0	51.0	53.7 54.7% $\text{MnCl}_2$ .

(Étard, *A. ch.* 1894, (7) 2. 537.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnCl}_2$ per 100 pts. $\text{H}_2\text{O}$	Sp. gr. of sat. solution
25	77.18	1.4991
30	80.71	1.5049
40	88.59	1.5348
50	98.15	1.5744
*57.65	105.40	1.6097

\* Temp. of transition into  $\text{MnCl}_2$ + $2\text{H}_2\text{O}$ .

(Dawson and Williams, *Z. phys. Ch.* 1899, 31. 63.)

Sat. aqueous solution of  $\text{MnCl}_2$ + $4\text{H}_2\text{O}$  contains 40.23%  $\text{MnCl}_2$  at  $6^\circ$ ; 44.6%  $\text{MnCl}_2$  at  $28.4^\circ$ . (Süss, *Z. Krist.* 1912, 51. 262.)

100 pts. 75% alcohol dissolve at  $t^\circ$ :

$t^\circ$	Pts. $\text{MnCl}_2$ + $4\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{MnCl}_2$ + $4\text{H}_2\text{O}$
10	53	43.75	144
25	132	87.5	100.1

(Brandes, *l. c.*)

Insol. in absolute ether, which also does not abstract crystal  $\text{H}_2\text{O}$ .

Insol. in boiling oil of turpentine. (Brandes. Sol. in conc.  $\text{HNO}_3$ +Aq.

+ $5\text{H}_2\text{O}$ . (Müller-Ersbach, *B.* 1889, 22. 3181.)

+ $6\text{H}_2\text{O}$ . Pptd. from solution in 11.7 mols.  $\text{H}_2\text{O}$  at  $-21^\circ$ . (Kuznetsoff, *C. C.* 1899, I. 246.)

**Manganese trichloride,  $\text{MnCl}_3$ .**

Immediately decomp. by  $\text{H}_2\text{O}$ ; sol. in abs. ether and in abs. alcohol. (Holmes, *J. Am. Chem. Soc.* 1907, 29. 1285.)

**Manganese tetrachloride,  $\text{MnCl}_4$ .**

Has not been isolated.

Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Nicklès, *J. B.* 1865. 225.)

Composition is  $\text{Mn}_2\text{Cl}_4$ . (Christensen, *J. pr.* (2) 34. 41.)

**Manganese hydrogen tetrachloride (chloromanganic acid),  $\text{MnCl}_4 \cdot 2\text{HCl}$ .**

Sol. in ether; decomp. by  $\text{H}_2\text{O}$ . (Franke, (2) 36. 31.)

**Manganese heptachloride,  $\text{MnCl}_7$ (?).**

Decomp. by  $\text{H}_2\text{O}$ . (Dumas, *Bers. J. B.* 7. 112.)

Has the formula  $\text{MnO}_2\text{Cl}$  (?). (Aschoff, J. pr. 81. 29.)

**Manganous mercuric chloride**,  $\text{MnCl}_2, \text{HgCl}_2, +4\text{H}_2\text{O}$ .

Deliquescent in moist air. Easily sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

$\text{MnCl}_2, 2\text{HgCl}_2$ . (Varet, C. R. 1896, 123, 422.)

**Manganous potassium chloride**,  $\text{MnCl}_2, \text{KCl} + 2\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , but is decomp. thereby. (Remsen and Saunders, Am. Ch. J. 14. 129.)

$\text{MnCl}_2, 2\text{KCl} + 2\text{H}_2\text{O}$ . (Süss, Z. Kryst. 1912, 51. 262.)

**Manganic potassium chloride**,  $\text{MnCl}_2, 2\text{KCl} + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  apparently without decomp. (Rice, Chem. Soc. 1898, 73. 261.)

$\text{MnCl}_2, 2\text{KCl}$ . Very easily decomp. (Meyer and Best, Z. anorg. 1899, 22. 186.)

$\text{MnCl}_2, \text{MnCl}_2, 5\text{KCl}$ . Easily decomp. (Meyer and Best, Z. anorg. 1899, 22. 185.)

**Manganous rubidium chloride**,  $\text{MnCl}_2, 2\text{RbCl}$ .

(Godeffroy.)

$+3\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol; conc.  $\text{HCl}$  + ppt. anhydrous salt from aqueous solution. (Godeffroy, Arch. Pharm. (3) 12. 40.)

Contains only  $2\text{H}_2\text{O}$ . (Saunders, Am. Ch. J. 14. 139.)

**Manganous thallic chloride**,  $\text{MnCl}_2, 2\text{TlCl}_2 + 6\text{H}_2\text{O}$ .

Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A. 1909, 366. 224.)

**Manganous stannic chloride.**

See Chlorostannate, manganous.

**Manganous chloride hydrazine**,  $\text{MnCl}_2, 2\text{N}_2\text{H}_4$ .

Ppt. (Franzen, Z. anorg. 1908, 60. 285.)

**Manganous chloride hydroxylamine**,  $\text{MnCl}_2, 2\text{NH}_2\text{OH}$ .

Very stable; insol. in alcohol. (Feldt, B. 1894, 27. 405.)

**Manganous fluoride**,  $\text{MnF}_2$ .

Only sol. in  $\text{H}_2\text{O}$  containing  $\text{HF}$ . (Berzelius.)

Insol. in  $\text{H}_2\text{O}$ ; decomp. by boiling with  $\text{H}_2\text{O}$ ; sl. sol. in liquid  $\text{NH}_3$ ; easily sol. in cold or hot conc.  $\text{HNO}_3$  and  $\text{HCl}$ ; slowly sol. in dil.  $\text{HCl}$ ; decomp. by fused  $\text{K}_2\text{CO}_3$ ,  $\text{KOH}$ ,  $\text{KNO}_3$ , and  $\text{KClO}_3$ ; insol. in alcohol and

ether. Slowly sol. in acetic acid. (Moissan, C. R. 1900, 130. 1160.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Manganese trifluoride**,  $\text{MnF}_3$ .

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by dilution or boiling. (Berzelius.)

$+6\text{H}_2\text{O}$ . Efflorescent. (Christensen, J. pr. (2) 35. 57.)

Sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{O}$ ; insol. in most organic solvents. (Moissan, C. R. 1900, 130. 626.)

**Manganomanganic fluoride**,  $\text{Mn}_2\text{F}_7 + 10\text{H}_2\text{O}$ .

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by dilution. (Nicklès, C. R. 67. 448.)

**Manganese tetrafluoride**,  $\text{MnF}_4$ .

Not isolated. Sol. in absolute alcohol or ether; decomp. by  $\text{H}_2\text{O}$ . (Nicklès, C. R. 65. 107.)

Probably does not exist. (Christensen, J. pr. (2) 35. 161.)

**Manganese heptafluoride**,  $\text{MnF}_7$  (?).

Sol. in  $\text{H}_2\text{O}$  with decomp. (Wöhler.)

**Manganese sesquifluoride with MF.**

See also Fluomanganate, M.

**Manganic nickel fluoride**,  $2\text{NiF}_2, \text{Mn}_2\text{F}_7 + 8\text{H}_2\text{O}$ .

(Christensen, J. pr. (2) 34. 41.)

**Manganic potassium fluoride**,  $\text{Mn}_2\text{F}_7, 4\text{KF} + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl}$  + Aq, dil.  $\text{HNO}_3$  + Aq, conc.  $\text{H}_2\text{SO}_4$  + Aq,  $\text{H}_3\text{PO}_4$  + Aq,  $\text{H}_2\text{C}_2\text{O}_4$  + Aq,  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$  + Aq, and dil.  $\text{HF}$  + Aq. (Christensen, J. pr. (2) 35. 72.)

$\text{MnF}_2, 2\text{KF}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Nicklès, C. R. 65. 107.)

True composition is  $\text{Mn}_2\text{F}_7, 4\text{KF}$ , also with  $2\text{H}_2\text{O}$ . (Christensen, J. pr. (2) 34. 41.)

$\text{MnF}_2, 4\text{KF}$ . (Nicklès.)

See also Fluomanganate, potassium.

**Manganic rubidium fluoride.**

See Fluomanganate, rubidium.

**Manganic silver fluoride**,  $2\text{AgF}, \text{Mn}_2\text{F}_7 + 14\text{H}_2\text{O}$ .

Sol. in  $\text{HF}$  + Aq. (Christensen, J. pr. (2) 34. 41.)

**Manganic sodium fluoride**,  $\text{Mn}_2\text{F}_7, 4\text{NaF}$ .

Decomp. by much  $\text{H}_2\text{O}$ . Not as sol. in  $\text{HF}$  + Aq as the K salt. (Christensen, J. pr. (2) 35. 161.)



**Manganomanganic thalious fluoride,  $5\text{TiF}_6$ ,  $2\text{MnF}_3$ ,  $\text{MnF}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sl. sol. in dil., easily sol. in conc. HF.

Sol. in conc.  $\text{HCl}$ , dil.  $\text{HNO}_3$ , and cold or hot conc.  $\text{H}_2\text{SO}_4$ .

Sol. in warm  $\text{H}_2\text{O}$ , containing  $\text{H}_2\text{SO}_4$ .

Sol. in dil. tartaric and oxalic acids. (Ephraim, B. 1909, 42, 4458.)

**Manganous stannic fluoride.**

See Fluostannate, manganous.

**Manganic zinc fluoride,  $2\text{ZnF}_2$ ,  $\text{Mn}_2\text{F}_6$ ,  $+8\text{H}_2\text{O}$**

See Fluomanganate, zinc.

**Manganous zirconium fluoride.**

See Fluozirconate, manganous.

**Manganous fluoride ammonia,  $3\text{MnF}_2$ ,  $2\text{NH}_3$ .**

(Moissan, C. R. 1900, 130, 1161.)

**Manganous hydroxide,  $\text{MnO}_2\text{H}_2$ .**

$2.15 \times 10^{-4}$  g.-mol. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Sackur, Z. Elektrochem, 1909, 15, 846.)

Solubility in  $\text{H}_2\text{O} = 0.6 \times 10^{-4}$  g. mol. (Hers, Z. anorg. 1899, 22, 284.)

1 l.  $\text{H}_2\text{O}$  dissolves  $2 \times 10^{-4}$  mol.  $\text{MnO}_2\text{H}_2$ . (Tamm, Z. phys. Ch. 1910, 74, 500.)

Very sl. sol. in  $\text{H}_2\text{O}$  or alkalis. (Fresenius.) Easily sol. in acids. Insol. in  $\text{NaOH}$ , or  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{NH}_3$ , salts +  $\text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{NaOH} + \text{Aq}$  in presence of glycerine. (Donath, Dingl. 229, 542.)

Not pptd. by  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of  $\text{H}_2\text{C}_2\text{H}_3\text{O}_4$ ; by  $\text{KOH} + \text{Aq}$  in presence of cane sugar; by  $\text{KOH} + \text{Aq}$  in presence of Na citrate.

Solubility of  $\text{MnO}_2\text{H}_2$  in organic Na salts +  $\text{Aq}$ . (0.5 normal.)

Na tartrate, 0.0068 mol. per l.

Na malate, 0.0042 " " "

Na citrate, 0.0126 " " "

(Tamm, Z. phys. Ch. 1910, 74, 496.)

Min. *Pyrochroite*.

**Manganomanganic hydroxide,  $\text{Mn}_2\text{O}_4$ ,  $x\text{H}_2\text{O}$ .**

Not attacked by boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Behaves towards acids as  $\text{Mn}_2\text{O}_3$ .

**Manganic hydroxide,  $\text{Mn}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ .**

Insol. in hot or cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Sol. in conc.  $\text{H}_2\text{SO}_4$  at somewhat over  $100^\circ$ . (Carius.)

Sol. in tartaric, oxalic, and malic acids, with subsequent decomp. Insol. in formic, acetic, benzoic, or hippuric acids. (Hermann, Pogg. 74, 303.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in cane sugar +  $\text{Aq}$ . (Pescher.)

Min. *Manganite*. Sol. in conc.  $\text{HCl} + \text{Aq}$ . Sl. sol. in conc.  $\text{H}_2\text{SO}_4$ .

**Manganese dihydroxide,  $\text{MnO}_2$ ,  $\text{H}_2\text{O}$ .**

See Manganous acid.

**Manganous iodide,  $\text{MnI}_2$ .**

*Anhydrous*. Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29, 374.)

Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25, 212.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

+  $4\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Kusnetsoff, C. C. 1900, II, 525.)

+  $9\text{H}_2\text{O}$ . (Kusnetsoff.)

**Manganous mercuric iodide,  $\text{MnI}_2$ ,  $2\text{HgI}_2$ ,  $+6\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. without decomp. in alcohol and acetone. (Dobroserdoff, C. C. 1901, I, 363.)

$3\text{MnI}_2$ ,  $5\text{HgI}_2$ ,  $+20\text{H}_2\text{O}$ .

A sat. solution in  $\text{H}_2\text{O}$  at  $17^\circ$  has composition 1.4  $\text{MnI}_2$ ,  $\text{HgI}_2$ ,  $+10.22 \text{H}_2\text{O}$  and sp. gr. = 2.98. (Duboin, C. R. 1906, 142, 1338.)

Very sol. without decomp. in methyl, propyl, isopropyl, isobutyl, and allyl alcohols, ethyl acetate and ethyl cyanide. Somewhat less sol. in amyl, propyl and isobutyl acetates, acetone, acetic acid, formic acid (with ppt. of  $\text{HgI}_2$ ), ethyl benzoate, ethyl oxalate, butyl alcohol, amyl alcohol and nitrobenzene. Sl. decomp. by glycerine. Insol. in ethyl nitrate, ethylene bromide, toluene, benzene,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , ethyl iodide, monobrom- and monochlorobenzene. (Duboin, A. ch. 1909, (8), 16, 278.)

**Manganese nitride,  $\text{Mn}_2\text{N}_3$ .**

Sol. in  $\text{HNO}_3$  only on heating.  $\text{HCl} + \text{Aq}$  dissolves only in presence of Pt. Aqua regia dissolves slowly.  $\text{H}_2\text{SO}_4$  acts only when hot and conc. Insol. in acetic acid. (Prelinger, M. 1894, 15, 398.)

$\text{Mn}_2\text{N}_3$ . Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in  $\text{HCl}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$  with decomp. (Prelinger, M. 1894, 15, 398.)

$\text{Mn}_2\text{N}_3$ . Easily attacked by acids and alkalis. (Wedekind, B. 1908, 41, 3772.)

**Manganous oxide,  $\text{MnO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Readily sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

**Manganic oxide (Manganese sesquioxide),  $\text{Mn}_2\text{O}_3$ .**

Decomp. by boiling with  $\text{HNO}_3 + \text{Aq}$  into  $\text{MnO}$ , which dissolves, and  $\text{MnO}_2$ , which is insol. (Berthier); also by boiling with dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Turner.) Sol. in hot conc.  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Sol. in cold  $\text{HCl} + \text{Aq}$  without decomp. If perfectly pure, is insol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but if it contains any  $\text{MnO}$ , it dissolves. (Rose.) Insol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

Solubility in (calcium sucrate+sugar)+Aq.

1 l. solution containing 418.6 g. sugar and 34.3 g. CaO dissolves 0.50 g.  $\text{Mn}_2\text{O}_3$ ; containing 296.5 g. sugar and 24.2 g. CaO dissolves 0.37 g.  $\text{Mn}_2\text{O}_3$ ; containing 174.4 g. sugar and 14.1 g. CaO dissolves 0.32 g.  $\text{Mn}_2\text{O}_3$ . (Bodenbender, J. B. 1865. 600.)

Min. *Brunnrite*.

*Colloidal*. Solution in  $\text{H}_2\text{O}$  containing 0.21 g. to a litre is precipitated by  $\text{KNO}_3$ +Aq (1:1000);  $\text{K}_2\text{SO}_4$ +Aq (1:1100);  $(\text{NH}_4)_2\text{SO}_4$ +Aq (1:1500);  $\text{NaCl}$ +Aq (1:1580);  $\text{MgSO}_4$ +Aq (1:40,983);  $\text{BaCl}_2$ +Aq (1:58,823);  $\text{MnSO}_4$ +Aq (1:147,929);  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ +Aq (1:362,318);  $\text{K}_2\text{Cr}_2(\text{SO}_4)_4$ +Aq (1:416,668);  $\text{HCl}$ +Aq (1:61,350);  $\text{HC}_2\text{H}_3\text{O}_2$  (1:17,262);  $\text{H}_2\text{SO}_4$  (1:62,500). (Spring and de Boeck, Bull. Soc. (2) 48. 170.)

### Manganomanganic oxide, $\text{Mn}_2\text{O}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Boiling dil. or conc.  $\text{HNO}_3$ +Aq dissolves out  $\text{MnO}$  (Berthier); also boiling dil.  $\text{H}_2\text{SO}_4$ +Aq. (Turner.) Sol. in hot  $\text{HCl}$ +Aq. (Otto.)  $\text{NH}_4\text{Cl}$ +Aq dissolves out  $\text{MnO}$ . (Rose.) Sol. without decomp. in hot very conc.  $\text{H}_3\text{PO}_4$ +Aq, and cold conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , oxalic, and tartaric acids+Aq.

Min. *Hausmannite*.

### Manganese dioxide, $\text{MnO}_2$ .

Min. *Pyrolusite*. Insol. in  $\text{H}_2\text{O}$ . Very slowly sol. in conc.  $\text{H}_2\text{SO}_4$  with evolution of  $\text{O}_2$ . Sol. in cold  $\text{HCl}$ +Aq; decomp. by hot  $\text{HCl}$ +Aq. Sol. in aqua regia. Sol. in  $\text{SO}_2$ +Aq or  $\text{N}_2\text{O}_5$ +Aq. (Karsten.)

Insol. in  $\text{HNO}_3$ , or dil.  $\text{H}_2\text{SO}_4$ +Aq, except in presence of organic reducing substances. Decomp. by citric acid, and more easily by oxalic acid. (Bolton.)

Sl. sol. in hot conc., but insol. in dil.  $\text{HNO}_3$ +Aq. (Deville.) When pure it is insol. in cold dil.  $\text{H}_2\text{SO}_4$ +Aq, but if a small quantity of  $\text{MnO}$  is added much  $\text{MnO}_2$  dissolves. (Carius.)

Not decomp. by boiling  $\text{NH}_4\text{Cl}$ +Aq.

Easily sol. in a mixture of nitrososulphuric acid and conc.  $\text{HCl}$ +Aq. (Bornträger, Rep. anal. Ch. 1887. 741.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

### Manganese oxides, $\text{Mn}_2\text{O}_3$ , $\text{Mn}_2\text{O}_{11}$ , etc.

See *Manganite*, *manganous*.

### Manganese trioxide, $\text{MnO}_3$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , with subsequent decomp. Decomp. by ether. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Franke, J. pr. (2) 36. 31.)

### Manganese tetroxide, $\text{MnO}_4$ (?).

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Decomp. by  $\text{H}_2\text{SO}_4$  or ether. (Franke, J. pr. (2) 36. 166.)

### Manganese heptoxide, $\text{Mn}_2\text{O}_7$ .

Very unstable; takes up  $\text{H}_2\text{O}$  from air. Sol. in  $\text{H}_2\text{O}$  with evolution of heat and rapid decomposition. Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. (Aschoff.)

### Manganese oxychloride, $3\text{Mn}_2\text{O}_3$ , $\text{MnCl}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Saint-Gilles, C. R. 55. 329.)  $\text{MnCl}_3$ ,  $\text{MnO}$  (?). (Gorgeu, A. ch. (6) 4. 515.)

$\text{MnO}_2\text{Cl}$ . See *Manganyl chloride*.

### Manganic oxyfluoride, $\text{MnOF}_3$ .

Sol. in absolute ether.

$\text{MnOF}_3 \cdot 2\text{HF}$  = fluoxymanganic acid. (Nickles, C. R. 659. 107.)

### Manganic oxyfluoride potassium fluoride.

See *Fluoxymanganate*, *potassium*.

### Manganic sesquioxofluoride potassium fluoride.

See *Sesquifluoxymanganate*, *potassium*.

### Manganous oxyiodide, $\text{MnI}_2$ , $\text{MnO} + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Kusnetzoff, C. C. 1913, I. 1659.)

### Manganous oxysulphide, $\text{MnO}$ , $\text{MnS}$ .

Sol. in acids. (Arfvedson, Pogg. 1. 50.)

### Manganese phosphide, $\text{Mn}_3\text{P}_2$ .

Insol. in dil. acids; sol. in hot conc.  $\text{HNO}_3$ . (Wedekind, B. 1907, 40. 1268.)

Sol. in aqua regia; insol. in  $\text{HNO}_3$ . (Granger, C. R. 1897, 124. 191.)

$\text{Mn}_3\text{P}_2$ .  $\text{HCl}$ +Aq. dissolves out  $\text{Mn}_3\text{P}_2$  and leaves  $\text{Mn}_2\text{P}_3$ , which is sol. in  $\text{HNO}_3$ +Aq. (Wöhler and Merkel, A. 86. 371.)

Not attacked by boiling  $\text{H}_2\text{O}$  or by  $\text{HCl}$ . Easily sol. in warm  $\text{HNO}_3$  or aqua regia. (Wedekind and Veit, B. 1907, 40. 1268.)

$z\text{Mn}_3\text{P}_2$ ,  $y\text{Mn}_2\text{P}_3$ . Easily sol. in aqua regia; partly sol. in  $\text{H}_2\text{SO}_4$  or  $\text{HCl}$ +Aq. (Struve, J. pr. 79. 321.)

$\text{Mn}_2\text{P}_3$ . Insol. in  $\text{HCl}$ +Aq. Sol. in  $\text{HNO}_3$ +Aq. (Schrötter, W. A. B. 1849, 1. 305.)

### Manganous phosphoselenide, $\text{MnS}$ , $\text{P}_2\text{Se}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ +Aq or  $\text{HNO}_3$ +Aq. Insol. in cold, sl. decomp. by hot alkalis+Aq. (Hahn, J. pr. 93. 436.)

$2\text{MnSe}$ ,  $\text{P}_2\text{Se}_3$ . Insol. in cold, slowly sol. in hot  $\text{HCl}$ +Aq. Not decomp. by alkalis.

$2\text{MnSe}$ ,  $\text{P}_2\text{Se}_3$ . Easily decomp. by acids. (Hahn.)

**Manganese selenide, MnSe.**

Decomp. by  $H_2O$  and min. acids. (Wedekind, B. 1911, **44**. 2667.)

*Cryst.* Sl. decomp. by  $H_2O$  at  $100^\circ$ ; easily sol. in dil. acids. (Fonzes-Diacon, C. R. 1900, **130**. 1025.)

**Manganese silicide.**

Sol. in HF; only very sl. sol. in other acids. (Warren, C. N. 1898, **78**. 319.)

$Mg_2Si$ . Sol. in  $HCl + Aq$  with evolution of  $SiH_4$ . (Wöhler, A. 106. 54.)

$Mn_2Si$ . Insol. in  $H_2O$ . (Vigouroux, C. R. 1895, **121**. 772.)

Easily sol. in HF. (Wedekind, B. 1911, **44**. 2668.)

Easily sol. in dil. acids, HF and  $HNO_3$ . Insol. in  $KOH + Aq$ . (Vigouroux, A. ch. 1897, (7) **12**. 179.)

Easily sol. in HF when heated; in  $HCl$  when red hot. Sol. in dil. min. acids with decomp. (Vigouroux, C. R. 1895, **121**. 772.)

Insol. in  $HNO_3$ ; sol. in dil. or conc.  $HCl$ . Slowly decomp. by alkali hydroxides. (Lebeau, C. R. 1903, **136**. 91.)

$Mn_2Si$ . Easily sol. in molten alkali. (Vigouroux, C. R. 1895, **121**. 772.)

$MnSi$ . Slowly attacked by hot conc.  $HCl$ . Not acted upon by dil. or conc.  $HNO_3$  or  $H_2SO_4$ . (Lebeau, C. R. 1903, **136**. 91.)

$MnSi_2$ . Not attacked by  $HNO_3$  or  $H_2SO_4$ . Easily sol. in cold HF; decomp. by conc. alkalis +  $Aq$ . (Lebeau, C. R. 1903, **136**. 233.)

**Manganous sulphide,  $MnS$ .**

*Anhydrous.* Insol. in  $H_2O$ . Sol. in weak acids, even in acetic acid.

1 l.  $H_2O$  dissolves  $71.60 \times 10^{-4}$  moles  $MnS$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, **58**. 294.)

Insol. in acetone. (Naumann, B. 1904, **37**. 4329.)

Min. *Alabandite*. Sol. in  $HCl + Aq$ . +  $\frac{1}{2}H_2O$ . *Green*. Decomp. by boiling with  $H_2O$ . Sol. in weak acids, as acetic or sulphurous acid. Very sl. sol. in  $(NH_4)_2S + Aq$ . (Wackenroder.)

Sol. in  $NH_4$  salts +  $Aq$ . 100 ccm. of sat.  $NH_4Cl + Aq$  at  $12^\circ$  dissolve 0.43 g.  $MnS$ . (Clermont and Guyot, C. R. **85**. 37.)

+  $\frac{1}{2}H_2O$ . *Flesh-colored*. Less sol. in  $NH_4$  salts, or acetic acid +  $Aq$  than the preceding salt. 100 ccm. of sat.  $NH_4Cl + Aq$  at  $12^\circ$  dissolve 0.088 g. (Clermont and Guyot.)

Neither green nor flesh-coloured  $MnS$  contains  $H_2O$ . (Antony and Donnini, Gazz. ch. it. **23**. 560.)

$MnS$  is not pptd. in presence of alkali citrates, tartrates, or grape sugar; cane or milk sugar do not prevent precipitation. (Spiller.) Not pptd. in presence of  $Na_2P_2O_7$ . (Rose.)

**Manganese sulphide,  $Mn_2S_3$ .**

Decomp. by  $H_2O$ . Sol. in cold dil. acids. (Gautier and Hallopeau, C. R. 1889, **108**. 809.)

**Manganese disulphide,  $MnS_2$ .**

(Senarmont, J. pr. **51**. 385.)

Min. *Hauerite*. Decomp. by hot  $HCl + Aq$  with separation of S.

**Manganous phosphorus sulphide,  $MnS, P_2S_5$ .**

Sol. in  $HCl + Aq$  with decomp. (Berzelius, A. **46**. 147.)

**Manganous potassium sulphide,  $3MnS, K_2S$ .**

Nearly insol. in water, alcohol, or ether. Easily sol. in acids. (Völcker, A. **59**. 35.)

**Manganous sodium sulphide,  $3MnS, Na_2S$ .**

Insol. in  $H_2O$ , alcohol, or ether. Sol. in dil. acids, and  $SO_2 + Aq$ . (Völcker.)  $2MnS, Na_2S$ . Decomp. by  $H_2O$ . (Schneider, Pogg. **151**. 446.)

**Manganese telluride,  $MnTe$ .**

Decomp. by  $H_2O$  and min. acids. (Wedekind, B. 1911, **44**. 2667.)

**Manganic acid,  $H_2MnO_4$ .**

Known only in solution, which decomposes rapidly. (Franke, J. pr. (2) **36**. 31.)

**Barium manganate,  $BaMnO_4$ .**

Insol. in  $H_2O$ ; decomp. by acids. (Mitscherlich.)

**Didymium manganate,  $Di_2(MnO_4)_3$ .**

Insol. in  $H_2O$ . Sol. in  $H_2SO_4 + Aq$ . (Frerichs and Smith, A. **191**. 331.)

Does not exist. (Cleve, B. **11**. 912.)

**Lanthanum manganate,  $La_2(MnO_4)_3$ .**

Ppt. (Frerichs and Smith, A. **191**. 331.)

Does not exist. (Cleve, B. **11**. 912.)

**Manganese manganate,  $Mn_2O_3, MnO, = 3MnO_2$ .**

See **Manganese dioxide**.

**Lead manganate,  $PbMnO_4 + 2H_2O$ .**

Ppt. (Jolles, C. C. **1886**. 58.)

**Potassium manganate,  $K_2MnO_4$ .**

Sol. in water containing alkalis without decomp., but decomp. by pure  $H_2O$ . Can be recrystallised from dil.  $KOH + Aq$ .

Solubility in KOH + Aq at t°.		
Solvent	t°	Mol. $K_2MnO_4$ in 1 l. of sat. solution
2-N KOH	0	0.907
	10	1.013
	20	1.140
	30	1.252
	45	1.424
4-N KOH	0	0.554
	17	0.681
	25	0.733
	30	0.772
	40	0.852
	45	0.889
	51	0.938
	60	1.003
	70	1.074
	80	1.143
6-N KOH	0	0.155
	15	0.224
	23	0.261
	30	0.303
	40	0.362
	45	0.388
	60	0.469
	70	0.528
	80	0.587
8-N KOH	0	0.063
	10	0.070
	20	0.078
	30	0.096
	40	0.119
	50	0.142
	60	0.167
	70	0.196
	80	0.222
10-N KOH	0	0.0145
	10	0.0152
	20	0.0160
	30	0.0215
	40	0.0305
	50	0.0462
	63	0.0620
	70	0.0700
	80	0.0830

(Sackur, Z. Elektrochem. 1912, 18. 724.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Potassium manganate permanganate,**  
 $K_2MnO_4, KMnO_4$ .

Sol. without decomp. in 20% KOH + Aq. (Gorgeu, A. ch. (3) 61. 355.)

**Sodium manganate,**  $Na_2MnO_4 + 10H_2O$ .

Sol. in  $H_2O$ , with partial decomp. (Gen-tele, J. pr. 82. 58.)

**Strontium manganate,**  $SrMnO_4$ .

Insol. in  $H_2O$ . (Fromherz.)

**Permanganic acid.**

See Permanganic acid.

**Manganicyanhydric acid,**  $H_2Mn(CN)_6$ .

Not known in the free state.

**Barium manganicyanide,**  $Ba_2[Mn(CN)_6]_2$ .

Sol. in  $H_2O$ . (Fittig and Eaton.)

**Barium potassium manganicyanide barium cyanide,**  $2KBaMn(CN)_6, 3Ba(CN)_2 + 8H_2O$ .

Decomp. by  $H_2O$ . (Lehmann, Dissert. 1898.)

**Calcium manganicyanide,**  $Ca_2[Mn(CN)_6]_2$ .

Sol. in  $H_2O$ . (Fittig and Eaton.)

**Potassium manganicyanide,**  $K_2Mn(CN)_6$ .

Sol. in  $H_2O$ . (Christensen, J. pr. (2) 31. 163.)

**Sodium manganicyanide,**  $Na_2Mn(CN)_6 + 2H_2O$ .

Sol. in  $H_2O$ . (Fittig and Eaton.)

**Manganimanganic acid.**

**Barium manganimanganate,**  $Ba_2Mn_2O_8 + H_2O$ .

Insol. in  $H_2O$ . Identical with Rosenstiehl's "basic barium manganate," (J. Pharm. 1864, 46. 344). (Auger and Billy, C. R. 1904, 138. 501.)

**Lithium manganimanganate,**  $Li_2Mn_2O_8 + H_2O$ .

Insol. in  $H_2O$ . (Auger and Billy.)

**Manganiperiodic acid,**  $H_2O, Mn_2O_8, I_2O_7$ .

Wholly insol. in  $H_2O$ , in hot dil. or conc.  $HNO_3$ , and in hot dil.  $H_2SO_4$ . (Price, Am. Ch. J. 1903, 30. 182.)

**Potassium manganiperiodate,**  $K_2O, Mn_2O_8, I_2O_7$ .

Apparently entirely insol. and unchanged when boiled with  $H_2O$ , dil. or conc.  $HNO_3$ , or dil.  $H_2SO_4$ . (Price.)

**Sodium manganiperiodate,**  $Na_2O, Mn_2O_8, I_2O_7$ .

Apparently insol. and unchanged when treated with boiling  $H_2O$ , boiling dil. or conc.  $HNO_3$ , and boiling dil.  $H_2SO_4$ . (Price.)

**Manganocyanhydric acid,**  $H_2Mn(CN)_6$ .

Most easily decomp. Sl. sol. in alcohol. Insol. in ether. (Descamps, A. ch. (5) 24. 185.)

**Ammonium cuprous manganocyanide,**  
 $(\text{NH}_4)_2\text{Cu}_2\text{Mn}(\text{CN})_6$ .

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and alkalis; very unstable. (Straus, Z. anorg. 1895, 9. 14.)

**Ammonium manganous manganocyanide,**

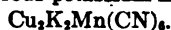
Sol. in  $\text{NH}_4\text{CN} + \text{Aq.}$  (Fittig and Eaton, A. 145. 157.)

**Barium manganocyanide,  $\text{Ba}_2\text{Mn}(\text{CN})_6$ .**

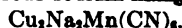
Sol. in cold  $\text{H}_2\text{O}$ . (Fittig and Eaton.)

**Calcium manganocyanide,  $\text{Ca}_2\text{Mn}(\text{CN})_6$ .**

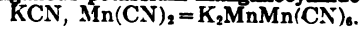
Very deliquescent. Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Fittig and Eaton.)

**Cuprous potassium manganocyanide,**

Sol. in  $\text{H}_2\text{O}$  with sl. decomp. Easily decomp. by acids and alkalis. (Straus, Z. anorg. 1895, 9. 12.)

**Cuprous sodium manganocyanide,**

Sol. in  $\text{H}_2\text{O}$  with only sl. decomp. Partially decomp. by acids. (Straus.)

**Manganous potassium manganocyanide,**

Ppt. Sol. in  $\text{KCN} + \text{Aq.}$

**Potassium manganocyanide,  $\text{K}_4\text{Mn}(\text{CN})_6 + 3\text{H}_2\text{O}$ .**

Very efflorescent. Sol. in  $\text{H}_2\text{O}$ ; decomp. by boiling.

**Potassium manganocyanide chloride,**

Easily sol. in  $\text{H}_2\text{O}$ . (Descamps.)

**Sodium manganocyanide,  $\text{Na}_4\text{Mn}(\text{CN})_6 + 8\text{H}_2\text{O}$ .**

Very efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Fittig and Eaton.)

**Strontium manganocyanide,  $\text{Sr}_2\text{Mn}(\text{CN})_6$ .**

As the Ba comp. (Descamps.)

**Permanganomolybdic acid.**

See Permanganomolybdic acid.

**Permanganotungstic acid.**

See Permanganotungstic acid.

**Manganosulphuric acid.**

See Sulphate, manganic.

**Manganous acid,  $\text{H}_2\text{MnO}_3 = \text{MnO}_2, \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Franke, J. pr. (2) 36. 451.)  
 $2\text{MnO}_2, \text{H}_2\text{O}$  (?). Min. Wad.

**Barium manganite,  $\text{BaO}, 5\text{MnO}_2$ .**

Sl. sol. in  $\text{HCl} + \text{Aq.}$ , less sol. in  $\text{HNO}_3 + \text{Aq.}$

(Rissler, Bull. Soc. (2) 30. 111.)

$\text{BaO}, 7\text{MnO}_2$ . (Rousseau, C. R. 104. 786.)

$\text{BaO}, 2\text{MnO}_2$ . Insol. in  $\text{H}_2\text{O}$ .

$\text{BaO}, \text{MnO}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Rousseau, C. R. 102. 425.)

$\text{Ba}(\text{H}_2\text{Mn}_2\text{O}_{10})_2$ . (Morawski and Stingl, J. pr. (2) 18. 92.)

**Calcium manganite,  $\text{CaO}, 5\text{MnO}_2$ .**

Easily sol. in  $\text{HCl} + \text{Aq.}$ , less in  $\text{HNO}_3 + \text{Aq.}$  (Rissler.)

$3\text{CaO}, \text{MnO}_2$  (?). Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq.}$  with evolution of Cl. Scarcely sol. in cold  $\text{HNO}_3$ , but sol. on heating. (Dufau, A. ch. 1897, (7) 12. 275.)

$2\text{CaO}, \text{MnO}_2$ . Sol. in dil. min. acids. (Rousseau, C. R. 116. 1060.)

$\text{CaO}, 2\text{MnO}_2$ . (Rousseau, C. R. 102. 425.)

$\text{CaO}, 3\text{MnO}_2$ .

$\text{CaO}, \text{MnO}_2$ . Sol. in fuming  $\text{HCl} + \text{Aq.}$ , but not in dil.  $\text{HNO}_3 + \text{Aq.}$  (Rousseau, C. R. 116. 1060.)

**Chromium manganite,  $\text{Cr}_2\text{O}_3, 3\text{MnO}_2 = \text{Cr}_2(\text{MnO}_3)_3$ .**

Slowly decomp. by acids. (Gröger, Z. anorg. 1905, 44. 458.)

**Cobaltous manganite,  $\text{CoO}, \text{MnO}_2 + 2\text{H}_2\text{O}$ .**

Ppt. (Salinger, Z. anorg. 1903, 33. 352.)

$+ 4\text{H}_2\text{O}$ . Ppt. (Salinger.)

**Cobalt copper manganite,  $\text{CoO}, \text{CuO}, 2\text{MnO}_2 + 4\text{H}_2\text{O}$ .**

Min. *Asbolitic*. Sol. in  $\text{HCl} + \text{Aq.}$ , with evolution of Cl.

**Cupric manganite,  $\text{CuO}, 4\text{MnO}_2$ .**

(Gorgeu, Bull. Soc. 1903, (3) 29. 1167.)

$\text{CuO}, 8\text{MnO}_2 + 3\text{H}_2\text{O}$ . (Baubigny, C. R. 1897, 124. 955.)

**Cupric manganous manganite,  $4\text{CuO}, \text{MnO}, 7\text{MnO}_2 + 8\text{H}_2\text{O}$ .**

Ppt. (Salinger, Dissert. 1902.)

$\text{Mn}_2\text{O}_3, 3\text{CuO}$ . Sol. in  $\text{HCl} + \text{Aq.}$  (Schneider, Am. Ch. J. 9. 269.)

**Lead manganite,  $\text{PbO}, 5\text{MnO}_2$ .**

Not attacked by conc. acids; sol. in aqua regia. (Rissler.)

**Magnesium manganite,  $2\text{MgO}, \text{MnO}_2$ .**

(Lemoine, Ann. Min. (7) 3. 5.)

$+ x\text{H}_2\text{O}$ . (Vollard.)

**Manganous manganite,  $\text{Mn}_2\text{O}_3 = \text{MnO}, 2\text{MnO}_2$ .**

(Reissig, A. 103. 27.)

$\text{Mn}_2\text{O}_{11} = \text{MnO}, 5\text{MnO}_2$ . (Veley, Chem. Soc. 33. 581.)

$3\text{MnO}_2, 2\text{MnO}$ . Decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Franke, J. pr. (2) 36. 166.)  
 $3\text{MnO}_2, \text{MnO} + \text{H}_2\text{O}$ . Min. *Varviciite*.

**Manganous zinc manganite**,  $\text{MnO}, \text{ZnO}, \text{MnO}_2$ .

(Gorgeu, Bull. Soc. 1903, (3) 29. 1168.)  
 $2\text{MnO}, \text{ZnO}, 2\text{MnO}_2$ . (Gorgeu.)

**Potassium manganite**,  $\text{K}_2\text{O}, 2\text{MnO}_2$ .

Insol. in  $\text{H}_2\text{O}$ .  
 $\text{K}_2\text{O}, 5\text{MnO}_2$ .  
 $\text{K}_2\text{O}, 7\text{MnO}_2 + 3\text{H}_2\text{O}$ .  
 $\text{K}_2\text{O}, 8\text{MnO}_2 + 3\text{H}_2\text{O} = \text{KH}_2\text{Mn}_3\text{O}_{10}$ . (Morawski and Stingl, J. pr. (2) 18. 91.)  
 Does not exist. (Wright and Menke, Chem. Soc. 37. 22.)  
 $\text{K}_2\text{O}, 10\text{MnO}_2$ .  
 $\text{K}_2\text{O}, 16\text{MnO}_2 + 6\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl} + \text{Aq}$ . (Rousseau, C. R. 114. 72.)

**Silver manganite**,  $\text{AgH}_2\text{Mn}_4\text{O}_{10}$ .

(Morawski and Stingl, J. pr. (2) 18. 92.)  
 $\text{Ag}_2\text{MnO}_2$ . Ppt. (Gorgeu, C. R. 110. 958.)

**Silver (argentous) manganite**,  $\text{Ag}_2\text{O}, \text{Mn}_2\text{O}_3$  (?).

Insol. in cold dil.  $\text{HNO}_3 + \text{Aq}$ , and separates  $\text{Mn}_2\text{O}_3$  on warming. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rose, Pogg. 101. 229.)

**Silver (argentoargentic) manganite**,  $\text{Ag}_2\text{O}, 2\text{Ag}_2\text{O}, \text{Mn}_2\text{O}_3$  (?).  
 (Rose.)

**Sodium manganite**,  $\text{Na}_2\text{O}, 5\text{MnO}_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Rousseau, C. R. 103. 261.)  
 $\text{Na}_2\text{O}, 12\text{MnO}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Rousseau.)  
 $+4\text{H}_2\text{O}$ . (Rousseau, C. R. 112. 525.)  
 $\text{Na}_2\text{O}, 8\text{MnO}_2 + 5\text{H}_2\text{O}$ . (Rousseau.)  
 $\text{Na}_2\text{O}, 16\text{MnO}_2 + 8\text{H}_2\text{O}$ . (Rousseau.)

**Strontium manganite**,  $\text{MnO}_2, \text{SrO}$ .

Insol. in  $\text{H}_2\text{O}$ .  
 $2\text{MnO}_2, \text{SrO}$ . Insol. in  $\text{H}_2\text{O}$ . (Rousseau, C. R. 101. 167.)  
 $\text{MnO}_2, 5\text{SrO}$ . Sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . (Rissler, Bull. Soc. (2) 30. 110.)

**Zinc manganite**,  $\text{ZnO}, 5\text{MnO}_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Rissler.)  
 $\text{ZnO}, 4\text{MnO}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Gorgeu, Bull. Soc. 1903, (3) 29. 1168.)  
 $3\text{ZnO}, \text{MnO}_2 + 7\frac{1}{2}\text{H}_2\text{O}$ . (Salinger, Dissert. 1902.)  
 $27\text{ZnO}, 2\text{MnO}_2 + 25\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Salinger.)

**Manganyl chloride**,  $\text{MnO}_2\text{Cl}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Aschoff, J. pr. 81. 29.)

**Melanocobaltic chloride**,  
 $\text{Co}_2(\text{NH}_3)_4\text{Cl}_2\text{NH}_4\text{Cl}$ , or  
 $\text{Co}_2(\text{NH}_3)_4\text{Cl}_2\text{NH}_3$ .

Very al. sol. in cold  $\text{H}_2\text{O}$  or very dil.  $\text{HCl} + \text{Aq}$ . Decomp. by long standing or warming. Cold conc.  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  does not attack, but decomp. on warming.  $\text{HNO}_3 + \text{Aq}$  decomp. on warming. Sol. in cold  $\text{H}_2\text{SO}_4$  or  $\text{NH}_4\text{OH} + \text{Aq}$ ; from both solutions it can be precipitated by  $\text{HCl} + \text{Aq}$ . (Vortmann, B. 10. 1455.)

— **chloroplatinate**,  $\text{Co}_2(\text{NH}_3)_4\text{NH}_4\text{Cl}_2$ ,  
 $\text{PtCl}_4$ .

Ppt. (Vortmann, B. 15. 1902.)  
 $\text{Co}_2(\text{NH}_3)_4\text{NH}_4\text{Cl}_2(\text{OH})_2$ ,  $\text{PtCl}_4$ . Ppt. (Vortmann.)

— **mercuric chloride**,  
 $\text{Co}_2(\text{NH}_3)_4(\text{NH}_3)_2\text{Cl}_2(\text{OH})_2$ ,  $3\text{HgCl}_2 + \text{H}_2\text{O}$ .

Ppt. Difficultly sol. in cold  $\text{H}_2\text{O}$ , quite easily in warm  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$ . (Vortmann.)

— **chloride chromate**,  
 $\text{Co}_2(\text{NH}_3)_4\text{NH}_4\text{Cl}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Vortmann.)

**Mercuriammonium comps.**

See Mercury ammonium comps.

**Mercuriammonium bromide**,  $\text{Hg}(\text{NH}_2)\text{Br}$ .  
 See Dimercuriammonium ammonium bromide.

**Mercuriammonium chloride**,  $\text{Hg}(\text{NH}_2)\text{Cl}$ .  
 See Dimercuriammonium ammonium chloride.

**Mercuriammonium oxydimercuriammonium chloride**,  $4\text{Hg}(\text{NH}_2)\text{Cl}, \text{NH}_3(\text{HgOHg})\text{Cl}$ . (Millon.)

Correct composition is Dimercuriammonium ammonium chloride,  $\text{NH}_2\text{HgCl}, \text{NH}_4\text{Cl}$ , which see. (Balestra, Gazz. ch. it. 21, 2. 294.)

$\text{Hg}(\text{NH}_2)\text{Cl}, 2\text{NH}_3(\text{HgOHg})\text{Cl}$ . (Millon.)  
 Correct composition is Dimercuriammonium mercuric chloride,  $2\text{NH}_2\text{HgCl}, \text{HgCl}_2 + \text{H}_2\text{O}$ , or Dimercuriammonium hydrogen chloride,  $\text{NH}_2\text{HgCl}, \text{HCl}$ . (Balestra.)

**Mercuriammonium nitrate**,  $2\text{NH}_3, 2\text{HgO}, \text{N}_2\text{O}_5 = \text{NH}_2\text{HgNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Easily decomp. by  $\text{HCl}$ , or alkali sulphides +  $\text{Aq}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{H}_2\text{SO}_4, \text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Mitscherlich.)

Is dimercuriammonium ammonium nitrate,  $\text{NH}_2\text{HgNO}_3, \text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuriammonium oxydimercuriammonium nitrate**,  $3\text{HgO} \cdot 2\text{NH}_3 \cdot \text{N}_2\text{O}_5 = \text{NH}_2\text{HgNO}_3 \cdot (\text{NH}_2\text{OH})_2\text{NO}_3 + \text{H}_2\text{O}$ .

Decomp. by boiling with  $\text{H}_2\text{O}$ , which dissolves out  $\text{NH}_4\text{NO}_3$ . Sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  containing  $\text{NH}_4\text{OH}$ . (Mitscherlich.)

Is *dimercuriammonium ammonium nitrate*,  $3\text{NH}_2\text{HgNO}_3 \cdot \text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuriammonium oxydimercuriammonium sulphate**,  $(\text{NH}_2\text{Hg})_2\text{SO}_4 \cdot 3(\text{NH}_2\text{OH})_2\text{SO}_4$ .

Boiling  $\text{H}_2\text{O}$  dissolves out  $\text{H}_2\text{SO}_4$ . Gradually decomp. by boiling  $\text{KOH} + \text{Aq}$ . Completely sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in conc. or dil.  $\text{HCl}$ , or very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in conc. or dil.  $\text{HNO}_3 + \text{Aq}$  or conc.  $\text{H}_2\text{SO}_4$ . (Schneider.)

Correct formula is  $7(\text{NH}_2\text{Hg})_2\text{SO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ , *dimercuriammonium ammonium sulphate*. (Pesci, Gazz. ch. it. 20. 485.)

**Mercuridiammonium chloride (fusible white precipitate)**,  $\text{Hg}(\text{NH}_2)_2\text{Cl}_2$ .

Is *dimercuriammonium ammonium chloride*,  $\text{Hg}_2\text{NCl} \cdot 3\text{NH}_4\text{Cl}$ , which see. (Rammelsberg J. pr. 38. 558.)

**Mercuridiammonium mercuric chloride**,  $\text{Hg}(\text{NH}_2)_2\text{Cl}_2 \cdot \text{HgCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. by boiling therewith. (Rose, Pogg. 20. 158.)

Partly sol. in  $\text{H}_2\text{O}$ . (Kane.)

**Mercuridiammonium iodide**,  $\text{Hg}(\text{NH}_2)_2\text{I}_2$ .

$\text{H}_2\text{O}$  extracts all the  $\text{NH}_3$ . Partly sol. in little alcohol. Partly sol. in ether without decomp. (Nessler.)

Correct composition is *dimercuriammonium ammonium iodide*,  $\text{NH}_2\text{Hg}_2\text{I} \cdot 3\text{NH}_4\text{I}$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuridiammonium cupric iodide**,  $4\text{NH}_2\text{Hg}_2\text{I}_2 \cdot \text{CuI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol +  $\text{HC}_2\text{H}_3\text{O}_2$ . (Jørgensen, J. pr. (2) 2. 347.)  $2\text{Hg}(\text{NH}_2)_2\text{I}_2 \cdot \text{CuI}_2$ . (Decomp. by  $\text{H}_2\text{O}$ . (Jørgensen.)

**Mercuridiammonium iodide**,  $\text{Hg}(\text{NH}_2)_2\text{I}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Partly sol. in a little alcohol. Partly sol. in ether. (Nessler.)

Correct composition is *dimercuriammonium ammonium iodide*,  $\text{NH}_2\text{Hg}_2\text{I} \cdot 3\text{NH}_4\text{I}$ . (Pesci.)

**Mercuridiammonium mercuric iodide**,  $\text{Hg}(\text{NH}_2)_2 \cdot \text{HgI}_2$ , or  $\text{NH}_2\text{Hg}_2\text{I}_2$ .

Decomp. by  $\text{H}_2\text{O}$  or dil. acids. (Caillot and Corriol, J. Pharm. 9. 381.)

Correct composition is *dimercuriammonium ammonium mercuric iodide*,  $3\text{NH}_2\text{Hg}_2\text{I} \cdot 8\text{NH}_4\text{I} \cdot 4\text{HgI}_2$ . (Pesci, Gazz. ch. it. 20. 485.)

**Mercuridiammonium sulphate**,  $\text{Hg}(\text{NH}_2)_2\text{SO}_4$ .

Decomp. with  $\text{H}_2\text{O}$ .

Does not exist. (Pesci, Gazz. ch. it. 20. 485.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ , very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$ . Insol. in conc.  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  or  $\text{NH}_4\text{Cl} + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$ . (Schneider, J. pr. 75. 136.)

Correct composition is  $(\text{NH}_2\text{Hg})_2\text{SO}_4 \cdot 3(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ , *dimercuriammonium ammonium sulphate*. (Pesci.)

**Dimercuriammonium acetate**,  $\text{NH}_2\text{Hg}_2\text{C}_2\text{H}_3\text{O}_2$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HCl}$  or  $\text{NH}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Balestra, Gazz. ch. it. 22, 2. 563.)

**Dimercuriammonium ammonium acetate**,  $\text{NH}_2\text{Hg}_2\text{C}_2\text{H}_3\text{O}_2 \cdot 3\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{H}_2\text{O}$ .

Deliquescent; sol. in a little  $\text{H}_2\text{O}$  without decomp., but decomp. into  $\text{NH}_2\text{C}_2\text{H}_3\text{O}_2$  and  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  by excess of  $\text{H}_2\text{O}$ . (Balestra.)

— **arsenate**,  $\text{NH}_2\text{Hg}_2\text{H}_2\text{AsO}_4$ .

(Hirzel, Zeit. Pharm. 1853. 3.)

— **bromate**,  $\text{NH}_2\text{Hg}_2\text{BrO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Ppt. (Rammelsberg, Pogg. 55. 82.)

Is *oxydimercuriammonium bromate*,  $(\text{NH}_2\text{Hg}_2\text{O})\text{BrO}_3$ .

— **bromide**,  $\text{NH}_2\text{Hg}_2\text{Br}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Pesci, Gazz. ch. it. 19. 509.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$ . (Balestra, Gazz. ch. it. 22, 2. 558.)

Sol. in ammoniacal solutions of ammonium salts and in aq. acids. (Franklin, J. Am. Chem. Soc. 1905, 27. 839.)

— **ammonium bromide**,  $\text{NH}_2\text{Hg}_2\text{Br} \cdot \text{NH}_4\text{Br}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 19. 511.)

$4\text{NH}_2\text{Hg}_2\text{Br} \cdot 5\text{NH}_4\text{Br}$ . Decomp. by  $\text{H}_2\text{O}$ . Insol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Sol. in conc. or dil.  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ . (Pesci.)

$\text{NH}_2\text{Hg}_2\text{Br} \cdot 3\text{NH}_4\text{Br}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Pesci.)

Sol. in  $\text{NH}_4\text{Br}$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{I} + \text{Aq}$ ; sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ .

— **mercuric bromide**,  $2\text{NH}_2\text{Hg}_2\text{Br} \cdot \text{HgBr}_2$ .

Ppt. Sol. in  $\text{HBr}$  and in  $\text{HCl}$ . (Ray, Chem. Soc. 1902, 81. 649.)

— **carbonate**,  $(\text{NH}_2\text{Hg}_2)_2\text{CO}_3 + 2\text{H}_2\text{O}$ .

Ppt. Not decomp. by  $\text{KOH} + \text{Aq}$ , but easily by  $\text{K}_2\text{S}$ , or  $\text{KI} + \text{Aq}$ . (Rammelsberg, J. pr. (2) 38. 567.)

**Dimercuriammonium chloride,  $\text{NH}_4\text{Cl}$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ . Sl. attacked by cold dil.  $\text{HCl} + \text{Aq}$ , but is gradually dissolved thereby. Decomp. by hot  $\text{KOH} + \text{Aq}$ . (Weyl.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$ .

+  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HNO}_3$ , and  $\text{HCl} + \text{Aq}$ . Not decomp. by  $\text{KOH} + \text{Aq}$ . Decomp. by  $\text{KCl}$ ,  $\text{NaCl}$ , or  $\text{KI} + \text{Aq}$ . (Rammelsberg, Pogg. 48. 181.)

**— hydrogen chloride,  $\text{NH}_4\text{Cl}$ ,  $2\text{HCl}$ .**

Correct composition of mercuric chloramide chloride. (Balestra, Gazz. ch. it. 21, 2. 299.)

Decomp. by  $\text{H}_2\text{O}$ .

$\text{NH}_4\text{Cl}$ ,  $\text{HCl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Balestra, l. c.)

$\text{NH}_4\text{Cl}$ ,  $4\text{HCl}$ . Sol. in  $\text{H}_2\text{O}$ . (Ray, Proc. Chem. Soc. 1901, 17. 96.)

**— ammonium chloride,  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{Cl}$ . (Infusible white precipitate.)**

Correct composition of what has been called mercuric chloramide,  $\text{Hg}(\text{NH}_2)\text{Cl}$ . (Rammelsberg, J. pr. 38. 558.)

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Milon, A. ch. (3) 18. 413.) Sol. in 600 pts.  $\text{H}_2\text{O}$ . (Wittstein.) Sol. in 719.98 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl.) Insol. in alcohol.

Sol. in acids, even in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , also in  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Pelouse and Fremy.)

Sol. in warm  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

Sl. sol. in alkali chlorides +  $\text{Aq}$ , which partially decomp. (Miahle, A. ch. (3) 8. 180.)

Decomp. by  $\text{KOH} + \text{Aq}$ . Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , with evolution of  $\text{NH}_3$ . (Balestra.)

When freshly prepared is sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Saha and Choudhuri, Z. anorg. 1910, 67. 359.)

Sol. in excess of  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$ . Insol. in excess of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Carnegie and Burt, C. N. 1897, 76. 175.)

Insol. in excess of  $\text{NH}_4\text{OH} + \text{Aq}$ . (Carnegie and Burt.)

 **$\text{NH}_4\text{Cl}$ ,  $3\text{NH}_4\text{Cl}$  (Fusible white precipitate).**

Correct composition of what has been called mercuridiammonium chloride,  $\text{Hg}(\text{NH}_2)_2\text{Cl}_2$ . (Rammelsberg, J. pr. (2) 38. 558.)

Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in acids, even  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Not decomp. by cold, but by boiling  $\text{KOH} + \text{Aq}$ . (Weyl.)

Sol. in warm, less in cold  $\text{NH}_4\text{OH} + \text{Aq}$ . (Mitscherlich.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , with evolution of  $\text{NH}_3$ . (Balestra.)

Sol. in 10%  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and acetic acid. (Hofmann and Marburg, A. 1899, 305. 198.)

**Dimercuriammonium mercuric chloride,  $2\text{NH}_4\text{Cl}$ ,  $\text{HgCl}_2$ .**

Insol. in, and not decomp. by boiling  $\text{H}_2\text{O}$ , alkalis, conc.  $\text{HNO}_3$ , or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in boiling  $\text{HCl} + \text{Aq}$ . (Mitscherlich, J. pr. 19. 453.)

Sl. decomp. by  $\text{H}_2\text{O}$ , readily by  $\text{KOH} + \text{Aq}$ . (Gaudechon, A. ch. 1911, (8) 22. 212.)

Ppt. Sol. in  $\text{HBr}$ . (Ray, Proc. Chem. Soc. 1902, 18. 86.)

**— chloride ammonia,  $\text{NH}_4\text{Cl}$ ,  $\frac{1}{2}\text{NH}_3$ .**

Decomp. by water and by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gaudechon, A. ch. 1911, (8) 22. 212.)

**— chromate.**

See **Oxydimercuriammonium chromate.**

**— hydroxide,  $\text{NH}_4\text{OH}$ .**

Takes up  $\text{H}_2\text{O}$  to form  $\text{NH}_4\text{OH} + \text{H}_2\text{O}$  or  $(\text{NH}_4)_2\text{OH}_2$ , oxydimercuriammonium hydroxide, which also see.

Sol. in warm  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ .

**— iodate,  $\text{NH}_4\text{IO}_3$ ,  $2\text{NH}_4\text{IO}_3$ .**

Insol. in  $\text{HNO}_3$ . (Rammelsberg, J. pr. (2) 38. 568.)

**— iodide,  $\text{NH}_4\text{I}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by boiling with  $\text{KOH} + \text{Aq}$  or  $\text{KCl} + \text{Aq}$ . (Weyl, Pogg. 121. 601.) Decomp. by hot  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Balestra.)

Decomp. by dilute  $\text{HCl}$ . Sol. in ammonium salts +  $\text{Aq}$ . (Franklin, Z. anorg. 1905, 46. 21.)

+  $\text{H}_2\text{O}$ . See **Oxydimercuriammonium iodide.**

**— ammonium iodide,  $\text{NH}_4\text{I}$ ,  $3\text{NH}_4\text{I}$ .**

Correct composition of mercuridiammonium iodide,  $\text{Hg}(\text{NH}_2)_2\text{I}_2$ . (Pesci, Gazz. ch. it. 20. 485.)

$3\text{NH}_4\text{I}$ ,  $8\text{NH}_4\text{I}$ ,  $4\text{HgI}_2$ . Correct formula for mercuridiammonium mercuric iodide,  $\text{Hg}(\text{NH}_2)_2\text{I}_2$ ,  $\text{HgI}_2$ . (Pesci.)

**— nitrate,  $\text{NH}_4\text{NO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg, J. pr. (2) 38. 566.)

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , with evolution of  $\text{NH}_3$ . (Balestra, Gazz. ch. it. 22. 2. 560.)

+  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305. 212.)

Sl. sol. in  $\text{HNO}_3$ . (Ray, Z. anorg. 1902, 33. 209.)

**— ammonium nitrate,  $\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3$  +  $\text{H}_2\text{O}$ .**

Correct formula for mercuriammonium nitrate,  $\text{NH}_4\text{HgNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

$\text{NH}_4\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . Correct for-



mula for oxydimercuriammonium ammonium nitrate,  $(\text{NH}_4\text{OH})_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ . (Pesci.)

$\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_4\text{NO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Pesci.)

$3\text{NH}_4\text{NO}_3$ ,  $\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . Correct formula for mercuriammonium oxydimercuriammonium nitrate,  $\text{NH}_4\text{HgNO}_3$ ,  $(\text{NH}_4\text{OH})_2\text{NO}_3 + \text{H}_2\text{O}$ . (Pesci.)

**Dimercuriammonium nitrite**,  $\text{NH}_4\text{NO}_2$ .

Readily sol. in warm  $\text{HCl}$  or  $\text{HBr}$ . (Ray, Chem. Soc. 1902, 81. 648.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{HCl}$ . (Ray, Proc. Chem. Soc. 1902, 18. 85.)

$+ \text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305. 214.)

— **oxide**,  $(\text{NH}_4)_2\text{O}$ .

Slowly decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Decomp. by hot  $\text{KOH}$ , or  $\text{KCl} + \text{Aq}$ . (Weyl, Pogg. 121. 601.)

Sol. in  $\text{KCN} + \text{Aq}$  by heating 4–5 hours at  $130^\circ$ . Not completely sol. in  $\text{HCl}$  owing to formation of  $\text{Hg}_2\text{Cl}_2$ . (Gaudechon, C. R. 1907, 144. 1419.)

— **phosphate**,  $(\text{NH}_4)_2\text{PO}_4$ ,  $2\text{NH}_4\text{OH} + 10\text{H}_2\text{O}$ .

(Rammelsberg, J. pr. (2) 38. 567.)

See Oxydimercuriammonium phosphate.

— **ammonium salicylate**,  $2\text{NH}_4\text{C}_6\text{H}_5\text{OHC}_6\text{H}_4\text{O}_2$ ,  $5\text{NH}_4\text{C}_6\text{H}_5\text{OHC}_6\text{H}_4\text{O}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{C}_6\text{H}_5\text{O}_2$ ,  $\text{HCl}$ , or  $\text{KI} + \text{Aq}$ . (Balestra.)

— **selenate**,  $(\text{NH}_4)_2\text{SeO}_4 + 2\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Cameron and Davy, C. N. 44. 63.)

— **sulphate**,  $(\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Rammelsberg, J. pr. (2) 38. 565.) Sol. (Kane), insol. (Hirzel) in  $\text{HNO}_3 + \text{Aq}$ .

Sol. in  $\text{KI}$ , or  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  with evolution of  $\text{NH}_3$ . (Balestra.)

$+ \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$ . (Ray, Chem. Soc. 1905, 87. 9.)

— **ammonium sulphate**,  $(\text{NH}_4)_2\text{SO}_4$ ,  $3(\text{NH}_4)_2\text{SO}_4 + 4\text{H}_2\text{O}$ .

Correct formula for mercuridiammonium sulphate,  $2\text{NH}_4$ ,  $\text{HgO}$ ,  $\text{SO}_3 + \text{H}_2\text{O}$ . (Pesci, Gazz. ch. it. 20. 485.)

$5(\text{NH}_4)_2\text{SO}_4$ ,  $14(\text{NH}_4)_2\text{SO}_4 + 16\text{H}_2\text{O}$ . (Pesci.)

$7(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{SO}_4 + 12\text{H}_2\text{O}$ . Correct formula for mercuriammonium oxydimercuriammonium sulphate,  $(\text{NH}_4\text{Hg})_2\text{SO}_4$ ,  $3(\text{NH}_4\text{OH})_2\text{SO}_4$ . (Pesci.)

**Dimercuriammonium tartrate**,  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{KI}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , or  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + \text{Aq}$ . (Balestra, Gazz. ch. it. 22, 2. 563.)

— **ammonium tartrate**,  $2(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6$ ,  $(\text{NH}_4)_2\text{C}_4\text{H}_4\text{O}_6 + \text{H}_2\text{O}$ .

As above. (B.)

**Trimercuriammonium sulphate**,  $(\text{NH}_4)_3(\text{NH}_4\text{Hg})_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Millon.)

Does not exist. (Pesci, Gazz. ch. it. 20. 485.)

**Dimercuriarsonium mercuric chloride**,  $\text{AsHg}_2\text{Cl}_2 = \text{AsHg}_2\text{Cl}$ ,  $\text{HgCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Decomp. by warm  $\text{HNO}_3 + \text{Aq}$ . (Rose, Pogg. 51. 423.)

**Mercurimidosulphonic acid**,  $(\text{HO}_2\text{S})_2\text{N}_2\text{Hg}$ .

Very unstable. (Berglund, B. 9. 256.)

**Barium mercurimidosulphonate**,  $\text{Ba}_2(\text{SO}_3)_2\text{N}_2\text{Hg} + 5\text{H}_2\text{O}$ .

(Berglund, B. 9. 256.)

**Cadmium** —,  $\text{Cd}_2\text{HgN}_2(\text{SO}_3)_4 + 12\text{H}_2\text{O}$ .

Unstable; al. sol. in  $\text{H}_2\text{O}$ . (Berglund, Bull. Soc. (2) 25. 452.)

**Cobalt** —,  $\text{Co}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (B.)

**Copper** —,  $\text{Cu}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (B.)

**Magnesium** —,  $\text{Mg}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (B.)

**Manganous** —,  $\text{Mn}_2\text{HgN}_2(\text{SO}_3)_4 + 10\text{H}_2\text{O}$ .

Unstable. (B.)

**Mercuric** —,  $(\text{Hg}_2\text{O})_2\text{HgN}_2(\text{SO}_3)_4$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (B.)

**Nickel** —,  $\text{Ni}_2\text{HgN}_2(\text{SO}_3)_4 + 15\text{H}_2\text{O}$ .

(B.)

**Potassium** —,  $(\text{KO}_2\text{S})_2\text{N}_2\text{Hg} + 4\text{H}_2\text{O}$ .

Precipitate. (Raschig, A. 241. 161.)

**Potassium silver** —,  $(\text{AgSO}_3)_2(\text{KSO}_3)_2\text{HgN}_2 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Berglund.)

**Sodium** —,  $(\text{NaSO}_3)_2\text{HgN}_2 + 5\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{K}$  salt. (Berglund.)

**Strontium** —,  $\text{Sr}_2(\text{SO}_3)_2\text{HgN}_2 + 15\text{H}_2\text{O}$ .

More sol. than  $\text{Ba}$  salt. (B.)

**Zinc mercurimidosulphonate,**  
 $\text{Zn}_2(\text{SO}_3)_2\text{HgN}_2 + 15\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (B.)

**Dimercuriphosphonium mercuric bromide,**  $2\text{PHg}_2\text{Br}$ ,  $\text{HgBr}_2$ .

(Lemoult, C. R. 1907, 145. 1176.)

**Dimercuriphosphonium mercuric chloride,**  
 $\text{HgCl}_2$ ,  $\text{PHg}_2\text{Cl}$ .

(Lemoult, C. R. 1907, 145. 1176.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by hot, slowly by cold  $\text{H}_2\text{O}$  into  $\text{Hg}$ ,  $\text{HCl}$ , and  $\text{H}_3\text{PO}_3$ . Decomp. by acids or alkalis. (Rose, Pogg. 40. 75.)

**Dimercuriphosphonium mercuric iodide,**  
 $\text{HgI}_2$ ,  $\text{PHg}_2\text{I}$ .

Slowly decomp. by cold or warm  $\text{H}_2\text{O}$ , quickly by  $\text{MOH} + \text{Aq}$ . Not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Rapidly attacked by  $\text{HNO}_3$  and aqua regia. (Lemoult, C. R. 1904, 139. 479.)

**Dimercuriphosphonium mercuric nitrate,**  
 $\text{P}_2\text{Hg}_2$ ,  $6\text{HgO}$ ,  $3\text{N}_2\text{O}_5 = 2[\text{PHg}_2\text{NO}_3]$ ,  
 $\text{Hg}(\text{NO}_3)_2$ ,  $3\text{HgO}$ .

(Rose, Pogg. 40. 75.)

**Dimercuriphosphonium mercuric sulphate,**  
 $\text{P}_2\text{Hg}_2$ ,  $6\text{HgO}$ ,  $4\text{SO}_3 + 4\text{H}_2\text{O} = (\text{PHg}_2)_2\text{SO}_4$ ,  
 $3\text{HgSO}_4$ ,  $2\text{HgO} + 4\text{H}_2\text{O}$ .

Sol. in aqua regia. (Rose, Pogg. 40. 75.)

### Mercuric acid.

**Calcium mercurate (?)**.

(Berthollet, A. ch. 1. 61.)

**Potassium mercurate,**  $\text{K}_2\text{O}$ ,  $2\text{HgO}$ .

Gradually decomp. by  $\text{H}_2\text{O}$ ; less rapidly by absolute alcohol. (St. Meunier, C. R. 60. 557.)

**Sodium mercurate,**  $\text{Na}_2\text{O}$ ,  $\text{HgO}$ .

(Bettendorff, Bull. Soc. (2) 34. 328.)

**Mercurioammonium chloride,**

$\text{Hg}(\text{NH}_4)\text{Cl}$ .

(Rose, Pogg. 20. 158.)

Mixture of  $\text{Hg}$ ,  $\text{HgNH}_4\text{Cl}$ , and  $\text{NH}_4\text{Cl}$ . (Barfoed, J. pr. (2) 39. 201.)

— nitrate,  $(\text{NH}_4\text{Hg}_2)\text{NO}_3$ , "*Hahnemann's soluble mercury*."

Sol. in hot  $\text{HCl}$  and  $\text{HCl} \cdot \text{H}_2\text{O}_2 + \text{Aq}$ . Decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ , or  $\text{NH}_4$  salts +  $\text{Aq}$ . Probably mixture of mercurous salts and  $\text{Hg}$ .

**Mercurodiammonium chloride,**

$\text{Hg}_2(\text{NH}_4)_2\text{Cl}_2$ .

Easily decomp. (Rose, Pogg. 20. 158.)

Mixture of  $\text{Hg}$ ,  $\text{NH}_4\text{HgCl}$ , and  $\text{NH}_4\text{Cl}$ . (Barfoed, J. pr. (2) 39. 201.)

**Mercurodiammonium fluoride,**  
 $\text{Hg}_2(\text{NH}_4)_2\text{F}_2$  (?).

Decomp. by  $\text{H}_2\text{O}$ . (Finkener, Pogg. 110. 147.)

**Mercurousulphonic acid.**

**Mercurousulphonates,**  $\text{Hg}(\text{SO}_3\text{M})_2$ .

Correct composition for the double sulphites,  $\text{HgSO}_3$ ,  $\text{M}_2\text{SO}_3$ . (Divers and Shimidzu, Chem. Soc. 49. 583; Barth, Z. phys. Ch. 9. 195.)

**Mercuroxy-comps.**

See Oxymercur-comps.

**Mercury, Hg.**

Not attacked by  $\text{H}_2\text{O}$ . Not attacked by boiling conc.  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in dil. or conc.  $\text{HNO}_3 + \text{Aq}$ ; also in  $\text{HBr}$  or  $\text{HI} + \text{Aq}$ .

Not attacked by pure  $\text{HNO}_3$ , unless heated, but readily attacked by cold dil.  $\text{HNO}_3 + \text{Aq}$  containing  $\text{NO}$ . (Millon.)

Anhydrous  $\text{H}_2\text{SO}_4$  attacks  $\text{Hg}$  gradually at ord. temp. (Berthelot, C. R. 1897, 125. 749.)

$\text{H}_2\text{SO}_4$  attacks only when hot and conc. (Ditte, A. ch. 1890, (6) 19. 68.)

Conc.  $\text{H}_2\text{SO}_4$  does not attack dry or moist  $\text{Hg}$  either with or without air. (Pitman, J. Am. Chem. Soc. 1898, 20. 100.)

$\text{H}_2\text{SO}_4$  attacks  $\text{Hg}$  at  $20^\circ$  if it contains 99.7%; does not attack if it contains only 95.6%. (Baikerville, J. Am. Chem. Soc. 1898, 20. 515.)

Insol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  alone or in presence of  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4$ . (Berthelot, A. ch. 1898, (7) 14. 198.)

Not attacked by  $\text{HF} + \text{Aq}$  at any temp. (Gay-Lussac.)

$\text{HI}$  dissolves  $\text{Hg}$  rapidly at ord. temp. (Norris and Cottrell, Am. Ch. J. 1896, 18. 99.)

More rapidly attacked by  $\text{HBr} + \text{Aq}$  than by  $\text{HCl} + \text{Aq}$ . Rapidly acted upon by  $\text{HI}$  in absence of  $\text{O}$ . (Bailey, Chem. Soc. 1888, 53. 760.)

Not attacked by pure  $\text{HCl} + \text{Aq}$ , but in presence of  $\text{O}$ ,  $\text{Hg}_2\text{OCl}_2 + \text{H}_2\text{O}$  is formed. Action is apparently less in sunlight than in the dark. (Bailey, Chem. Soc. 1888, 53. 759.)

Small amts. of ferric salts hinder action of  $\text{HNO}_3$  on  $\text{Hg}$ , but it is hastened by presence of  $\text{Mn}(\text{NO}_3)_2$  or  $\text{NaNO}_2$ . (Ray, Chem. Soc. 1911, 99. 1015.)

$\text{HNO}_3$  under 33% does not attack  $\text{Hg}$  if metal and acid are kept in motion and  $\text{HNO}_3$  is absent. (Veley, B. 1895, 28. 928.)

Rapidly sol. in  $\text{HClO}_4$ . (Balard, Dissert. 1834.)

Alkali chlorides +  $\text{Aq}$  in presence of air decomp.  $\text{Hg}$ ; action is not increased by heat. (Miahle.)

Insol. in alkali chlorides +  $\text{Aq}$  in neutral or

alkaline solution. (Bhaduri, Z. anorg. 1897, 13. 407.)

Very sol. in conc. solution of I in KI+Aq. (Varet, Bull. Soc. 1897, (3) 17. 451.)

Slowly sol. in KCl or KI+Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, 59. 136.)

Slowly sol. in  $\text{Na}_2\text{S}$ +Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, 59. 137.)

Hg is appreciably sol. in the sulpho salts of Mo, W, V, As, Sb and Sn. (Storch, B. 1883, 16. 2015.)

Persulphates in alkali or neutral solution attack Hg.  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  in  $\text{NH}_4\text{OH}$  solution has strongest action. This dissolves Hg by repeated shaking at high temp. (Tarugi, Gazz. ch. it. 1903, 33, (1) 127.)

Insol. in KCN+Aq. (Elmer, J. pr. 1888, (2) 37. 442.)

Slowly sol. in KCN+Aq in presence of air. (Palmaer, Z. phys. Ch. 1907, 59. 136.)

Sol. in considerable quantity in 6% KCN+Aq. (Goyder, C. N. 1894, 69. 268.)

Most sol. in  $\text{K}_4\text{Fe}(\text{CN})_6$ +Aq when KOH is present. (Smith, J. Am. Chem. Soc. 1905, 27. 544.)

Hg dissolves in  $\text{Br}_2$  in the presence of KBr al. faster than in I, but in  $\text{CuBr}_2$  much more slowly. (Van Name and Edgar, Am. J. Sci. 1910, (4) 29. 255.)

Not attacked by  $\text{PCl}_5$  even at  $350^\circ$ . (Moissan, A. ch. 1885 (6) 6. 457.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0075 g. Hg in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

**Mercurous acetylde,  $\text{Hg}_2\text{C}_2+\text{H}_2\text{O}$ .**

(Burkard and Travers, Chem. Soc. 1902, 81. 1271.)

**Mercuric acetylde, basic,  $2\text{HgO}$ ,  $3\text{HgC}_2+2\text{H}_2\text{O}$ .**

(Burkard and Travers, Chem. Soc. 1902, 81. 1272.)

**Mercuric acetylde,  $\text{HgC}_2$ .**

Very sol. in HCl with evolution of  $\text{H}_2\text{C}_2$ . (Keiser, Am. Ch. J. 1893, 15. 535.)

$+\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , alcohol and ether. Sol. in  $\text{NH}_4$  acetate+Aq, and in KCN+Aq. Sl. attacked by cold HCl, easily by hot. Easily sol. in  $\text{HNO}_3$ . Dil.  $\text{H}_2\text{SO}_4$  attacks slowly; conc. causes explosion. (Plimpton and Travers, Chem. Soc. 1894, 65. 267.)

**Mercuric acetylde chloride,  $\text{HgC}_2$ ,  $\text{HgCl}_2+\frac{1}{2}\text{H}_2\text{O}$ .**

Not acted upon by dil. HCl. Decomp. by fuming  $\text{HNO}_3$  or aqua regia. Insol. in alcohol and ether. (Keiser, Am. Ch. J. 1893, 15. 538.)

**Mercuric acetylde mercuriomercuric chloride,  $\text{HgC}_2$ ,  $\text{HgCl}_2$ ,  $\text{HgCl}_2+\text{H}_2\text{O}$ .**

Insol. in all ordinary solvents. (Biltz and Mumm, B. 1904, 37. 4420.)

**Mercurous amidofluoride,  $\text{HgNH}_2\text{F}$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . Sol. in dil. HCl.

Probably dimercuriammonium ammonium fluoride,  $\text{NH}_4\text{F}$ ,  $\text{NH}_4\text{F}$ . (Böhm, Z. anorg. 1904, 43. 327.)

**Mercury ammonium comps.**

See—

**Mercurioammonium comps.,  $\text{NH}_2\text{HgR}$ .**

**Dimercuroammonium comps.,  $\text{NH}_2\text{Hg}_2\text{R}$ .**

**Mercurous chloramide,  $\text{Hg}(\text{NH}_2)\text{Cl}$ .**

**Dimercuriammonium comps.,  $\text{NH}_2\text{HgR}$ .**

**Mercuric chlor-, brom-, etc., amide,  $\text{Hg}(\text{NH}_2)_2\text{R}$ .**

**Mercuridiammonium comps.,  $\text{Hg}(\text{NH}_2)_2\text{R}$ .**

**Mercuriammonium comps.,  $\text{HgNH}_2\text{R}$ .**

**Dimercuridiammonium comps.,  $\text{Hg}_2\text{N}_2\text{H}_4\text{R}$ .**

**Trimercuriammonium comps.,  $\text{N}_3\text{H}_2\text{Hg}_3\text{R}$ .**

**Oxydimercuriammonium comps.,  $(\text{NH}_2\text{Hg}_2\text{O})\text{R}$ .**

**Mercurous arsinchloride,  $\text{AsHgCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Capitaine, J. Pharm. 25. 559.)

**Mercurous arsinchloride chloride,  $\text{AsHg}_2\text{Cl}_2$ ,  $=2\text{AsHgCl}$ ,  $\text{Hg}_2\text{Cl}_2$  (?).**

Decomp. by  $\text{H}_2\text{O}$ . (Capitaine.)

**Mercurous azoimide,  $\text{HgN}_3$ .**

Wholly insol. in  $\text{H}_2\text{O}$ . (Curtius, B. 24. 3324.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.25 g. (Wöhler and Krupko, B. 1913, 46. 2050.)

**Mercuric azoimide,  $\text{HgN}_6$ .**

Sol. in  $\text{H}_2\text{O}$  especially when hot. (Berthelot and Vieille, Bull. Soc. 1894, (3) 11. 747.)

Moderately sol. in  $\text{H}_2\text{O}$ . (Wöhler and Krupko, B. 1913, 46. 2050.)

**Mercuric bromamide,  $\text{Hg}(\text{NH}_2)_2\text{Br}$ .**

Insol. in  $\text{H}_2\text{O}$  and alcohol. Sl. sol. in  $\text{NH}_4\text{OH}$ +Aq. (Mitscherlich, J. pr. 19. 455.)

Correct composition is dimercuriammonium ammonium bromide,  $\text{Hg}_2\text{NBr}$ ,  $\text{NH}_4\text{Br}$ , which see. (Pesci, Gazz. ch. it. 19. 511.)

**Mercurous bromide,  $\text{Hg}_2\text{Br}_2$ .**

Solubility in  $\text{H}_2\text{O}=9.1 \times 10^{-7}$  g. equiv. per l. (Bodländer, Z. phys. Ch. 1898, 27. 61.)

Solubility in  $\text{H}_2\text{O}=7 \times 10^{-4}$  mols. per liter at  $25^\circ$ . (Sherrill, Z. phys. Ch. 193, 430. 735.)

Solubility in  $H_2O$  at  $25^\circ = 1.4 \times 10^{-7}$  equivalents per l. (Thompson, J. Am. Chem. Soc. 1906, 28, 762.)

Insol. in  $H_2O$  and dil. acids. Decomp. by  $HCl + Aq.$  Sol. in hot conc.  $H_2SO_4$  with evolution of  $SO_2$ . Sl. sol. in hot  $HNO_3 + Aq$  of 1.42 sp. gr. (Stromann, B. 20, 2818.)

Decomp. into Hg and  $HgBr_2$  by boiling with  $NH_4Br$ , or  $NH_4Cl + Aq$ ; also by ammonium carbonate or succinate, but not by ammonium sulphate or nitrate. (Wittstein.)

Sol. in  $Hg(NO_3)_2 + Aq.$  (Wackenroder, A. 41, 317.)

Partially decomp. by alkali chlorides +  $Aq$ ; when out of contact of air this decomp. is slight and  $HgBr_2$  is formed, while in the air  $HgCl_2$  is the resulting product. Much more rapidly decomp. in hot than cold solutions. (Miahle, A. ch. (3) 5, 177.)

A solution of  $HgBr$  in 0.1-N KBr contains about 1 mg. Hg ions in 1300 l.

Insol. in alcohol.

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1910, 43, 314.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329); (Eidmann, C. C. 1899, II, 1014.)

### Mercuric bromide, $HgBr_2$ .

Sol. in 250 pts.  $H_2O$  at ordinary temp., and 25 pts. boiling  $H_2O$ . (Wittstein.) Sol. in 240 pts.  $H_2O$  at  $18.75^\circ$ . (Abt.)

Sol. in 94 pts.  $H_2O$  at  $9^\circ$ , and in 4-5 pts. at  $100^\circ$ . (Lassaigne, J. chim. méd. 12, 177.)

Solubility in g-equivalents per litre =  $2 \times 10^{-3}$ . (Bodländer, Z. phys. Ch. 1898, 27, 61.)

1 l.  $H_2O$  dissolves about 4 g. at ord. temp. (Morse, Z. phys. Ch. 1902, 41, 731.)

1 l.  $H_2O$  dissolves 0.017 mol. at  $25^\circ$ . (Jander, Dissert. 1902.)

Solubility in  $H_2O$  at  $25^\circ = 0.017$  mol. liter. (Sherrill, Z. phys. Ch. 1903, 43, 735.)

Solubility at ord. temp. = 0.8%; at bpt. = 8-9%. (Larine, J. Pharm. 1904, (6) 20, 450.)

Solubility in cold  $H_2O = 4\%$ , but solution prepared by heating contains more Hg on account of decomp. into HBr and oxybromide. (Vicario, C. C. 1907, II, 1224.)

1 l.  $H_2O$  dissolves about 5-6 g. at ord. temp. (Gaudechon, A. ch. 1911, (8) 22, 212.)

1 l. aqueous solution at  $25^\circ$  contains 0.017 mol. (Herz and Paul, Z. anorg. 1913, 83, 431.)

Decomp. by warm  $HNO_3$ , or  $H_2SO_4 + Aq$ . Sol. in warm  $H_2SO_4$ . (Ditte, A. ch. (5) 17, 124.)

1 mol. is sol. in 1 mol. warm HI +  $Aq$ . in 1 mol. cold conc. HCl and in  $\frac{1}{2}$  mol. hot conc. HCl. (Léwig.)

### Solubility of $HgBr_2$ in $KBr + Aq$ at $25^\circ$ .

Mols. per liter	
KBr	$HgBr_2$
0.	0.017
0.05	0.055
0.10	0.088
0.5	0.0359
0.866	0.611
2	1.407
3	2.096
4	2.339

(Sherrill, Z. phys. Ch. 1903, 43, 705.)

### Solubility in various salts + $Aq$ at $25^\circ$ .

Salt	In 10 ccm. of the solution	
	Millimols $HgBr_2$	Millimols salt
NaBr	0.17	0
	0.78	1.18
	2.85	5.96
	5.40	11.42
	12.76	24.48
	15.50	29.97
KBr	23.06	52.46
	0.17	0
	0.98	2.09
	4.72	7.70
	13.60	23.80
	19.30	34.70
$CaBr_2$	0.17	0
	1.17	0.72
	6.76	6.45
	13.58	18.92
	27.66	24.79
	36.66	37.54
$SrBr_2$	0.17	0
	1.04	0.62
	4.71	3.28
	9.02	6.68
	17.70	14.01
	22.38	18.72
$BaBr_2$	0.17	0
	3.70	2.74
	5.40	3.96
	7.59	5.79
	14.78	10.96

(Herz and Paul, Z. anorg. 1913, 82, 434.)

Solubility in 0.1-N  $Hg(NO_3)_2 + Aq$  is about 20 g. per liter. (Morse, Z. phys. Ch. 1902, 41, 731.)

Sol. in KBr or NaBr +  $Aq$ . (Jander, Dissert. 1902.)

Solubility in 10 cc.  $Br_2 + Aq$  at  $25^\circ$ .

Millimol $Br_2$	0.753	1.797	2.231
" Hg	0.1844	0.1947	0.2120

(Herz and Paul, Z. anorg. 1914, 85, 215.)

Sat. solution in liquid  $\text{SO}_2$  contains about 1.5%  $\text{HgBr}_2$  at  $159.4^\circ$ . (Niggli, Z. anorg. 1912, 76. 182.)

Moderately sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)  
Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

1 ccm. of sat. solution in abs. alcohol at ord. temp. contains 0.0958 g.  $\text{HgBr}_2$ ; at bpt. contains 0.1262 g. (Hamper, Ch. Z. 1887, 11. 905.)

#### Solubility of $\text{HgBr}_2$ in alcohols + Aq at $t^\circ$ .

Alcohol	$t^\circ$	G. $\text{HgBr}_2$ per 100 g. alcohol
Methyl alcohol	0	41.15
	10	49.5
	19	66.3
	22	60.9
	39	71.3
	65	90.8
	97	139.1
Ethyl alcohol	0	25.2
	10	26.3
	19	29.7
	39	31.9
	65	44.5
	89	66.9
Propyl alcohol	0	14.6
	10	15.6
	19	15.5
	39	20.8
	65	31.3
	86.5	42.7
Isobutyl alcohol	0	4.61
	10	5.63
	23	6.65
	39	9.58
	65	15.80

(Timofeiew, Dissert. 1894.)

Much more sol. than  $\text{HgI}_2$  in alcohol. 100 g. of solution sat. at  $0^\circ$  contain 13.33–13.05 g.  $\text{HgBr}_2$ ; 16.53 g. at  $25^\circ$ ; 22.63 g. at  $50^\circ$ . (Reinders, Z. phys. Ch. 1900, 32. 522.)

Solubility of  $\text{HgBr}_2$  in methyl alcohol + Aq at  $25^\circ$ .

P = g. alcohol in 100 g. alcohol + Aq.  
 $\text{HgBr}_2$  = millimols.  $\text{HgBr}_2$  in 10 cc. of the solution.

P	$\text{HgBr}_2$	Sp. gr.	P	$\text{HgBr}_2$	Sp. gr.
0	0.167	1.0022	47.06	0.700	0.9401
10.60	0.201	0.9857	64.00	1.90	0.9386
30.77	0.358	0.9588	78.05	4.07	0.9744
37.21	0.422	0.9508	100	13.96	1.2275

(Herz and Anders, Z. anorg. 1907, 52. 165.)

Solubility of  $\text{HgBr}_2$  in ethyl alcohol + Aq at  $25^\circ$ .

P = g. alcohol in 100 g. alcohol + Aq.

$\text{HgBr}_2$  = millimols.  $\text{HgBr}_2$  in 10 cc. of the solution.

P	$\text{HgBr}_2$	Sp. gr.
0	0.167	1.0022
20.18	0.187	0.9717
40.69	0.440	0.9435
70.01	1.829	0.9214
100	6.337	0.9873

(Herz and Anders.)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{HgBr}_2$  in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S $25^\circ/4^\circ$
0	5.02	1.227
11.11	4.728	1.1954
23.8	4.153	1.1524
65.2	2.530	1.0257
91.8	1.635	0.9437
93.75	1.586	0.9368
96.6	1.466	0.9275
100	1.873	0.9213

(Herz and Kuhn, Z. anorg. 1908, 60. 158.)

Solubility in mixtures of ethyl and propyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g.  $\text{HgBr}_2$  in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S $25^\circ/4^\circ$
0	2.28	0.9873
8.1	2.225	0.9802
17.85	2.106	0.9740
56.6	1.763	0.9487
88.6	1.476	0.9269
91.2	1.464	0.9239
95.2	1.406	0.9227
100	1.378	0.9213

(Herz and Kuhn, Z. anorg. 1908, 60. 161.)

Solubility of  $\text{HgBr}_2$  in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

P = % methyl alcohol in the mixtures.

$\text{HgBr}_2$  = g.  $\text{HgBr}_2$  in 10 ccm. of the solution.

S  $25^\circ/4^\circ$  = sp. gr. of the sat. solution.

P	$\text{HgBr}_2$	S $25^\circ/4^\circ$
0	2.28	0.9873
4.37	2.31	0.9932
10.4	2.54	1.009
41.02	3.33	1.080
80.69	4.57	1.185
84.77	4.68	1.193
91.25	4.86	1.211
100	5.02	1.227

(Herz and Kuhn, Z. anorg. 1908, 58. 163.)

Cold sat. solution in anhydrous ether contains 0.00567 g. in 1 cc.; hot solution contains 0.032 g. (Hampe, Ch. Z. 1887, 11. 905.)

Solubility in organic solvents at 18°-20°.  
100 g. chloroform dissolve 0.126 g.  $\text{HgBr}_2$ .  
100 g. tetrachlormethane dissolve 0.003 g.  $\text{HgBr}_2$ .

100 g. bromoform dissolve 0.679 g.  $\text{HgBr}_2$ .

100 g. ethyl bromide dissolve 2.310 g.  $\text{HgBr}_2$ .

100 g. ethylene dibromide dissolve 2.340 g.  $\text{HgBr}_2$ .

(Sulc, Z. anorg. 1900, 25. 401.)

#### Solubility in $\text{CS}_2$ at $t^\circ$ .

$t^\circ$	100 pts. sat. solution contain pts. $\text{HgBr}_2$
-10	0.049
5	0.068
0	0.087
+5	0.105
10	0.122
15	0.140
20	0.187
25	0.232
30	0.274

(Arctowski, Z. anorg. 1894, 6. 267.)

100 g. boiling methyl acetate (bpt. 56.2-56.7°) dissolves 24 g.  $\text{HgBr}_2$ . (Schroeder and Steiner, J. pr. 1909, (2) 79. 49.)

1 g.  $\text{HgBr}_2$  is sol. in 4.56 g. methyl acetate at 18°. Sp. gr. 18°/4° of sat. solution = 1.09. (Naumann, B. 1909, 42. 3795.)

100 g. anhydrous ethyl acetate or sat. with  $\text{H}_2\text{O}$  at 18° dissolve 130.5-135 g.  $\text{HgBr}_2$ . (Hamers, Dissert. 1906.)

Solubility of  $\text{HgBr}_2$  in ethyl acetate + Aq at 25°.

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.

$\text{HgBr}_2$  = millimols  $\text{HgBr}_2$  in 10 cc. of the solution.

P	$\text{HgBr}_2$	Sp. gr.
0	0.167	1.0022
4.39	0.159	1.0018
96.76	7.42	1.1159
100	3.93	1.0113

(Hers and Anders, Z. anorg. 1907, 52. 172.)

1 pt.  $\text{HgBr}_2$  sol. in 7.66 pts. ethyl acetate at 18°. (Naumann, B. 1910, 43. 315.)

Easily sol. in acetone. (Oppenheim, B. 2. 572.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Acetone dissolves much more  $\text{HgBr}_2$  than  $\text{HgI}_2$ . 100 g. sat. solution at 25° contain 34.58 g.  $\text{HgBr}_2$ . (Reinders, Z. phys. Ch. 1900, 32. 514.)

Solubility in diethyl oxalate is much greater than that of  $\text{HgI}_2$  and is equal to 12% at 100°. (Reinders, Z. phys. Ch. 1900, 32. 507.)

Solubility in benzene = 0.0194 mol. per l. at 25°. (Sherrill, Z. phys. Ch. 1903, 43. 735.)

Sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

#### Solubility in aniline.

S = temp. of solidification.

Mols. $\text{HgBr}_2$ per 100	S	Mols. $\text{HgBr}_2$ per 100	S	Mols. $\text{HgBr}_2$ per 100	S
4.9	9°	25.4	115.5°	49.6	123
10.	43.5	33.9	117	54.9	124
12.5	57	39.5	108	58.8	134
14.9	68	41.9	113	64.0	133
19.7	89	43.9	118		
23.4	106	46.2	121		

(Staronka, Anz. Ak. Wiss. Krakau, 1910, 372.)

#### Solubility of $\text{HgBr}_2$ in quinoline.

S = temp. of solidification.

Mols. $\text{HgBr}_2$ per 100	S	Mols. $\text{HgBr}_2$ per 100	S	Mols. $\text{HgBr}_2$ per 100	S
4.4	88°	8.9	111°	14.3	127°
				17.6	134°

(Staronka, Anz. Wiss. Krakau, 1910. 372.)

Mol. weight determined in ethyl sulphide. (Werner, Z. anorg. 1897, 15. 30.)

+4 $\text{H}_2\text{O}$ . (Thomsen.)

#### Mercuric perbromide, $\text{HgBr}_4$ .

(Hers and Paul, Z. anorg. 1914, 85. 216.)

#### Mercuric hydrogen bromide (Bromomercuric acid), $\text{HgBr}_2$ , $\text{HBr} = \text{HHgBr}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Neumann, M. 10. 236.)

#### Mercuric nickel bromide, basic, $\text{HgBr}_2$ , $\text{NiBr}_2$ , $6\text{NiO} + 20\text{H}_2\text{O}$ .

(Mailhe, A. ch. 1902, (7) 27. 369.)

#### Mercuric platinum bromide.

See Bromoplatinate, mercuric.

#### Mercuric potassium bromide, $\text{HgBr}_2$ , $\text{KBr}$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. by a large amount, with separation of one half of the  $\text{HgBr}_2$ . (v. Bonsdorff, Pogg. 19. 339.)

2 $\text{HgBr}_2$ ,  $\text{KBr} + 2\text{H}_2\text{O}$ . Permanent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (v. Bonsdorff.)

#### Mercuric sodium bromide, $\text{HgBr}_2$ , $\text{NaBr}$ .

Deliquescent. (v. Bonsdorff.)

(Varet, C. R. 1890, 111, 527.)

**HgBr<sub>2</sub>, 2NaBr.**  
Very sol. in H<sub>2</sub>O. (Vicario, J. Pharm. 1907, (6) 26. 145.)  
**2HgBr<sub>2</sub>, NaBr+3H<sub>2</sub>O.** Sol. in H<sub>2</sub>O and alcohol. (Berthemot.)

**Mercuric strontium bromide, HgBr<sub>2</sub>, SrBr<sub>2</sub>.**  
Sol. in all proportions of H<sub>2</sub>O. (Löwig, Mag. Pharm. 33. 7.)  
**2HgBr<sub>2</sub>, SrBr<sub>2</sub>.** Decomp. by H<sub>2</sub>O into HgBr<sub>2</sub> and HgBr<sub>2</sub>, SrBr<sub>2</sub>. (Löwig.)

**Mercuric zinc bromide.**  
Deliquescent in moist air. (v. Bonsdorff.)

**Mercuric zinc bromide cyanide ammonia.**  
*See* Cyanide zinc bromide ammonia, mercuric.

**Mercuric bromide ammonia, HgBr<sub>2</sub>, 2NH<sub>3</sub>.**  
Decomp. by boiling H<sub>2</sub>O. Sol. in min. acids and acetic acid. (Naumann, B. 1910, 43. 316.)

**Mercuric bromide cadmium oxide,**  
**HgBr<sub>2</sub>, CdO+H<sub>2</sub>O.**  
(Mailhe, A. ch. 1902, (7) 27. 371.)

**Mercuric bromide cupric oxide,**  
**HgBr<sub>2</sub>, CuO+3H<sub>2</sub>O.**  
(Mailhe, Bull. Soc. 1901, (3) 25. 791.)

**Mercuric bromide hydrazine, HgBr<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>.**  
(Hofmann and Marburg, A. 1899, 305. 215.)

**Mercuric bromide potassium chloride,**  
**HgBr<sub>2</sub>, 2KCl.**  
Decomp. by H<sub>2</sub>O. (Harth, Z. anorg. 1897, 14. 345.)

**Mercuric bromide zinc oxide, HgBr<sub>2</sub>, ZnO+8H<sub>2</sub>O.**  
(Mailhe, C. R. 1901, 132, 1274.)

**Mercuric bromiodide, HgBrI.**  
Sol. in alcohol and ether. Can be recrystallised from ether without decomp. (Oppenheim, B. 2. 571.)

**Mercurous chloramide, Hg<sub>2</sub>(NH<sub>2</sub>)Cl.**  
Insol. in boiling H<sub>2</sub>O or NH<sub>4</sub>OH+Aq. (Kane, A. ch. (2) 72. 215.)  
Mixture of Hg and HgNH<sub>2</sub>Cl. (Barfoed, J. pr. (2), 39. 201.)

**Mercuric chloramide, Hg(NH<sub>2</sub>)Cl.**  
Composition is dimercuriammonium ammonium chloride, Hg<sub>2</sub>NCl, NH<sub>4</sub>Cl, which see.

**Mercuric chloramide oxymercuriammonium chloride, 4Hg(NH<sub>2</sub>)Cl, (NH<sub>2</sub>OH)<sub>2</sub>Cl.** (Millon.)  
Correct composition is dimercuriammonium ammonium chloride, NH<sub>2</sub>Cl, NH<sub>4</sub>Cl, which see. (Balestra, Gazz. ch. it. 21. (2) 294.)  
**Hg(NH<sub>2</sub>)Cl, (NH<sub>2</sub>OH)<sub>2</sub>Cl.** (Millon.)  
True composition is dimercuriammonium mercuric chloride, 2Hg<sub>2</sub>NCl, HgCl<sub>2</sub>+H<sub>2</sub>O; or dimercuriammonium hydrogen chloride, NH<sub>2</sub>Cl, HCl. (Balestra.)

**Mercuric chloramide chloride, Hg(NH<sub>2</sub>)Cl, HgCl<sub>2</sub>.**

Properties as mercuric chloramide. Decomp. by cold HCl+Aq. (Millon.)  
True composition is dimercuriammonium hydrogen chloride, NH<sub>2</sub>Cl, 2HCl. (Balestra, Gazz. ch. it. 21. (2) 294.)

**Mercuric chloramide chromate,**  
**2Hg(NH<sub>2</sub>)Cl, HgCrO<sub>4</sub>.**  
Decomp. by hot H<sub>2</sub>O. Easily sol. in HNO<sub>3</sub> or HCl+Aq. (Jäger and Krüss, B. 22. 2048.)

**Mercurous chloride, Hg<sub>2</sub>Cl<sub>2</sub>.**  
Almost absolutely insol. in cold, but gradually sl. decomp. by boiling H<sub>2</sub>O.  
Calculated from electrical conductivity of Hg<sub>2</sub>Cl<sub>2</sub>+Aq, 1 l. H<sub>2</sub>O dissolves 3.1 mg. Hg<sub>2</sub>Cl<sub>2</sub> at 18°. (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)  
1 l. H<sub>2</sub>O dissolves 2 mg. Hg<sub>2</sub>Cl<sub>2</sub> at 18°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)  
1 l. H<sub>2</sub>O dissolves 1.4 mg. at 0.5°; 21 mg. at 18°; 2.8 mg. at 24.6°; 7 mg. at 43°. (Kohlrausch, Z. phys. Ch. 1908, 64. 150.)

When finely divided, is 10% more sol. than when coarsely crystalline. (Sauer, Z. phys. Ch. 1904, 47. 184.)

Solubility in H<sub>2</sub>O = 0.8 × 10<sup>-4</sup> g. mol. (Ley, Z. Elektrochem. 1904, 10. 301.)

Sl. sol. with decomp. in boiling H<sub>2</sub>O free from air, 20 ccm. H<sub>2</sub>O affording 0.002 g. HgCl<sub>2</sub> after boiling 1 hour with Hg<sub>2</sub>Cl<sub>2</sub>. (Mialle, A. ch. (3) 5. 176.) Hg<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>+Aq containing 1 pt. Hg<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> to 250,000 pts. H<sub>2</sub>O give ppt. of Hg<sub>2</sub>Cl<sub>2</sub> with HCl+Aq. Sol. with decomp. in conc. HCl+Aq, hot HNO<sub>3</sub>+Aq, aqua regia, or Cl<sub>2</sub>+Aq. (Fresenius.) Insol. in cold dil. acids, but slowly sol. on heating.

The solubility of Hg<sub>2</sub>Cl<sub>2</sub> in HCl+Aq increases slowly with time, and finally reaches a point where it increases very rapidly, which takes place sooner the more dil. the acid. Presence of Hg<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>+Aq helps the solubility. (Why not oxidation to HgCl<sub>2</sub>?) (Varenne, C. R. 92. 1161.)

Solubility of  $\text{Hg}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$  at  $25^\circ$ .  
Solid phase =  $\text{Hg}_2\text{Cl}_2 + 0.1 \text{ g. Hg.}$

G. per l.		Sp. gr. of solutions
HCl	$\text{Hg}_2\text{Cl}_2$	
31.69	0.034	...
36.46	0.048	...
95.43	0.207	1.042
158.4	0.399	1.069
209.2	0.548	1.091
267.3	0.654	1.114
278.7	0.675	1.119
317.3	0.670	1.132
364.6	0.673	1.153

(Richards and Archibald, Z. phys. Ch. 1902, 40. 385.)

Cold conc.  $\text{H}_2\text{SO}_4$  does not dissolve or decomp. Boiling  $\text{H}_2\text{SO}_4$  dissolves with evolution of  $\text{SO}_2$ . (Vogel.)

Solubility of  $\text{Hg}_2\text{Cl}_2$  in chlorides + Aq at  $25^\circ$ .  
Solid phase =  $\text{Hg}_2\text{Cl}_2 + 0.1 \text{ g. Hg.}$

Salt	G. per liter		Sp. gr. of solutions
	NaCl	$\text{Hg}_2\text{Cl}_2$	
NaCl	5.85	0.0041	...
	58.50	0.041	1.040
	119.	0.129	1.078
	148.25	0.194	1.093
	222.3	0.380	1.142
	292.5	0.643	1.188
$\text{BaCl}_2$	104.15	0.044	1.088
	156.22	0.068	1.134
	208.30	0.107	1.174
	312.54	0.231	1.263
$\text{CaCl}_2$	39.96	0.022	...
	55.5	0.033	...
	111	0.081	1.064
	138.75	0.118	1.105
	195.36	0.231	1.151
	257.52	0.322	1.205
	324.67	0.430	1.243
	432.9	0.518	1.315
	499.5	0.510	1.358

(Richards and Archibald, Z. phys. Ch. 1902, 40. 385.)

Sol. in cold  $\text{HCN} + \text{Aq}$  with separation of Hg.

Sol. in alkali chlorides + Aq.  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolves out  $\text{Hg}_2\text{Cl}_2$  at ord. temp., much more at  $40-50^\circ$ . Dil.  $\text{NH}_4\text{Cl} + \text{Aq}$  decomposes more slowly than conc. Access of air hastens reaction. (Miahle.)

When heated several hours to  $40-50^\circ$ , 100 pts.  $\text{NH}_4\text{Cl} + 833$  pts.  $\text{H}_2\text{O}$  form 0.75 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ ; 100 pts.  $\text{NaCl} + 833$  pts.  $\text{H}_2\text{O}$  form 0.33 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ ; 100 pts.  $\text{KCl} + 833$  pts.  $\text{H}_2\text{O}$  form

0.25 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ ; 100 pts.  $\text{BaCl}_2 + 833$  pts.  $\text{H}_2\text{O}$  form 0.33 pt.  $\text{Hg}_2\text{Cl}_2$  from 25 pts.  $\text{Hg}_2\text{Cl}_2$ . (Miahle, J. Pharm. 26. 108.)

Other chlorides act as  $\text{NH}_4\text{Cl}$ , only less vigorously. (Pettenkofer.)

By boiling 1 pt.  $\text{Hg}_2\text{Cl}_2$ , 10 times with a solution of 1 pt.  $\text{NaCl}$  each time, the  $\text{Hg}_2\text{Cl}_2$  is finally completely decomp. (Henne.)

Boiling  $\text{BaCl}_2 + \text{Aq}$  or  $\text{CaCl}_2 + \text{Aq}$  dissolve traces.  $\text{K}_2\text{SO}_4 + \text{Aq}$ ,  $\text{KNO}_3 + \text{Aq}$ , or  $\text{KHC}_2\text{H}_3\text{O}_6 + \text{Aq}$  do not dissolve. (Pettenkofer.)

Sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{NH}_4$  nitrate, or succinate + Aq. (Wittstein.)

Sol. in hot  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ , and still more in hot  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ ; on cooling it crystallises out completely. 25 g.  $\text{Hg}_2\text{Cl}_2$  dissolve in 1.5 l.  $\text{H}_2\text{O}$  containing 50 g.  $\text{Hg}(\text{NO}_3)_2$ . (Debray, C. R. 70. 995.)

Sol. in  $\text{PtCl}_2 + \text{Aq}$ .

Decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ .

Decomp. by  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Faktor, C. C. 1905, I. 1524.)

Very sl. sol. in  $\text{NH}_4$  succinate. (Wittstein.)

Insol. in  $\text{SbCl}_3$ . (Klemensiewicz, C. C. 1908, II. 1850.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol or ether. More sol. in  $\text{H}_2\text{O}$  containing pepsin and an acid than in  $\text{H}_2\text{O}$ , and is not converted thereby into  $\text{HgCl}_2$ . (Torsellini, Ann. Chim. Ch. farm. (4) 4. 105.)

Small amts. are sol. with decomp. in alcohol, ether and  $\text{CHCl}_3$ . 1 g.  $\text{CHCl}_3$  dissolves 0.0046 g.  $\text{Hg}_2\text{Cl}_2$ . (MacLagan, Arch. Pharm. 1884, 232, 788.)

Formic acid (95%) dissolves at  $16.5^\circ$ , 0.02%; at  $18^\circ$ , 0.0003%. (Aschan, Ch. Z. 1913, 37. 1117.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1904, 37. 3602.) Somewhat sol. in hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, 23. 1216.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Solubility in organic solvents at  $18-20^\circ$ .

100 g. chloroform dissolve traces of  $\text{HgCl}_2$ .

100 g. bromoform dissolve 0.055 g.  $\text{HgCl}_2$ .

100 g. ethyl bromide dissolve traces of  $\text{HgCl}_2$ .

100 g. ethylene dibromide dissolve traces of  $\text{HgCl}_2$ . (Sulc, Z. anorg. 1900, 25. 401.)

**Mercuric chloride,  $\text{HgCl}_2$ .**

Permanent.

Sol. in 18.5 pts.  $\text{H}_2\text{O}$  at  $13.8^\circ$ , and 2-3 pts. at  $100^\circ$ . (J. Davy, 1822.) Sol. in 3 pts. boiling  $\text{H}_2\text{O}$ . (Wenzel.) Sol. in 18.23 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ , and 3 pts. at  $100^\circ$ . (M. R. and P.) Sol. in 18.46 pts. at  $18.75^\circ$ . (Abl.) Sol. in 18 pts. cold, and 3 pts. warm  $\text{H}_2\text{O}$ . (Dumas.)



100 pts. H<sub>2</sub>O dissolve pts. HgCl<sub>2</sub> at t°:

t°	Pts. HgCl <sub>2</sub>	t°	Pts. HgCl <sub>2</sub>	t°	Pts. HgCl <sub>2</sub>
0	5.73	40	9.62	80	24.30
10	6.57	50	11.34	90	37.05
20	7.39	60	13.86	100	53.96
30	8.43	70	17.29	...	...

(Poggiale, A. ch. (3) 8. 468.)

Solubility of HgCl<sub>2</sub> in H<sub>2</sub>O.

t°	% HgCl <sub>2</sub>	t°	% HgCl <sub>2</sub>
+ 1	3.9	80	23.6
4.5	4.8	87	28.2
4.5	4.8	100	39.3
7.5	5.1	121	59.7
13.8	5.2	127	69.7
25.1	7.1	140	77.0
29.5	7.6	150	78.4
38.0	9.9	159	80.2
49	11.3	160	81.7
61	15.1	165	81.8

(Étard, A. ch. 1894, (7) 2. 557.)

71.17 g. HgCl<sub>2</sub> are sol. in 1 l. H<sub>2</sub>O at 25°.

(Morse, Z. phys. Ch. 1902, 41. 726.)

Solubility at 25° = 0.267 mol. in 1 l. H<sub>2</sub>O.

(Jander, Z. Elektrochem. 1903, 8. 688.)

Solubility in H<sub>2</sub>O at 25° = 0.263 mol. liter.

(Sherrill, Z. phys. Ch. 1903, 43. 735.)

Sat. HgCl<sub>2</sub>+Aq at 25° contains 6.9% HgCl<sub>2</sub>.

(Foote, Am. Ch. J. 1906, 35. 238.)

HgCl<sub>2</sub>+Aq contains 3.95 g. HgCl<sub>2</sub> in 100 g. of solution at 0°; 7.67 g. at 30°.

(Schreinemakers, Ch. Weekbl. 1910, 7. 202.)

HgCl<sub>2</sub>+Aq sat. at (?) contains 6.8% HgCl<sub>2</sub>.

(Abe, J. Tok. Chem. Soc. 1912, 33. 1087.)

HgCl<sub>2</sub>+Aq sat. at 35° contains 8.51% HgCl<sub>2</sub>.

(Schreinemakers and Thonus, Ver. K. Akad. Wet. Amsterdam, 1912, 21. 333.)

1 l. aqueous solution sat. at 25° contains 0.265 mol. HgCl<sub>2</sub>.

(Herz and Paul, Z. anorg. 1913, 82. 431.)

H<sub>2</sub>O dissolves 7.39% at 20°.

(Aschan, Ch. Z. 1913, 37. 1117.)

HgCl<sub>2</sub>+Aq sat. at 8° has 1.041 sp. gr.

(Anthon, 1887.)

Sp. gr. of HgCl<sub>2</sub>+Aq at 20°.

% HgCl <sub>2</sub>	Sp. gr.	% HgCl <sub>2</sub>	Sp. gr.
1	1.0072	4	1.0323
2	1.0148	5	1.0411
3	1.0236	...	...

(Schröder, calculated by Gerlach, Z. anal. 27. 306.)

Sp. gr. of HgCl<sub>2</sub>+Aq at 15°.

% HgCl <sub>2</sub>	Sp. gr.	% HgCl <sub>2</sub>	Sp. gr.
8	1.071	11	1.1035
9	1.0815	12	1.115
10	1.095	13	1.127

(Mendelejeff, calculated by Gerlach, Z. anal. 27. 306.)

Sp. gr. of HgCl<sub>2</sub>+Aq.

% HgCl <sub>2</sub>	Sp. gr.			
	at 0°	at 10°	at 20°	at 30°
4.72	1.04070	1.04033	1.03856	1.03566
3.57	1.03050	1.03022	1.02885	1.02577
2.42	1.02035	1.02018	1.01856	1.01585
1.22	1.01008	1.00990	1.00835	1.00575

(Schröder, B. 19. 161 R.)

Sp. gr. of HgCl<sub>2</sub>+Aq at room temp. containing:0.226 3.55% HgCl<sub>2</sub>.  
1.0233 1.0328

(Wagner, W. Ann. 1883, 18. 266.)

Sp. gr. of HgCl<sub>2</sub>+Aq at 25°.

Concentration of HgCl <sub>2</sub> +Aq.	Sp. gr.
$\frac{1}{c}$ -normal	1.0275
$\frac{1}{s}$ - " "	1.0138

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Sp. gr. at 16°/4° of HgCl<sub>2</sub>+Aq containing 4.5256% HgCl<sub>2</sub> = 1.03806.Sp. gr. at 16°/4° of HgCl<sub>2</sub>+Aq containing 4.2224% HgCl<sub>2</sub> = 1.03491.

(Schönrock, Z. phys. Ch. 1893, 11. 768.)

HgCl<sub>2</sub>+Aq containing 6.04% HgCl<sub>2</sub> has sp. gr. 20°/20° = 1.0523.HgCl<sub>2</sub>+Aq containing 6.08% HgCl<sub>2</sub> has sp. gr. 20°/20° = 1.0526.

(Le Blanc and Rohland, Z. phys. ch. 1896, 19. 282.)

Sat. HgCl<sub>2</sub>+Aq boils at 101.1°. (Griffiths.)B.-pt. of HgCl<sub>2</sub>+Aq

% HgCl <sub>2</sub>	B.-pt.	% HgCl <sub>2</sub>	B.-pt.
4.8	100.10°	11.04	100.20°
9.0	100.16	15.2	100.275

(Skinner, Chem. Soc. 61. 340.)

Solubility in HCl+Aq is greater than in H<sub>2</sub>O.(Dumas.)  
Sol. in 0.5 pt. HCl+Aq of 1.158 sp. gr. at 23.3°, forming a solution of 2.412 sp. gr. (Davy, 1822.)

Solubility of  $\text{HgCl}_2$  in  $\text{HCl} + \text{Aq.}$ 

Pts. $\text{HCl}$ in 100 pts. $\text{H}_2\text{O}$	Pts. $\text{HgCl}_2$ dissolved by 100 pts. liquid	Pts. $\text{HCl}$ in 100 pts. $\text{H}_2\text{O}$	Pts. $\text{HgCl}_2$ dissolved by 100 pts. liquid
0.0	6.8	21.6	127.4
5.6	46.8	31.0	141.9
10.1	73.7	50.0	148.0
13.8	87.8	68.0	154.0

(Ditte, A. ch. (5) 22. 551.)

Solubility in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .  $\frac{\text{HgCl}_2}{2} = \frac{1}{2}$  mols. $\text{HgCl}_2$  (in mgs.) in 10 ccm. solution;  $\text{HCl}$  = mols.  $\text{HCl}$  ditto;  $\text{H}_2\text{O}$  = grms.  $\text{H}_2\text{O}$  present.

$\frac{\text{HgCl}_2}{2}$	$\text{HCl}$	Sp. gr.	$\text{H}_2\text{O}$
9.7	4.3	1.117	9.704
19.8	9.9	1.238	9.340
35.5	17.8	1.427	9.816
55.6	26.9	1.665	8.135
68.9	32.25	1.811	7.714
72.37	34.25	1.874	7.679
85.5	41.5	2.023	7.131
88.65	48.1	2.066	6.893
95.675	70.875	2.198	6.431

(Engel, A. ch. (6) 17. 362.)

Not decomp. by  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq.}$ Sol. in 630 pts.  $\text{H}_2\text{SO}_4$ , and in more than 500 pts. hot  $\text{HNO}_3 + \text{Aq}$  of 1.41 sp. gr. without decomp. (J. Davy.)Sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HIO}_3$ , or  $\text{H}_2\text{CrO}_4$  without decomp. (Millon, A. ch. (3) 18. 373.)Very sl. sol. in  $\text{HNO}_3$ , but not decomp. thereby. (Wurtz.)Solubility of  $\text{HgCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ .

Composition of liquid phase			Solid phase
$\text{HgCl}_2$	$\text{NH}_4\text{Cl}$	% $\text{H}_2\text{O}$	
0	29.5	70.5	$\text{NH}_4\text{Cl}$
15.68	27.56	56.76	"
22.80	26.91	50.29	"
31.96	26.16	41.88	"
42.45	25.05	32.50	"
50.05	24.79	25.16	$\{\text{NH}_4\text{Cl} + \text{HgCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
50.60	24.31	25.09	$\text{HgCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
53.08	22.77	24.15	"
55.97	21.42	22.61	"
58.91	20.06	21.03	$\text{HgCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O} +$
58.89	19.98	21.13	$\text{HgCl}_2, \text{NH}_4\text{Cl}, \text{H}_2\text{O}$
56.83	18.86	24.61	$\text{HgCl}_2, \text{NH}_4\text{Cl}, \text{H}_2\text{O}$
56.38	18.50	25.12	"
55.83	17.70	26.47	"
55.70	17.13	27.17	"
55.58	16.82	27.60	"

Solubility of  $\text{HgCl}_2$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ .—Continued.

Composition of liquid phase			Solid phase
% $\text{HgCl}_2$	% $\text{NH}_4\text{Cl}$	% $\text{H}_2\text{O}$	
55.55	15.94	28.51	$\text{HgCl}_2, \text{NH}_4\text{Cl}, \text{H}_2\text{O}$
55.85	15.35	28.80	"
56.71	14.22	29.07	"
57.04	14.10	28.86	$\text{HgCl}_2, \text{NH}_4\text{Cl}, \text{H}_2\text{O} +$
56.98	14.14	28.88	$3\text{HgCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
56.83	13.90	29.27	$3\text{HgCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O}$
56.26	13.04	30.70	"
56.43	11.88	31.69	"
56.70	11.05	32.23	"
57.05	9.92	33.02	"
58.55	9.23	32.22	"
58.65	9.20	32.15	$\{3\text{HgCl}_2, 2\text{NH}_4\text{Cl}, \text{H}_2\text{O} +$
51.83	8.76	39.41	$9\text{HgCl}_2, 2\text{NH}_4\text{Cl}$
46.00	7.52	46.48	$9\text{HgCl}_2, 2\text{NH}_4\text{Cl}$
39.02	6.28	54.70	"
35.60	5.26	59.14	"
35.10	5.18	59.72	"
32.90	5.06	62.04	"
29.65	3.62	66.73	$9\text{HgCl}_2, 2\text{NH}_4\text{Cl} + \text{HgCl}_2$
40.12	5.13	54.75	$\text{HgCl}_2$
21.00	2.29	76.71	"
7.67	0	92.33	"

(Meerburg, Z. anorg. 1908, 59. 139.)

1 pt. sat.  $\text{NaCl} + \text{Aq}$  dissolves 1.29 pts.  $\text{HgCl}_2$  at  $14^\circ$ . (Voit, A. 104. 364.)Sat.  $\text{NaCl} + \text{Aq}$  (20 grains  $\text{H}_2\text{O} + 7$  grains  $\text{NaCl}$ ) dissolves 32 grains  $\text{HgCl}_2$  at  $15.5^\circ$ , and 3 grains more on warming. Sp. gr. of solution = 2.14. (Davy, 1832.)Sat.  $\text{KCl} + \text{Aq}$  (21 grains  $\text{H}_2\text{O} + 7$  grains  $\text{KCl}$ ) dissolves 8 grains  $\text{HgCl}_2$  on being gently heated. (Davy.)Sat.  $\text{BaCl}_2 + \text{Aq}$  (20 grains  $\text{H}_2\text{O} + 8.7$  grains  $\text{BaCl}_2 + 2\text{H}_2\text{O}$ ) dissolves 16 grains  $\text{HgCl}_2$  at  $15.5^\circ$ , and 4 grains more on heating. Sp. gr. of solution = 1.9. (Davy.) $\text{MgCl}_2 + \text{Aq}$  (31 grains  $\text{HCl} + \text{Aq}$  of 1.58 sp. gr. neutralised with  $\text{MgO}$ ) dissolves 40 grains  $\text{HgCl}_2$ , and 25 grains more on gently heating. Sp. gr. of solution = 2.83. (Davy.)Sol. in sat.  $\text{KCl}$ ,  $\text{NaCl} + \text{Aq.}$  and in  $\text{MnCl}_2$ ,  $\text{ZnCl}_2$ ,  $\text{CoCl}_2$ ,  $\text{FeCl}_2$ ,  $\text{NiCl}_2$  and  $\text{CuCl}_2 + \text{Aq.}$  (v. Bonsdorff, Pogg. 17. 123.)The solubility in  $\text{H}_2\text{O}$  is greatly increased by the addition of cupric chloride. 8.5%  $\text{HgCl}_2$  is sol. in pure  $\text{H}_2\text{O}$  and 52.8%  $\text{HgCl}_2$  is sol. in 18.06%  $\text{CuCl}_2 + \text{Aq.}$  (Schreinemakers, C. C. 1913, I. 1858.)

Solubility of  $\text{HgCl}_2 + \text{KCl}$  at 25°.

Composition of solution		Composition of undissolved residue			Solid phase
% KCl	% $\text{HgCl}_2$	% KCl	% $\text{HgCl}_2$	% $\text{H}_2\text{O}$	
26.46	0	100	0	...	KCl
26.24	15.04	...	3.63	...	KCl + 2KCl, $\text{HgCl}_2, \text{H}_2\text{O}$
26.23	15.02	...	26.15	...	"
26.38	15.02	...	52.01	...	"
26.33	14.92	...	61.04	...	"
23.74	18.91	34.61	61.66	3.73	2KCl, $\text{HgCl}_2, \text{H}_2\text{O}$
22.36	21.39	34.77	62.02	3.21	"
21.39	23.88	34.05	61.84	3.35	"
20.32	27.62	...	65.24	...	2KCl, $\text{HgCl}_2, \text{H}_2\text{O} + \text{KCl}$
20.26	27.38	...	73.98	...	KCl, $\text{HgCl}_2, \text{H}_2\text{O}$
17.85	25.34	21.89	75.10	3.01	"
9.26	18.95	21.02	73.36	5.62	"
7.80	19.56	20.76	73.06	6.18	"
6.84	22.81	20.75	74.54	4.71	"
6.66	24.32	20.54	73.99	5.47	"
6.52	25.13	...	76.46	...	KCl, $\text{HgCl}_2, \text{H}_2\text{O} + \text{KCl}, 2\text{HgCl}_2, 2\text{H}_2\text{O}$
6.64	25.16	...	80.60	...	KCl, 2 $\text{HgCl}_2, 2\text{H}_2\text{O}$
6.27	25.11	12.09	83.20	4.71	"
5.77	24.73	11.87	83.18	4.95	KCl, 2 $\text{HgCl}_2, 2\text{H}_2\text{O} + \text{HgCl}_2$
4.68	24.75	...	84.46	...	"
4.66	25.17	...	93.58	...	"
4.69	24.82	...	98.50	...	"
0	6.90	0	100	0	$\text{HgCl}_2$

(Foote and Levy, Am. Ch. J. 1906, 35. 239.)

Solubility of  $\text{HgCl}_2 + \text{KCl}$  at 20°.

G. per 100 g. $\text{H}_2\text{O}$		Solid phase
KCl	$\text{HgCl}_2$	
0	7.39	$\text{HgCl}_2$
1.12	11.63	"
2.39	15.72	"
4.05	22.17	"
4.84	25.16	$\text{HgCl}_2 + 2\text{HgCl}_2, \text{KCl}$
5.60	25.13	$2\text{HgCl}_2, \text{KCl}$
6.71	25.66	"
7.39	26.41	$2\text{HgCl}_2, \text{KCl} + \text{HgCl}_2, \text{KCl}$
7.46	24.70	$\text{HgCl}_2, \text{KCl}$
8.95	19.93	"
15	22.87	"
17.57	26.12	"
20.35	29	"
26.31	34.83	"
30.32	39.10	"
34.12	42.82	$\text{HgCl}_2, \text{KCl} + \text{HgCl}_2, 2\text{KCl}$
34.18	39.34	$\text{HgCl}_2, 2\text{KCl}$
34.34	35.16	"
34.54	30.63	"
37.72	24.30	"
41.13	19.33	$\text{HgCl}_2, 2\text{KCl} + \text{KCl}$
39.66	15.76	KCl
37.87	10.28	"
35.32	2.1	"

(Tichomiroff, J. russ. Phys. Chem. Soc. 1907 39. 731.)

Solubility of  $\text{HgCl}_2 + \text{RbCl}$  in  $\text{H}_2\text{O}$ . Solubility data are given showing double salts formed at 25°. (Foote and Levy, l. c.)Solubility in  $\text{NaCl} + \text{Aq.}$  100 pts.  $\text{NaCl} + \text{Aq.}$  containing given %  $\text{NaCl}$  dissolve g.  $\text{HgCl}_2$ .

% NaCl	g. $\text{HgCl}_2$ at 15°	g. $\text{HgCl}_2$ at 65°	g. $\text{HgCl}_2$ at 100°
26	128	152	208
25	120	142	196
10	58	68	110
5	30	36	64
1	14	18	48
0.5	10	13	44

(Homeyer and Ritsert, Pharm. Ztg. 33. 738.)

Solubility of  $\text{HgCl}_2 + \text{NaCl}$  at 25°.

Composition of solution		Composition of undissolved residue			Solid phase
% NaCl	% $\text{HgCl}_2$	% NaCl	% $\text{HgCl}_2$	% $\text{H}_2\text{O}$	
26.5	0	100	0	0	NaCl
18.66	51.35	...	16.39	...	NaCl + NaCl, $\text{HgCl}_2, 2\text{H}_2\text{O}$
18.71	51.32	...	21.98	...	"
18.64	51.42	...	65.45	...	"
18.87	51.26	...	71.25	...	"
14.97	57.74	16.38	74.18	9.44	NaCl, $\text{HgCl}_2, 2\text{H}_2\text{O}$
14.03	59.69	16.36	74.21	9.43	"
13.25	62.16	16.16	74.70	9.14	"
13.17	62.59	15.96	74.76	9.28	"
12.97	62.50	...	78.20	...	NaCl, $\text{HgCl}_2, 2\text{H}_2\text{O} + \text{HgCl}_2$
13.14	62.48	...	88.64	...	"
13.15	62.55	...	90.83	...	"

(Foote and Levy, Am. Ch. J. 1906, 35. 239.)

105.0 g.  $\text{HgCl}_2$  are sol. in 1 l. of 0.1-N  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  at 25°. (Morse, Z. phys. Ch. 1902, 4. 726.)Solubility in  $\text{MCl} + \text{Aq}$  at 25°.

Salt	In 10 ccm. of the solution	
	Millimols $\text{HgCl}_2$	Millimols salt
LiCl	2.65	0
	3.51	4.14
	6.66	8.35
	10.21	12.71
	16.78	17.38
	22.14	22.65
	28.96	30.91
	30.62	35.27
NaCl	2.65	0
	3.72	2.12
	5.08	4.16
	7.48	6.71
	11.92	11.53
	20.22	19.41
	27.54	27.83
	34.34	31.62

Solubility in  $\text{MCl} + \text{Aq}$  at  $25^\circ$ .—*Continued.*

Salt	In 10 ccm. of the solution	
	Millimols $\text{HgCl}_2$	Millimols salt
$\text{KCl}$	2.65	0
	3.55	1.74
	3.81	2.21
	8.36	6.83
$\text{MgCl}_2$	2.65	0
	3.74	1.68
	7.19	4.15
	11.31	5.70
	18.64	9.97
	25.69	13.20
	32.06	17.28
$\text{CaCl}_2$	2.65	0
	3.64	1.90
	7.66	4.02
	11.08	6.56
	18.11	9.64
	26.45	14.29
	33.04	17.23
$\text{SrCl}_2$	2.65	0
	3.15	1.64
	5.63	3.11
	8.29	5.19
	13.42	7.24
	17.76	10.46
	22.93	13.86
$\text{BaCl}_2$	2.65	0
	6.97	3.85
	11.67	5.72
	16.20	7.76
	26.45	13.36
	53.48	30.30

(Hers and Paul, Z. anorg. 1913, 82. 433.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{I}_2$ . (Hers and Paul, Z. anorg. 1914, 85. 214.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, 23. 213.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Abundantly sol. in  $\text{H}_2\text{PtCl}_4 + \text{Aq}$ . (Nilson, B. 1876, 9. 1146.)

Sol. in 2.5 pts. cold alcohol (Richter); 3 pts. (Karl); 2.5 pts. alcohol of 0.833 sp. gr. at ordinary temp., and 1.167 pts. on boiling (Berselius); 2 pts. alcohol of 0.816 sp. gr. at  $15.5^\circ$  (sp. gr. of solution = 1.08) (J. Davy, Phil. Trans. 1822. 358).

At  $10^\circ$ , sol. in 2.57 pts. alcohol of  $39^\circ$  (Cartier), in 2.9 pts. alcohol of  $38^\circ$ ; in 3.6 pts. alcohol of  $35^\circ$ ; in 4.2 pts. alcohol of  $30^\circ$ ; in 9.3 pts. alcohol of  $22^\circ$ ; in 14.6 pts. alcohol of  $14^\circ$ . (N. E. Henry.)

Sol. in 25 mols. methyl, 13.1 mols. ethyl, and 20.3 mols. propyl alcohol at  $8.5^\circ$ ; in

16.2 mols. methyl, 12.4 mols. ethyl, and 18 mols. propyl alcohol at  $20^\circ$ ; in 6.8 mols. methyl, 10.6 mols. ethyl, and 14.6 mols. propyl alcohol at  $38.2^\circ$ . (Timofejew, C. R., 113. 1224.)

100 pts. absolute methyl alcohol dissolve 66.9 pts.  $\text{HgCl}_2$  at  $25^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 49.5 pts.  $\text{HgCl}_2$  at  $25^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

At  $15^\circ$ , 1 pt. by weight is sol. in:—

13.53 pts.  $\text{H}_2\text{O}$ .

1.5 " methyl alcohol of sp. gr. 0.7990

2.5 " ethyl " " " 0.8100

6.3 " propyl " " " 0.8160

(Rohland, Z. anorg. 1899, 18. 328.)

100 g.  $\text{HgCl}_2 + \text{CH}_3\text{OH}$  contain 1.2 g.  $\text{HgCl}_2$  at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, 72. 437.)

Solubility of  $\text{HgCl}_2$  in methyl alcohol +  $\text{Aq}$  at  $25^\circ$ .

$P = \text{g. alcohol in 100 g. alcohol} + \text{Aq.}$

$\text{HgCl}_2 = \text{millimols HgCl}_2$  in 10 cc. of the solution.

P	$\text{HgCl}_2$	Sp. gr.
0	2.67	1.0565
10.60	2.92	1.0441
30.77	4.18	1.0420
37.21	4.96	1.0507
47.06	7.27	1.0809
64.00	14.19	1.2015
78.05	21.11	1.3314
100	17.95	1.2160

(Herz and Anders, Z. anorg. 1907, 52. 165.)

100 cc. 90% ethyl alcohol dissolve  $27.5^\circ$  g.  $\text{HgCl}_2$  at  $15.5^\circ$ . Sp. gr. 15° of sat. solution = 1.065. (Greenish and Smith, Pharm. J. 1903, 71. 881.)

100 g. 99.2% ethyl alcohol dissolve 33.4 g.  $\text{HgCl}_2$  at  $25^\circ$ . (Osaka.)

Solubility of  $\text{HgCl}_2$  in ethyl alcohol +  $\text{Aq}$  at  $25^\circ$ .

$P = \text{g. alcohol in 100 g. alcohol} + \text{Aq.}$

$\text{HgCl}_2 = \text{millimols HgCl}_2$  in 10 cc. of the solution.

P	$\text{HgCl}_2$	Sp. gr.
0	2.67	1.0565
20.18	2.49	1.0214
40.69	3.94	1.0180
70.01	8.70	1.0616
100	13.61	1.1067

(Herz and Anders, Z. anorg. 1907, 52. 170.)

Solubility of  $\text{HgCl}_2$  in ethyl alcohol + Aq at 25°.

% $\text{C}_2\text{H}_5\text{OH}$	% $\text{HgCl}_2$	% $\text{C}_2\text{H}_5\text{OH}$	% $\text{HgCl}_2$
0	6.80	45.84	15.36
5.08	6.65	49.86	18.18
14.49	6.41	53.61	21.40
21	6.55	57.26	24.51
28.25	7.31	60.55	27.67
31.53	8.51	63.95	29.86
36.85	10.32	67.39	32.40
41.36	12.69		

(Abe, J. Tok. Chem. Soc. 1912, 33. 1087.)

Solubility in alcohol is increased by presence of hydroxylamine hydrochloride. (Adams, Am. Ch. J. 1902, 28. 213.)

Solubility of  $\text{HgCl}_2$  in a mixture of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the mixture.  
 $\text{HgCl}_2$  = g.  $\text{HgCl}_2$  in 10 ccm. of the solution.  
 S = sp. gr. of the sat. solution.

P	$\text{HgCl}_2$	S 25°/4°
0	3.686	1.107
4.37	3.943	1.130
10.4	4.261	1.157
41.02	5.837	1.294
80.69	6.167	1.321
84.77	5.782	1.288
91.25	5.385	1.254
100	4.862	1.216

(Herz and Kuhn, Z. anorg. 1908, 58. 161.)

## Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
 G = g.  $\text{HgCl}_2$  in 10 ccm. of the solution.  
 S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	4.862	1.2160
11.11	5.034	1.2278
23.8	5.714	1.2848
65.2	4.228	1.1568
91.8	2.509	1.0090
93.75	2.323	1.0029
96.6	2.152	0.9851
100	2.003	0.9720

(Herz and Kuhn, Z. anorg. 1908, 60. 157.)

## Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
 G = g.  $\text{HgCl}_2$  in 10 ccm. of the solution.  
 S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	3.686	1.1070
8.1	3.667	1.0988
17.85	3.406	1.0857
56.6	2.711	1.0272
88.6	2.166	0.9854
91.2	2.160	0.9824
95.2	2.087	0.9772
100	2.003	0.9720

(Herz and Kuhn, Z. anorg. 1908, 60. 160.)

Sp. gr. of  $\text{HgCl}_2$  + alcohol.

% $\text{HgCl}_2$	Sp. gr. 25°/20°
0	0.7948
5.44	0.8346
6.52	0.8431

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 283.)

Sp. gr. of alcoholic solution of  $\text{HgCl}_2$ .

% $\text{HgCl}_2$	Sp. gr.			
	at 0°	at 10°	at 20°	at 30°
0.00	0.83135	0.82286	0.81435	0.80594
1.22	0.8397	0.8312	0.8228	0.8141
2.38	0.8484	0.8399	0.8314	0.8227
4.42	0.8635	0.8549	0.8463	0.8375
8.56	0.8966	0.8877	0.8789	0.8689
12.43	0.9306	0.9213	0.9119	0.9024
15.91	0.9629	0.9523	0.9425	0.9329
19.32	0.9951	0.9852	0.9753	0.9652
22.46	1.0285	1.0184	1.0083	0.9982

(Schröder, B. 19. 161 R.)

Sp. gr. at 16°/4° of  $\text{HgCl}_2$  + ethyl alcohol containing 23.5489%  $\text{HgCl}_2$  = 0.99885; containing 11.8801% = 0.88572. (Schönrock, Z. phys. Ch. 1893, 11. 768.)

Sp. gr. at 16°/4° of  $\text{HgCl}_2$  + amyl alcohol containing 10.9948%  $\text{HgCl}_2$  = 0.89550. (Schönrock, Z. phys. Ch. 1893, 11. 769.)

Sol. in 4 pts. ether (Karl); in 4.1 pts. (Henry); in 2.86 pts. ether of 0.745 sp. gr. (sp. gr. of solution = 1.08); the solvent power is not increased by elevating the temp., and b.-pt. of ether is not raised. (J. Davy.)

Ether extracts  $\text{HgCl}_2$  from  $\text{HgCl}_2$  + Aq. (Orfila); very slightly if  $\text{HgCl}_2$  + Aq is dil. (Lassaigne.)

Very sl. sol. in pure ether. (Polis, B. 20. 717.)

6.35 pts. are sol. in 100 pts. ether at 0°.

6.44 " " " " 100 " " " 18.

6.38 " " " " 100 " " " 35.5.

(Lassacynski, B. 1894, 27. 2286.)

Sol. in  $7\frac{1}{2}$ -8 pts. ether. (Madsen, Ch. Z. Report, 1897, 21. 169.)

Solubility in 100 cc. ether at  $17^\circ = 4.1-4.12$  g. (Strömholm, J. pr. 1902, (2), 66. 450.)

The solubility of  $\text{HgCl}_2$  in  $\text{H}_2\text{O}$  is only sl. affected by the presence of ether. An aqueous solution sat. with ether and  $\text{HgCl}_2$  contains about 10% less  $\text{HgCl}_2$  than a pure sat. aqueous solution. Partition coefficient for ether  $\text{HgCl}_2/\text{H}_2\text{O} = 4.9$  at  $0^\circ$ ; 3.02 at  $14.6^\circ$ ; 2.80 at  $16.8^\circ$ . (Strömholm, Z. phys. Ch. 1903, 44. 70.)

#### Solubility of $\text{HgCl}_2$ in ether + Aq at $25^\circ$ .

% Ether	% $\text{H}_2\text{O}$	% $\text{HgCl}_2$
87.86	5.22	6.92
1.2	93.6	5.2
5.2	90.5	4.3
5.4	91.8	2.8
5.4	93.1	1.5

(Abe, J. Tok. Chem. Soc. 1912, 33. 1087.)

#### Solubility of $\text{HgCl}_2$ in ether + ethyl alcohol at $25^\circ$ .

% Alcohol	% $\text{HgCl}_2$	% Alcohol	% $\text{HgCl}_2$
67.57	32.43	27.16	36.29
58.59	32.50	22.48	34.08
51.02	37.39	15.20	28.55
44.79	37.96	8.97	20.67
38.69	38.24	0	5.49
32.84	37.75		

(Abe.)

4 pts. ether dissolve 1 pt.  $\text{HgCl}_2$ , but 4 pts. ether + 1.33 pts. camphor dissolve 1.33 pts.  $\text{HgCl}_2$ ; 4 pts. ether + 4 pts. camphor dissolve 2 pts.  $\text{HgCl}_2$ ; 4 pts. ether + 8 pts. camphor dissolve 4 pts.  $\text{HgCl}_2$ ; 4 pts. ether + 16 pts. camphor dissolve 8 pts.  $\text{HgCl}_2$ . (Karls, Pogg, 10. 608.)

3 pts. alcohol dissolve 1 pt.  $\text{HgCl}_2$ , but 3 pts. alcohol + 1 pt. camphor dissolve 2 pts.  $\text{HgCl}_2$ ; 3 pts. alcohol + 3 pts. camphor dissolve 3 pts.  $\text{HgCl}_2$ ; 3 pts. alcohol + 6 pts. camphor dissolve 6 pts.  $\text{HgCl}_2$ . (Karls, l. c.)

Solution can be obtained containing 25 pts. camphor, 16 pts.  $\text{HgCl}_2$ , and only 4 pts. alcohol. Sp. gr. of solution = 1.326. (Simon, Pogg, 37. 553.)

100 pts. acetone dissolve 60 pts.  $\text{HgCl}_2$  at  $25^\circ$ . (Krug and M'Elroy, J. Anal. Appl. Ch. 184.)

98.35 pts.  $\text{HgCl}_2$  are sol. in 100 pts. acetone at  $0^\circ$ .

110.95 pts.  $\text{HgCl}_2$  are sol. in 100 pts. acetone at  $10^\circ$ .

126.80 pts.  $\text{HgCl}_2$  are sol. in 100 pts. acetone at  $18^\circ$ . (Laszcynski, B. 1894, 27. 2287.)

1 g.  $\text{HgCl}_2$  is sol. in 0.70 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.956$ . (Naumann, B. 1904, 37. 4334.)

Sat. solution in acetone contains 57.74 g.  $\text{HgCl}_2$  in 100 g. solution at  $25^\circ$ . (Foote and Haigh, J. Am. Chem. Soc. 1911, 33. 461.)

Sp. gr. at  $26.7^\circ/4^\circ$  of  $\text{HgCl}_2$  + acetone containing 36.25%  $\text{HgCl}_2 = 1.1585$ . (Schönrock, Z. phys. Ch. 1893, 11. 769.)

#### Sp. gr. of $\text{HgCl}_2$ + acetone.

% $\text{HgCl}_2$	Sp. gr. $20^\circ/20^\circ$
0	0.8003
10.94	0.8847
21.05	0.9799

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 283.)

100 g. methyl acetate dissolve 46 g. at bpt. ( $55.5^\circ$ ). (Schroeder and Steiner, J. pr. 1909, (2) 79. 49.)

1 g.  $\text{HgCl}_2$  is sol. in 2.35 g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/4^\circ$  of the sat. solution = 1.251. (Naumann, B. 1909, 42. 3793.)

#### Solubility in ethyl acetate.

Pts. sol. in 100 pts. ethyl acetate.	
Pts. $\text{HgCl}_2$	$t^\circ$
28.92	0
29.03	13
30.71	35
31.87	48
32.77	60
35.98	83

(Laszcynski, B. 1894, 27. 2286.)

Solubility in ethyl acetate = 1:3.466 at  $18^\circ$ . (Alexander, Dissert. 1899.)

#### Solubility of $\text{HgCl}_2$ in ethyl acetate.

Temp.	$0^\circ$	$13^\circ$	$30^\circ$	$40.5^\circ$	$50.2^\circ$
Mol. $\text{HgCl}_2$ in 100 mols. $\text{C}_4\text{H}_8\text{O}_2$	15.4	15.9	16.0	16.1	16.3

(Linebarger, Am. Ch. J. 1894, 16. 214.)

1 g.  $\text{HgCl}_2$  is sol. in 3.5 g. ethyl acetate at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.110$ . (Naumann, B. 1904, 37. 3602.)

Solubility of  $\text{HgCl}_2$  in ethyl acetate and acetone at  $t^\circ$ .

$t^\circ$	Molecules $\text{HgCl}_2$ sol. in 100 molecules of ethyl acetate	Molecules $\text{HgCl}_2$ sol. in 100 molecules of acetone	Solid present in acetone
-15	9.10	14.5	$\text{HgCl}_2$ , $\text{CH}_3\text{COCH}_3$
0	9.25	14.3	
+10	....	18.7	
10	....	23.5	$\text{HgCl}_2$
17	....	23.2	
25	9.15	22.8	

(Aten, Z. phys. Ch. 1906, 54. 121.)

Solubility of  $\text{HgCl}_2$  in ethyl acetate + Aq at  $25^\circ$ .

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.  
 $\text{HgCl}_2$  = millimols.  $\text{HgCl}_2$  in 10 cc. of the solution.

P	$\text{HgCl}_2$	Sp. gr.
0	2.67	1.0565
4.39	2.72	1.0581
96.76	15.34	1.2371
100	9.75	1.1126

(Hers and Anders, Z. anorg. 1907, 52. 172.)

1 pt. is sol. in 2.05 pts. ethyl acetate at  $18^\circ$   
 or 100 g. ethyl acetate dissolve 48.7 g.  $\text{HgCl}_2$ .  
 (Naumann, B. 1910, 43. 315.)

Easily sol. in glycerine; sol. in 14 pts. glycerine. (Fairley, Monit. Scient. (3) 9. 685.)

100 g. glycerine dissolve 80 g.  $\text{HgCl}_2$  at  $25^\circ$ .  
 (Moles and Maquina, Ann. Soc. Echan. fis quin. 1914, 12. 383.)

## Solubility in organic solvents

Solvent	$t^\circ$	Sat. solution contains % $\text{HgCl}_2$
Methyl alcohol	-34	7.6
	-20	11.5
	-15	12.8
	-2	18.7
	+ 4	23.2
	12	27.6
	36	53.1
	51	61.0
	62	63.6
	64	63.7
	74	64.3
	100	68.7
	127	75.2

Solvent	$t^\circ$	Sat. solution contains % $\text{HgCl}_2$
Ethyl alcohol	-60	3.0
	-55	7.8
	-43	8.8
	-40	9.8
	-30	14.3
	-23	18.6
	-21	19.1
	-20	21.9
	-17	22.1
	-11	24.7
	- 9	27.0
	- 5	29.7
	0	29.0
	+ 3	30.0
	7	30.9
	10	31.3
	14	31.3
	19	32.0
	31	34.2
	43	36.4
N-propyl alcohol	51	38.9
	62	42.1
	63	42.5
	68	44.7
	75	45.2
	80	48.0
	92	51.0
	93	51.4
	100.	53.6
	115	60.6
	127	65.3
	138	67.8
Allyl alcohol	-32	14.7
	-22	15.4
	-14	15.6
	0	16.4
	0	16.5
	+16	18.2
	41	23.8
	53	27.9
	62	29.4
	67	32.7
	78	36.4
Acetone	100	43.8
	127	52.7
	-21	20.6
	- 1	29.6
	+ 8	35.2
Acetone	22	48.7
	-23	51.4
	-18	52.9
	-15	56.6
	-10	56.7
	- 8	58.4
	- 4	59.1
	- 1	60.1
	+ 6	61.9
	12	61.4
	15	61.8
	27	62.0
	36	61.9
	54	62.1

Solubility in organic solvents.—*Continued.*

Solvent	t°	Sat. solution contains % HgCl <sub>2</sub>
N-butyl alcohol	—21	12.4
	—6	13.0
	+9	14.3
	21	15.9
	59	25.8
	82	33.1
Isobutyl alcohol	—11	5.5
	—6	6.2
	0	6.7
	+11	7.5
	63	19.3
	98	32.1
	127	42.0
	145	47.2
	155	50.4
Amyl alcohol	—13	8.6
	+26	8.9
	50	14.0
	90	29.8
	106	35.1
Ether	—47	5.6
	—40	5.8
	—35	6.1
	—30	5.9
	—19	5.6
	0	5.8
	+13	5.8
	83	8.4
	100	8.7
	115	9.0
Ethyl formate	—20	29.6
	—3	29.2
	+24	30.0
	+46	31.0
Ethyl acetate	—50	39.6
	—20	40.5
	—14	40.2
	—6	40.0
	0	39.5
	+7	39.9
	19	40.2
	45	41.6
	66	44.0
	100	47.8
	131	50.1
	150	57.0
	180	59.3
Methyl acetate	—20	42.0
	+24	40.3
	55	41.5
Amyl acetate	+22	18.3
	48	18.5
Ethyl butyrate	+20	12.6
	55	13.5
	71	15.1

Solubility in organic solvents.—*Continued.*

Solvent	t°	Sat. solution contains % HgCl <sub>2</sub>
Acetic acid	+21	2.7
	22	3.0
	33	5.0
	43	6.0
	50	6.7
	61	8.0
	87	11.0
	95	12.0
	95	12.5
	115	16.0
	116	17.0
	127	20.0
	145	26.3
	182	44.8
	207	55.2
Formic acid	21	2.0
	50	3.2
	90	7.3

Very sl. sol. in propionic and isobutyric acids.

(Étard, A. ch. 1894, (7) 2. 557 et seq.)

Solubility of HgCl<sub>2</sub> in organic solvents at t°.

Solvent	t°	% HgCl <sub>2</sub>
CHCl <sub>3</sub>	—20.5	0.01
	+44.2	0.12
C <sub>6</sub> H <sub>6</sub>	+6.5	0.26
	18.0	0.53
	34.1	0.64
	54.1	1.02
	69.0	1.39
C <sub>2</sub> H <sub>5</sub> Cl <sub>2</sub>	0	1.33
	12.5	1.55
	20.8	1.68
	25.3	1.73
	30.2	1.92
	33.0	2.05
	45.9	2.42
CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub>	0	22.8
	6.5	22.7
	26.1	22.8
	38.5	23.5
	45.3	26.4

Dukelski, Z. anorg. 1907, 53. 329.



Solubility of  $\text{HgCl}_2$  in mixed organic solvents at  $t^\circ$ .

Solvent	$t^\circ$	% $\text{HgCl}_2$
$\text{C}_2\text{H}_6 + \text{C}_2\text{H}_5\text{OH}$	-2.5	15.20
	0.0	15.40
	6.0	16.38
	20.5	18.40
	20.65	18.50
	24.5	19.33
	34.5	21.34
	54.4	24.84
	54.5	24.42
$\text{C}_2\text{H}_6 + 2\text{C}_2\text{H}_5\text{OH}$	-5.2	19.45
	0	20.13
	+9.1	21.65
	20.9	23.57
	24.4	24.19
	36.5	26.53
	53.7	31.27
	74.0	38.74
$\text{CHCl}_3 + \text{C}_2\text{H}_5\text{OH}$	-20.5	3.82
	-12.0	4.43
	0.0	4.89
	+8.0	5.37
	23.0	7.12
	38.5	8.51
	44.2	9.51
	45.6	9.98
$\text{CHCl}_3 + 2\text{C}_2\text{H}_5\text{OH}$	-20.5	6.60
	0.0	7.69
	+8.0	8.96
	23.0	10.66
	38.5	12.50
	44.2	14.40
$\text{CHCl}_3 + \text{CH}_3\text{OH}$	-12.0	1.73
	0.0	3.51
	+8.0	5.63
	23.0	10.15
	24.9	10.71
	30.6	11.40
	38.5	12.02
$\text{CHCl}_3 + 2\text{CH}_3\text{OH}$	-12.0	3.33
	0.0	6.73
	+8.0	8.21
	23.0	16.56
	24.9	18.45
	30.6	19.70
	38.5	20.83
$\text{CCl}_4 + 2\text{CH}_3\text{OH}$	0.0	5.20
	7.7	6.69
	24.9	14.06
	30.6	19.40
	35.5	20.50
	36.1	21.80
	48.5	21.90

Solubility of  $\text{HgCl}_2$  in mixed organic solvents at  $t^\circ$ —Continued.

Solvent	$t^\circ$	$\text{HgCl}_2$
$\text{C}_2\text{H}_5\text{Cl}_2 + \text{CH}_3\text{OH}$	0.0	13.33
	12.5	21.30
	20.8	29.23
	25.3	34.78
	30.2	36.87
	33.0	37.01
	37.4	37.95
	45.9	39.36
$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{C}_2\text{H}_6$	0.0	9.62
	6.5	9.62
	25.7	9.78
	27.6	9.78
	35.5	10.81
$\text{CH}_3\text{COOC}_2\text{H}_5 + \text{CHCl}_3$	0.0	3.34
	26.1	4.07
	36.1	4.78
	46.0	5.38
	48.5	5.10
$2\text{CH}_3\text{COOC}_2\text{H}_5 + \text{CCl}_4$	0.0	9.24
	10.3	9.05
	25.7	9.32
	27.6	9.50
	38.5	9.89
	45.3	11.70

(Dukelski, Z. anorg. 1907, 53. 335.)

Solubility in organic solvents at  $18^\circ/20^\circ$ .

100 g. chloroform dissolve 0.106 g.  $\text{HgCl}_2$ .  
 100 g. tetrachloromethane dissolve 0.002 g.  $\text{HgCl}_2$ .  
 100 g. bromoform dissolve 0.486 g.  $\text{HgCl}_2$ .  
 100 g. ethyl bromide dissolve 2.010 g.  $\text{HgCl}_2$ .  
 100 g. ethylene dibromide dissolve 1.530 g.  $\text{HgCl}_2$ . (Sulc. Z. anorg. 1900, 25. 401.)

Solubility of  $\text{HgCl}_2$  in various organic solvents at  $25^\circ$ .G. = g.  $\text{HgCl}_2$  dissolved in 1 mol. of solvent.

Solvent	G. $\text{HgCl}_2$
Ethylene chloride	1.216
Tetrachlorethane	0.146
Chloroform	0.120
Dichlorethylene	0.110
Pentachlorethylene	0.039
Trichlorethylene	0.036
Perchlorethylene	0.012
Carbon tetrachloride	Trace

(Hofman, et al., B. 1910, 43. 186.)

Very sl. sol. in nitromethane at ord. temp.  
 Very sol. on warming. (Bruner, B. 1903, 36. 3298.)

Solubility in  $\text{CS}_2$  at  $t^\circ$ .

$t^\circ$	100 pts. sat. solution contain pts. $\text{HgCl}_2$
-10	0.010
-5	0.014
0	0.018
+5	0.022
10	0.026
15	0.032
20	0.042
25	0.053
30	0.063

(Arctowski, Z. anorg. 1894, 6. 267.)

0.030 g. is dissolved in 100 g. sat. solution in  $\text{CS}_2$  at  $8^\circ$ . (Arctowski, Z. anorg. 1894, 6. 256.)

Formic acid (95%) dissolves 2.1% at  $19^\circ$ . (Aschan, Ch. Z. 1913, 37. 1117.)

Sol. in molten urethane. (Castoro, Z. anorg. 1899, 20. 61.)

Sol. in ethyl sulphocyanate. (Kahlenberg, Z. phys. Ch. 1903, 46. 66.)

Solubility of  $\text{HgCl}_2$  in benzene.

100 pts.  $\text{C}_6\text{H}_6$  dissolve at:—

$15^\circ$   $41^\circ$   $55^\circ$   $84^\circ$

0.54 0.62 0.85 1.80 pts.  $\text{HgCl}_2$ .

(Laszcynski, B. 1894, 27. 2287.)

Solubility in  $\text{C}_6\text{H}_6 = 0.0197$  mol./l. at  $25^\circ$ . (Sherrill, Z. phys. Ch. 1903, 43. 735.)

Sol. in  $\text{C}_6\text{H}_6$ , toluene, xylene, and other aromatic hydrocarbons. Insol. or only sl. sol. in petroleum ether, hexane, decane and  $\text{CS}_2$ . (Gulewitsch, B. 1904, 37. 1563.)

Sol. in p-toluidine. (Werner.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Solubility of  $\text{HgCl}_2$  in pyridine.

$t =$  point of fusion.

Solid Phase =  $\text{HgCl}_2$ ,  $2\text{C}_5\text{H}_5\text{N}$ .

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
-32.8	2.76	40.90	29.29	78.0	49.72
-21.9	7.86	50.10	34.94	78.7	50.37
+0.02	13.14	60.03	40.36	80.2	51.52
12.58	17.34	70.15	46.44	82.5	52.40
18.78	19.78	70.8	45.77	89.0	56.45
23.60	21.59	74.6	48.00	90.8	57.01
27.23	22.65	75.2	48.38	94.1	60.09
31.05	24.46	76.4	49.15		

Solubility of  $\text{HgCl}_2$  in pyridine.—Continued.  
 $t =$  point of fusion.

Solid Phase =  $\text{HgCl}_2$ ,  $\text{C}_5\text{H}_5\text{N}$ .

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
74.7	48.38	90.61	53.50	104.1	60.09
83.5	50.53	75.0	56.45	104.2	60.72
86.5	52.37	99.5	56.07	104.7	58.97
87.3	52.02	99.5	57.01	107.	63.06
		100.5	57.84		

Solid Phase =  $3\text{HgCl}_2$ ,  $\text{C}_5\text{H}_5\text{N}$ .

$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$	$t^\circ$	% $\text{HgCl}_2$
94.7	60.72	113.6	63.06	124.2	65.00
95.2	60.77	114.0	63.18	129.4	65.63
106.4	61.93	115.7	63.37	145.5	69.66
109.8	62.58	118.2	64.09		

(McBride, Z. phys. Ch. 1910, 14. 196.)

## Solubility in pyridine.

$S =$  temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5.8	19	27.0	87	38.5	130
5.9	18.5	28.6	(98)	41.0	137
10.2	39.5	30.3	91.5	43.2	142
14.1	52	31.2	92	44.0	143.5
21.4	74.5	33.1	108	47.5	159
25.0	83	35.1	115.5	52.8	173

(Staronka, Anz. Ak. Wiss. Krakau, 1910. 372.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{HgCl}_2$  + pyridine containing 17.53%  $\text{HgCl}_2 = 1.1523$ ; containing 6.57%  $\text{HgCl}_2 = 1.0388$ . (Schönrock, Z. phys. Ch. 1893, 11. 768.)

Mol. weight determined in benzonitrile, methyl- and ethyl-sulphide. (Werner, Z. anorg. 1897, 15. 31. 26 and 30.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Easily sol. in oil of turpentine and other essential oils; sl. sol. in cold benzene, but much more on heating, crystallising on cooling. (Franchimont, B. 16. 387.)

Easily sol. in boiling creosote.

Insol. in olive oil.

Insol. in oils and fats but sol. when first dissolved in alcohol, free ether or anhydrous ketones. (Glock, Ch. Z. Repert. 36. 315.)

Extracted from  $\text{HgCl}_2$  + Aq by volatile oils.

Mercuric hydrogen chloride (Chloromercuric acid),  $\text{HgCl}_2$ ,  $\text{HCl} = \text{HHgCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Boullay, A. ch. 34. 243.)

Easily decomposed. (Neumann, M. 10. 236.)

$\text{HgCl}_2$ ,  $2\text{HCl}+7\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) 22. 551.)  
 $3\text{HgCl}_2$ ,  $4\text{HCl}+14\text{H}_2\text{O}$ . As above.  
 $2\text{HgCl}_2$ ,  $\text{HCl}+6\text{H}_2\text{O}$ . As above.  
 $4\text{HgCl}_2$ ,  $2\text{HCl}+9\text{H}_2\text{O}$ . As above.  
 $3\text{HgCl}_2$ ,  $\text{HCl}+5\text{H}_2\text{O}$ . As above.

**Mercuric hydrazine chloride**,  $\text{HgCl}_2$ ,  $2(\text{N}_2\text{H}_4, \text{HCl})$ .

Very sol. in  $\text{H}_2\text{O}$ . More sol. in hot alcohol than in cold; decomp. by  $\text{HNO}_3$ . (Curtius, J. pr. 1894, (2) 50. 332.)

**Mercuric nickel chloride, basic**,  $\text{HgCl}_2$ ,  $6\text{NiO}$ ,  $\text{NiCl}_2+20\text{H}_2\text{O}$ , and  $\text{HgCl}_2$ ,  $7\text{NiO}$ ,  $\text{NiCl}_2$ .

(Mailhe, A. ch. 1902, (7) 27. 369.)

**Mercuric nickel chloride.**

Deliquescent. (v. Bonsdorff.)

**Mercuric nitrosyl chloride**,  $\text{HgCl}_2$ ,  $\text{NOCl}$ .

Sol. in  $\text{H}_2\text{O}$  without effervescence. (Sudborough, Chem. Soc. 59. 659.)

**Mercuric phosphoric chloride**,  $3\text{HgCl}_2$ ,  $2\text{PCL}_3$ .

Decomp. and dissolved by  $\text{H}_2\text{O}$ . (Baudrimont, A. ch. (4) 2. 45.)

**Mercuric potassium chloride**,  $2\text{HgCl}_2$ ,  $\text{KCl}+2\text{H}_2\text{O}$ .

Very easily sol. in warm  $\text{H}_2\text{O}$ . A clear solution at  $18^\circ$  is filled with crystals at  $15^\circ$ . Sl. sol. in alcohol. (v. Bonsdorff, Pogg. 17. 122.)

$\text{HgCl}_2$ ,  $\text{KCl}+\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (v. Bonsdorff, Pogg. 19. 336.)

$\text{HgCl}_2$ ,  $2\text{KCl}+\text{H}_2\text{O}$ . As above.

Solubility determinations show that the double salts formed by mercuric and potassium chlorides at  $25^\circ$  are:

$2\text{KCl}$ ,  $\text{HgCl}_2+\text{H}_2\text{O}$ .

$\text{KCl}$ ,  $\text{HgCl}_2+\text{H}_2\text{O}$ . Can be recryst. without decomp.

$\text{KCl}$ ,  $2\text{HgCl}_2+2\text{H}_2\text{O}$ . Gives  $\text{HgCl}_2$  on recryst. from  $\text{H}_2\text{O}$ . (Foote and Levy, Am. Ch. J. 1906, 35. 237.)

**Mercurous rhodium chloride.**

See Chlororhodite, mercurous.

**Mercuric rubidium chloride**,  $\text{HgCl}_2$ ,  $\text{RbCl}$ .

Sol. in  $\text{H}_2\text{O}$ .

$\text{HgCl}_2$ ,  $2\text{RbCl}$ . Sol. in  $\text{H}_2\text{O}$  and  $\text{HCl}+\text{Aq}$ . (Godeffroy, Arch. Pharm. (3) 13. 47.)

$+2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Godeffroy.)

$2\text{HgCl}_2$ ,  $\text{RbCl}$ . Sol. in  $\text{H}_2\text{O}$ . (Godeffroy.)

Solubility determinations show that at  $25^\circ$  there exist five double mercuric rubidium chlorides with the following formulas:

$\text{RbCl}$ ,  $5\text{HgCl}_2$ . Gives  $\text{HgCl}_2$  on recryst. from  $\text{H}_2\text{O}$ .

$3\text{RbCl}$ ,  $4\text{HgCl}_2+\text{H}_2\text{O}$ . Gives  $\text{RbCl}$ ,

$5\text{HgCl}_2$  on recryst. from  $\text{H}_2\text{O}$ .

$\text{RbCl}$ ,  $\text{HgCl}_2+\text{H}_2\text{O}$ . Gives  $3\text{RbCl}$ ,  $4\text{HgCl}_2$  on recryst. from  $\text{H}_2\text{O}$ .

$3\text{RbCl}$ ,  $2\text{HgCl}_2+2\text{H}_2\text{O}$ . Gives  $3\text{RbCl}$ ,  $4\text{HgCl}_2$  on recryst. from  $\text{H}_2\text{O}$ .  
 $2\text{RbCl}$ ,  $\text{HgCl}_2+\text{H}_2\text{O}$ . Gives  $3\text{RbCl}$ ,  $4\text{HgCl}_2$  on recryst. from  $\text{H}_2\text{O}$ .  
 (Foote and Levy, Am. Ch. J. 1906, 35. 241.)

**Mercurous silver chloride**,  $\text{HgCl}_2$ ,  $\text{AgCl}$ .

(Jones, J. Soc. Chem. Ind. 1893, 12. 983.)

$2\text{HgCl}_2$ ,  $\text{AgCl}$ . Min. *Bordosite*. (Jones, J. Soc. Chem. Ind. 1893, 12. 983.)

$3\text{HgCl}_2$ ,  $\text{AgCl}$ . (Jones, Chem. Soc. 1910, 97. 338.)

**Mercuric sodium chloride**,  $\text{HgCl}_2$ ,  $\text{NaCl}$ .

Sp. gr. at  $16^\circ/4^\circ$  of aqueous solution containing 14.937% salt = 1.13310; containing 11.0736% = 1.09528. (Schönrock, Z. phys. Ch. 1893, 11. 782.)

$+\text{H}_2\text{O}$ . (Linebarger, Am. Ch. J. 1893, 15. 344.)

$+1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in 0.33 pt.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Schindler, Report. 36. 240.)

Extremely easily sol. in alcohol. (Voit.)

Sol. in 275 pts. ether. Ether dissolves the undecomposed salt out of  $\text{H}_2\text{O}$  solution. (Lassaigne, A. ch. 64. 104.)

$\text{HgCl}_2$ ,  $2\text{NaCl}$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Voit, A. 104. 354.)

$2\text{HgCl}_2$ ,  $\text{NaCl}$ . Decomp. by  $\text{H}_2\text{O}$  in dil. solution. Sol. in acetone and acetic ether. (Linebarger, Am. Ch. J. 1893, 15. 344.)

Solubility determinations show that the only double salt formed by mercuric and sodium chlorides between  $10.3^\circ$  and  $25^\circ$  is  $\text{NaCl}$ ,  $\text{HgCl}_2+2\text{H}_2\text{O}$ . Can be recryst. from  $\text{H}_2\text{O}$ . (Foote and Levy, Am. Ch. J. 1906, 35. 237.)

**Mercuric strontium chloride, basic**,  $\text{SrCl}_2$ ,  $\text{HgO}+6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (André, C. R. 104. 431.)

**Mercuric strontium chloride**,  $2\text{HgCl}_2$ ,  $\text{SrCl}_2+2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (v. Bonsdorff.)

$3\text{HgCl}_2$ ,  $\text{SrCl}_2+5-6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Swan, Am. Ch. J. 1898, 20. 632.)

**Mercurous sulphur chloride.**

See Mercurous sulphochloride.

**Mercuric thallous chloride**,  $\text{HgCl}_2$ ,  $\text{TlCl}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 6. 83.)

**Mercurous stannous chloride**,  $\text{Hg}_2\text{Cl}_2$ ,  $\text{SnCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Capitaine, J. Pharm. 25. 549.)

**Mercuric yttrium chloride**,  $3\text{HgCl}_2$ ,  $\text{YCl}_3+9\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Popp, A. 131. 179.)

**Mercuric zinc chloride,  $\text{HgCl}_2, \text{ZnCl}_2$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Harth, Z. anorg. 1897, 14. 323.)

$2\text{HgCl}_2, \text{ZnCl}_2$ . (Varet, C. R. 1896, 123. 422.)

**Mercuric zinc chloride ammonia,  $\text{HgCl}_2, 4\text{ZnCl}_2, 10\text{NH}_3 + 2\text{H}_2\text{O}$ .**

Insol. in boiling  $\text{H}_2\text{O}$ , but decomp. thereby. (André, C. R. 112. 995.)

$\text{HgCl}_2, 2\text{ZnCl}_2, 6\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ . As above. (André.)

**Mercuric chloride ammonia,  $\text{HgCl}_2, 12\text{NH}_3$ .**

Sl. sol. in ammonia. (Franklin, Am. Ch. J. 1900, 23. 300.)

**Mercuric chloride cadmium oxide,  $\text{HgCl}_2, \text{CdO} + \text{H}_2\text{O}$ .**

(Mailhe, A. ch. 1902, (7) 27. 371.)

**Mercuric chloride cobaltous oxide,  $\text{HgCl}_2, 3\text{CoO} + \frac{1}{2}\text{H}_2\text{O}$ .**

(Mailhe, C. R. 1901, 132. 1274.)

**Mercuric chloride cupric oxide,  $\text{HgCl}_2, 3\text{CuO} + \text{H}_2\text{O}$ .**

(Mailhe, Bull. Soc. 1901, (3) 25. 791.)

**Mercuric chloride hydrazine,  $\text{HgCl}_2, \text{N}_2\text{H}_4$ .**

Very unstable. Decomp. by  $\text{H}_2\text{O}$ . Pptd. from alcohol solution by  $\text{H}_2\text{O}$ ; very sol. in min. acids with decomp.

Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3$ . Decomp. by alkalies. Somewhat sol. in acetic acid. (Hofmann, B. 1897, 30. 2020.)

**Mercuric chloride hydroxylamine,  $\text{HgCl}_2, 2\text{NH}_2\text{OH}$ .**

Completely sol. in methyl and ethyl alcohol; insol. in ether; decomp. by  $\text{H}_2\text{O}$  and  $\text{NaOH} + \text{Aq}$ . Sol. in  $\text{NH}_2\text{OH}, \text{HCl} + \text{Aq}$ . (Adams, Am. Ch. J. 1902, 23. 210.)

**Mercuric chloride lead oxide,  $\text{HgCl}_2, 2\text{PbO} + 2\text{H}_2\text{O}$ .**

(Mailhe, A. ch. 1902, (7) 27. 372.)

**Mercuric chloride strontium chromate,  $2\text{HgCl}_2, \text{HCl}, \text{SrCrO}_4$ .**

Sol. in  $\text{H}_2\text{O}$  without decomp. (Imbert, Bull. Soc. 1897, (3) 17. 471.)

**Mercuric chloroiodide,  $2\text{HgCl}_2, \text{HgI}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Liebig.)  
 $\text{HgCl}_2, \text{HgI}_2$ . Sl. sol. in hot  $\text{H}_2\text{O}$  with partial decomp. More easily sol. in alcohol. (Köhler, B. 12. 1187.)

**Mercurous fluoride,  $\text{Hg}_2\text{F}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{Hg}_2\text{O}$ .

**Mercuric fluoride,  $\text{HgF}_2 + 2\text{H}_2\text{O}$ .**

Decomp. by cold  $\text{H}_2\text{O}$ , with separation of  $\text{Hg}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , and  $\text{HF} + \text{Aq}$ . (Finkener, Pogg. 110. 628.)

**Mercurous hydrogen fluoride,  $\text{Hg}_2\text{F}_2, 4\text{HF} + 4\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids and dil.  $\text{HF}$ . (Böhm, Z. anorg. 1905, 43. 327.)

**Mercurous silicon fluoride.**

See Fluosilicate, mercurous.

**Mercurous fluoride ammonia,  $\text{Hg}_2\text{F}_2, 2\text{NH}_3$ .**

Stable on air. (Finkener, Pogg. 110. 142.)

**Mercurous hydroxide,  $\text{HgOH}$ .**

Nearly insol. in cold, sol. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH} + \text{Aq}$ . (Bhaduri, Z. anorg. 1897, 13. 410.)

**Mercurous iodamide,  $\text{Hg}_2(\text{NH}_2)\text{I}$ .**

(Rammelsberg, Pogg. 48. 184.)  
Is a mixture of  $\text{Hg}$  and  $\text{Hg}(\text{NH}_2)\text{I}$ . (Barfoed.)

**Mercurous iodide,  $\text{Hg}_2\text{I}_2$ .**

Sol. in over 2375 pts.  $\text{H}_2\text{O}$ . (Saladin, J. chim. méd. 7. 530.)

Solubility in  $\text{H}_2\text{O} = 2.6 \times 10^{-8}$  g.-equiv. per liter (calculated). (Bodländer, Z. phys. Ch. 1898, 27. 58.)

Solubility in  $\text{H}_2\text{O} = 3 \times 10^{-10}$  mols. per litre at  $25^\circ$ . (Sherrill, Z. phys. Ch. 1903, 43. 735.)  
Sol. in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ . (Stromann, B. 20. 2815.)

Sol. in  $\text{KI} + \text{Aq}$ . Easily sol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , but less than  $\text{HgI}_2$ . Less sol. in  $\text{NH}_4\text{NO}_3$  than in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Brett.)

Partially sol. with separation of  $\text{Hg}$  and formation of  $\text{HgI}_2$ , in cold  $\text{KI} + \text{Aq}$ , hot  $\text{NaI}$ ,  $\text{CaI}_2$ ,  $\text{SrI}_2$ ,  $\text{BaI}_2$ ,  $\text{MgI}_2$ ,  $\text{ZnI}_2$ , and  $\text{NH}_4\text{I} + \text{Aq}$ ; in warm  $\text{NaCl}$ ,  $\text{KCl}$  and  $\text{NH}_4\text{Cl} + \text{Aq}$ ; and slowly in hot  $\text{HCl} + \text{Aq}$ . (Boullay, A. ch. (2) 34. 358.)

Decomp. by alkali chlorides +  $\text{Aq}$ . (Miahle, A. ch. (3) 5. 177.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Not wholly insol. in alcohol, ether, or chloroform. (MacLagan, Rep. anal. Ch. 1884. 378.)

Decomp. by boiling alcohol; 1000 g. boiling alcohol decomp. about 3.15 g.  $\text{Hg}_2\text{I}_2$ . (François, C. R. 1896, 121. 890.)

Boiling alcohol decomp.  $\text{Hg}_2\text{I}_2$  to  $\text{Hg}$  and  $\text{HgI}_2$ , which dissolves until 0.220 g.  $\text{HgI}_2$  are contained in 100 g. alcohol. (François, C. R. 1896, 121. 889.)

Insol. in cold ether. (François, J. Pharm. 1897, (6), 6. 445.)

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 345.)

Difficultly sol. in methyl acetate. (Nau-mann, B. 1909, 42. 3790.)

Phenol at  $180^\circ$  decomp. it into  $\text{Hg}$  and  $\text{HgI}_2$ , until a state of equilibrium is reached with

2.75 g.  $\text{HgI}_2$  to 100 g. phenol, above which point  $\text{HgI}$  is sl. sol. (0.05 g. in 100 g.) in phenol- $\text{HgI}_2$  mixture. Decomp. by cold aniline more rapidly than by hot. Equilibrium is reached when 26.35 g.  $\text{HgI}_2$  are present to 100 g. aniline at bpt. of aniline. Aniline containing more than 26 g.  $\text{HgI}_2$  to 100 g. dissolves  $\text{HgI}$  in considerable quantity. (François, C. C. 1896, I, 470.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sl. sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

### Mercuric iodide, $\text{HgI}_2$ .

Sol. in 150 (?) pts.  $\text{H}_2\text{O}$ . (Wurts.)

1 l.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolves 0.0403 g.  $\text{HgI}_2$ . (Bourgoin, A. ch. (6) 3. 429.)

Sol. in about 6500 pts.  $\text{H}_2\text{O}$ . (Hager.)

According to calculation from electrical conductivity of  $\text{HgI}_2 + \text{Aq}$ ,  $\text{HgI}_2$  is much less sol., 1 l.  $\text{H}_2\text{O}$  dissolving only 0.5 mg.  $\text{HgI}_2$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.054 g.  $\text{HgI}_2$  at  $22^\circ$ . (Rohland, Z. anorg. 1898, 15. 412.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves about 0.06 g. (Morse, Z. phys. Ch. 1902, 41. 731.)

1 l.  $\text{H}_2\text{O}$  at  $18^\circ$  dissolves  $4 \times 10^{-4}$  mol. (Abegg, Z. Elektrochem. 1903, 9. 553.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 0.00013$  mol. liter. (Sherrill, Z. phys. Ch. 1903, 43. 735.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.4 mg.  $\text{HgI}_2$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

1 l.  $\text{H}_2\text{O}$  at  $18^\circ$  dissolves 0.2 to 0.4 mg. (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

The yellow modification is always deposited from solution even in the presence of an excess of the red form. (Gernez, C. R. 1903, 136. 1323.)

Sol. in many acids, especially in  $\text{HCl}$ , and  $\text{HI} + \text{Aq}$ . Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Berthelot.) Scarcely sol. in dil.  $\text{HNO}_3 + \text{Aq}$ .

Not attacked by cold  $\text{H}_2\text{SO}_4$ , decomp. by hot. (Ditte, A. ch. 1879, (5) 17. 124.)

Sat. solution in  $\text{H}_2\text{SO}_4 + \text{Aq}$  contains at critical temp. ( $158.2^\circ$ ), 0.7%  $\text{HgI}_2$ . (Niggli, Z. anorg. 1912, 75. 182.)

Sol. in hot  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , cold  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or ammonium succinate +  $\text{Aq}$ . (Wittstein.)

Sol. in  $\text{HgCl}_2$ ,  $\text{Hg}(\text{NO}_3)_2$ , or  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . Easily sol. in  $\text{Na}_2\text{S}_2\text{O}_5 + \text{Aq}$ . Easily sol. in soluble iodides +  $\text{Aq}$ . More sol. in hot than in cold  $\text{NaI}$  or  $\text{KI} + \text{Aq}$ . When conc., 1 mol.  $\text{KI}$  in hot solution dissolves 3 mols.  $\text{HgI}_2$ , but a portion separates on cooling.  $\text{BaI}_2$ ,  $\text{SrI}_2$ ,  $\text{MgI}_2$ , and  $\text{CaI}_2$  act in the same way. Easily sol. in cold, more sol. in hot  $\text{ZnI}_2 + \text{Aq}$ , 2 mols.  $\text{HgI}_2$  being dissolved to 1 mol.  $\text{ZnI}_2$ . In  $\text{NH}_4\text{I} + \text{Aq}$ , 3 mols.  $\text{HgI}_2$  are dissolved to 2 mols.  $\text{NH}_4\text{I}$ . Abundantly sol. in hot  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$ , but separates out on cooling, and the trace remaining may be pptd. by  $\text{H}_2\text{O}$ , 2 g.  $\text{KCl}$  in solution dissolves 1.166 g.  $\text{HgI}_2$ . Sol. in  $\text{HgCl}_2 + \text{Aq}$ , and very easily sol. in

alcoholic solution of  $\text{HgCl}_2$ . (Boullay, A. ch. (2) 34. 346.)

### Solubility in $\text{MI} + \text{Aq}$ at $25^\circ$ .

Salt	In 10 ccm. of the solution	
	Millimols $\text{HgI}_2$	Millimols salt
$\text{NaI}$	4.12	7.94
	6.22	13.85
	9.45	22.25
$\text{KI}$	1.27	3.03
	1.80	3.90
	5.10	10.34
	7.00	15.54
	12.24	25.19
$\text{CaI}_2$	0.50	0.53
	2.61	2.52
	4.40	4.68
	4.58	4.84
	17.06	17.99
$\text{SrI}_2$	2.12	2.54
	3.20	3.55
	5.82	5.39
	6.94	6.06
$\text{BaI}_2$	0.59	0.99
	7.42	7.48
	8.98	9.78
	14.62	15.08

(Hers and Paul, Z. anorg. 1913, 82. 434.)

### Solubility of $\text{HgI}_2 + \text{KI}$ in $\text{H}_2\text{O}$ .

Temp. $-20^\circ$ .		
% $\text{KI}$	% $\text{HgI}_2$	Solid phase
50.9	19.3	$\text{KI}$
44.4	32.4	"
39	48	"
37.4	53.6	$\text{KI} + \text{KHgI}_2$
37.8	52.6	$\text{KHgI}_2$
35.1	52.2	"
35.5	51.2	$\text{KHgI}_2, \text{H}_2\text{O}$
26.7	50.3	$\text{KHgI}_2 + \text{HgI}_2$
26.6	49.4	$\text{HgI}_2$
23.7	40.2	"
14.9	22.5	"
Temp. $-30^\circ$		
60.6	....	$\text{KI}$
40	53	$\text{KI} + \text{KHgI}_2$
39.6	52.7	$\text{KHgI}_2$
40	52.2	"
40.2	51.2	"
39.3	50.3	"
33.7	49.8	"
33	52	"
31.4	51.7	$\text{KHgI}_2, \text{H}_2\text{O}$
29.1	52.2	"

(Dunningham, Chem. Soc. 1914, 105. 368.)

Very sol. in KSCN + Aq. (Philipp, Pogg. 1867, 131. 93.)

Sol. in 1.09 pts. cryst.  $\text{Na}_2\text{S}_2\text{O}_3$  + Aq. (Eder and Ulm, M. 1882, 3. 197.)

Very sol. in hot  $\text{CaCl}_2$  + Aq, less sol. in  $\text{BaCl}_2$ ,  $\text{KCl}$  and  $\text{NaCl}$  + Aq. (Lea, Z. anorg. 1896, 12. 341.)

Solubility in normal  $\text{Hg}(\text{NO}_3)_2$  + Aq = 48.0 g. per litre. (Morse, Z. phys. Ch. 1902, 41. 731.)

Extremely sol. in cold conc.  $\text{NH}_4\text{Br}$  + Aq. (Grossmann, B. 1903, 36. 1602.)

Sol. in alkali sulphites + Aq. (Barth, Z. phys. Ch. 1892, 9. 215.)

Sol. in  $\text{Ca}(\text{OCl})_2$  + Aq; sol. in  $\text{KOH}$  + Aq. (Melsens, A. ch. (3) 26. 222.)

Sol. in liquid  $\text{SO}_2$ . (Walden and Centnerszwer, C. C. 1902, I. 344.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$ ,  $\text{SO}_2\text{Cl}_2$ , warm  $\text{AsCl}_3$ ,  $\text{PBr}_3$ , warm  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

More sol. in alcohol than in  $\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  containing 10% of 90% alcohol dissolves 0.06 g.  $\text{HgI}_2$ . 1 l. of alcohol of 80° B. dissolves 2.851 g.  $\text{HgI}_2$ , 1 l. absolute alcohol dissolves 11.86 g.  $\text{HgI}_2$ . (Bourgoin, A. ch. (6) 3. 429.)

Sol. in 130 pts. cold, and 15 pts. hot 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 3.16 pts. at 15°; 100 pts. absolute ethyl alcohol dissolve 2.09 pts. at 15°. (de Bruyn, Z. phys. Ch. 10. 783.)

0.00842 pt. is sol. in 1 pt. alcohol at 15°. (Gautier and Charpy, C. R. 1890, 111. 647.)

100 g. methyl alcohol dissolve 3.7 g.  $\text{HgI}_2$  at 19°; ethyl alcohol, 1.86 g.; propyl alcohol, 1.25 g.; isobutyl alcohol, at 22.5°, 0.51 g. (Timofeiew, Dissert. 1894.)

At 15–20°, 100 g. methyl alcohol dissolve 3.24 g.  $\text{HgI}_2$ ; ethyl alcohol, 1.42 g.; propyl alcohol, 0.826 g. (Rohland, Z. anorg. 1898, 15. 412.)

Solubility of  $\text{HgI}_2$  in ethyl alcohol + Aq at 25°.

A = g. alcohol in 100 g. alcohol + Aq.  
 $\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 100 cc. of the solution.

A	$\text{HgI}_2$	Sp. gr.
100	3.86	0.80325
95.82	2.56	0.80950
92.44	1.92	0.81536
86.74	1.38	0.82996
78.75	0.935	0.84654
67.63	0.45	0.87214

(Hers and Knoch, Z. anorg. 1905, 45. 266.)

Solubility of  $\text{HgI}_2$  in methyl alcohol + Aq at 25°.

P = g. alcohol in 100 g. alcohol + Aq.  
 $\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 10 cc. of the solution.

P	$\text{HgI}_2$	Sp. gr.
0	0.0013	0.8187
47.06	0.0098	0.8334
64.00	0.0347	0.8519
78.06	0.0981	0.8155
100	0.571	

(Hers and Anders, Z. anorg. 1907, 52. 165.)

Solubility of  $\text{HgI}_2$  in ethyl alcohol + Aq at 25°.

P = g. alcohol in 100 g. alcohol + Aq.  
 $\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 10 cc. of the solution.

P	$\text{HgI}_2$	Sp. gr.
70.01	0.061	0.8636
100	0.386	0.8032

(Hers and Anders, Z. anorg. 1907, 52. 170.)

At 15°, 1 pt. by weight is sol. in:—  
 24813 pts.  $\text{H}_2\text{O}$ .

30.8 pts. methyl alcohol of sp. gr. at 0.7990.  
 70.3 " ethyl " " " " 0.8100.  
 121.0 " propyl " " " " 0.8160.

(Rohland, Z. anorg. 1899, 18. 328.)

Solubility of  $\text{HgI}_2$  in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the mixtures.  
 $\text{HgI}_2$  = g.  $\text{HgI}_2$  in 10 cm. of the solution.  
 $S$  25°/4° = Sp. gr. of the sat. solution.

P	$\text{HgI}_2$	S 25°/4°
0	0.180	0.8038
4.37	0.193	0.8039
10.4	0.208	0.8046
41.02	0.232	0.8077
80.69	0.289	0.8131
84.77	0.296	0.8140
91.25	0.298	0.8146
100	0.316	0.8156

(Hers and Kuhn, Z. anorg. 1908, 58. 164.)

## Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. HgI<sub>2</sub> in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.316	0.8156
23.8	0.304	0.8155
91.8	0.169	0.8101
93.75	0.167	0.8110
96.6	0.153	0.8108
100	0.142	0.8116

(Hers and Kuhn, Z. anorg. 1908, 60. 158.)

## Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. HgI<sub>2</sub> in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.180	0.8038
8.1	0.173	0.8036 (†)
17.85	0.165	0.8043
56.6	0.155	0.8075
91.2	0.152	0.8099
95.2	0.144	0.8108
100	0.142	0.8116

(Hers and Kuhn, Z. anorg. 1908, 60. 161.)

## Solubility in 100 pts. amyl alcohol equals:

0.66 pts. at 13°.  
3.66 " " 71°.  
5.30 " " 100°.  
9.57 " " 133.5°.

(Laszcynski, B. 1894, 27. 2287.)

Sp. gr. at 16°/4° of HgI<sub>2</sub>+alcohol containing 1.8358% HgI<sub>2</sub>=0.80718; containing 1.7119%=0.80597. (Schönrock, Z. phys. Ch. 1893, 11. 770.)

Somewhat sol. in ether. Sol. in 77 pts. ether. (Saladin.) Sol. in 60 pts. ether. (Hager.)

Sol. in cold ether. (François, J. Pharm. 1897, (6) 6. 445.)

Very sl. sol. in anhydrous ether. (Hampe.)

0.62 pt. is sol. in 100 pts. ether at 0°.

0.97 pt. is sol. in 100 pts. ether at 36°.

(Laszcynski, B. 1894, 27. 2286.)

Solubility in ether=0.3% at ord. temp. (Marsh, Chem. Soc. 1910, 97. 2299.)

Nearly insol. in ether. (Dunningham, Chem. Soc. 1914, 106. 368.)

Data are given on the system HgI<sub>2</sub>+KI+ether. (Dunningham.)

Solubility at 23° in chloroform=0.071%; in ether=0.551%; in acetone=2.005%; in ethyl alcohol=2%; in methyl alcohol=3.975%; in benzene=0.247%. (Beckmann and Stock, Z. phys. Ch. 1895, 17. 130.)

## Solubility in organic solvents at t°.

Solvent	t°	100 g. of the solvent dissolve g. HgI <sub>2</sub>
Chloroform	61	0.163
Tetrachlormethane	75	0.094
Ethylene dichloride	85.5	1.200
Isobutyl chloride	69	0.328
Ethyl bromide	38	0.773
Methyl alcohol	66	6.512
Ethyl alcohol	78	4.325
Isopropyl alcohol	81	2.266
Isobutyl alcohol	ca. 100	2.433
Methyl formate	36-38	1.166
Ethyl formate	52-55	2.150
Methyl acetate	56-59	2.500
Ether	35	0.470
Acetone	56	3.249
Acetal	ca. 100	2.000
Chloral	96	...
Epichlorhydrin	ca. 100	6.113
Hexane	67	0.072
Benzene	80	0.825
Ethyl acetate	74-78	4.200

(Sulc, Z. anorg. 1900, 25. 402.)

## Solubility in organic solvents at 18-20°.

100 g. chloroform dissolve 0.040 g. HgI<sub>2</sub>.

100 g. tetrachlormethane dissolve 0.006 g. HgI<sub>2</sub>.

100 g. bromoform dissolve 0.486 g. HgI<sub>2</sub>.

100 g. ethyl bromide dissolve 0.643 g. HgI<sub>2</sub>.

100 g. ethyl iodide dissolve 2.041 g. HgI<sub>2</sub>.

100 g. ethylene dibromide dissolve 0.748 g. HgI<sub>2</sub>.

(Sulc, Z. anorg. 1900, 25. 401.)

1 pt. ethylene bromide dissolves 0.00553 pts. HgI<sub>2</sub> at 15°. (Gautier and Charpy, C. R. 1890, 111. 647.)

100 pts. methylene iodide CH<sub>2</sub>I<sub>2</sub> dissolve 2.5 pts. HgI<sub>2</sub> at 15°, 16.6 pts. at 100°, and 58 pts. at 180°. (Retgers, Z. anorg. 3. 252.)

1 l. sat. solution in CCl<sub>4</sub> at 15° contains 0.170 g. HgI<sub>2</sub>. (Dawson, Chem. Soc. 1909, 95. 874.)

Sol. in 340 pts. glycerine. (Fairley, Monit. Scient. (3) 9. 685.)

100 pts. acetone dissolve 2.09 pts. HgI<sub>2</sub> at 25°. (Krug and M'Elroy, J. Anal. Ch. 6. 84.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, 11, 1014.)

Solubility in 100 pts. acetone equals:

2.83 pts. HgI<sub>2</sub> at — 1°.

3.36 " " " 18°.

4.73 " " " 40°.

6.07 " " " 53°.

(Laszcynski, B. 1894, 27. 2287.)

100 g. methyl acetate solution, sat. at 18°.

contain 1.10 g. HgI<sub>2</sub>. (Bezold, Dissert. 1906.)

100 g. boiling methyl acetate slowly dissolve 2.3 g.  $\text{HgI}_2$ . (Schroeder and Steiner, J. pr. 1909, (2) 79. 49.)

#### Solubility in ethyl acetate at $t^\circ$ .

Pts. sol. in 100 pts. ethyl acetate	$t^\circ$
1.49	— 2
1.56	+17.5
1.64	21
2.53	40
3.19	55
4.31	76

(Laszczyński, B. 1894, 27. 2286.)

100 g. ethyl acetate anhydrous, or sat. with  $\text{H}_2\text{O}$  at  $18^\circ$ , dissolve at  $18^\circ$ , 14.70 g.  $\text{HgI}_2$ . Solubility increases somewhat with temp. (Hamers, Dissert. 1906.)

#### Solubility of $\text{HgI}_2$ in ethyl acetate + Aq at $25^\circ$ .

P = g. ethyl acetate in 100 g. ethyl acetate + Aq.

$\text{HgI}_2$  = millimols.  $\text{HgI}_2$  in 10 cc. of the solution.

P	$\text{HgI}_2$	Sp. gr.
4.39	0.0028	0.9973
96.76	0.412	0.9063
100	0.241	0.9011

(Hers and Anders, Z. anorg. 1907, 52. 172.)

1 pt. is sol. in 68.03 pts. ethyl acetate at  $18^\circ$ . (Naumann, B. 1910, 43. 316.)

Solubility in diethyl oxalate is 12.5% at bpt. and 2.5% at  $100^\circ$ . (Reinders, Z. phys. Ch. 1900, 32. 507.)

#### Solubility in $\text{CS}_2$ at $t^\circ$ .

$t^\circ$	100 pts. sat. solution contain pts. $\text{HgI}_2$
—10	0.107
— 5	0.141
0	0.173
+ 5	0.207
10	0.239
15	0.271
20	0.320
25	0.352
30	0.445

(Arctowski, Z. anorg. 1894, 6. 267.)

#### Solubility in $\text{CS}_2$ .

100 g. of the sat. solution contain at:

—86.5°	—93°	—116°
0.024	0.023	0.017 g. $\text{HgI}_2$ .

(Arctowski, Z. anorg. 1896, 11. 274.)

0.0028 pt. is sol. in 1 pt.  $\text{CS}_2$  at  $15^\circ$ . (Gautier and Charpy, C. R. 1890, 111. 647.)

1 l. sat. solution in  $\text{CS}_2$  at  $15^\circ$  contains 3.127 g.  $\text{HgI}_2$ . (Dawson, Chem. Soc. 1909, 95. 874.)

Very sol. in liquid methylamine. (Gibbs, J. Am. Chem. Soc. 1906, 28. 1419.)

Abundantly sol. in methylamine. (Fitzgerald, J. phys. Chem. 1912, 16. 633.)

Somewhat sol. in allyl mustard oil. (Mathews, J. phys. Chem. 1905, 9. 647.)

Sol. in  $\text{Sb}(\text{CH}_3)_3$  + Aq.

Very sl. sol. in Na citrate + Aq. (Spiller.)

1 pt.  $\text{C}_6\text{H}_6$  dissolves 0.00217 pts.  $\text{HgI}_2$  at  $15^\circ$ . (Gautier and Charpy, C. R. 1890, 111. 647.)

#### Solubility in 100 pts. benzene equals:

0.22 pts. at $15^\circ$ .
0.88 " " $60^\circ$ .
0.95 " " $65^\circ$ .
1.24 " " $84^\circ$ .

(Laszczyński, B. 1894, 27. 2284.)

1 l.  $\text{C}_6\text{H}_6$  dissolves 0.00493 mol.  $\text{HgI}_2$  at  $25^\circ$ . (Sherrill, Z. phys. Ch. 1903, 43. 735.)

100 g. boiling phenol dissolve 10 g.  $\text{HgI}_2$ . (François, C. R. 1895, 121. 769.)

Sl. sol. in phenol with 20%  $\text{H}_2\text{O}$ . Not very sol. in acetic acid at  $119^\circ$ , in amyl acetate at  $133^\circ$ , in amyl bromide at  $119^\circ$ . Rather sol. in diethyl oxalate at  $186^\circ$ , in ethylene bromide at  $131^\circ$ , in amyl alcohol at  $137^\circ$ , in amyl iodide at  $150^\circ$ , in  $\text{CHBr}_3$  at  $151^\circ$ , in iodo-benzol at  $190^\circ$ , in oil of turpentine at  $160^\circ$ . Very sol. in benzaldehyde at  $179^\circ$  in methylene iodide at  $182^\circ$ . (Reinders, Z. phys. Ch. 1900, 32. 506.)

1000 pts. oil of bitter almonds dissolve 4 pts.  $\text{HgI}_2$  at ord. temp.; 1000 pts. olive oil, 4 pts.; 1000 pts. poppy oil, 10 pts.; 1000 pts. nut oil, 15 pts.; 1000 pts. castor oil, 20 pts.; 1000 pts. lard oil, 4. 5 pts.; 1000 pts. vaseline, 2.5 pts.; 1000 pts. benzene, 4 pts. Sol. in phenol. (Mehn, Pharm. J. 3. 327; B. 19. 8 R.)

#### Solubility in aniline.

S = Temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5.9	$12^\circ$	19.9	$48.5^\circ$	33.0	$128^\circ$
8.2	22.5	25.8	53.5	35.6	140
10.3	29	29.3	105	37.5	147
14.9	41.5	31.7	122	39.2	156
16.6	45	32.4	(55)		

(Staronka, Anz. Ak. Wiss. Krakau, 1910. 372.)



Solubility of  $\text{HgI}_2$  in aniline at  $t^\circ$ .

$t^\circ$	g. $\text{HgI}_2$ per 100 g. aniline	Solid phase
-6.5	23.35	$\text{HgI}_2 \cdot 2\text{C}_6\text{H}_5\text{NH}_2$
+0.4	28.69	"
17.8	42.85	"
21.1	47.55	"
26.9	55.47	"
30.1	62.05	"
36.2	75.80	"
42.9	96.49	"
46.8*	....	" + $\text{HgI}_2$ (red)
48.8	128.1	$\text{HgI}_2$ (red)
63.6	163.8	"
70.82	184.1	"
76.2	201.6	"
95.9	246.7	"
108.*	....	$\text{HgI}_2$ (red) + $\text{HgI}_2$ (yellow)
115.7	281.8	$\text{HgI}_2$ (yellow)
137.2	285.2	"
181.1	279	"
199.1	863.2	"

\* Transition point.

(Pearce and Fry, J. phys. Ch. 1914, 18. 667.)

Very sol. in boiling alcoholic solution of aniline. (Vohl, Dissert. 1871.)

Abundantly sol. in hot benzonitrile and other aromatic nitriles. (Werner, Z. anorg. 1897, 15. 7.)

Sol. in benzonitrile (0.98 g. in 100 g. at  $18^\circ$ ). 20 times more sol. by addition of 5 g. KI to 100 cc. benzonitrile. (Naumann, B. 1914, 47. 1375.)

Sol. in pyridine. (Naumann, B. 1904, 37. 4609.)

Solubility of  $\text{HgI}_2$  in pyridine.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
5	$10^\circ$	34.6	$107^\circ$	51.3	$93.5^\circ$
9.8	42.5	38.0	103	51.6	96
15.14	66.5	43.0	97	52.7	108
19.3	83	46.7	88.5	53.2	109
26.3	102.5	48.5	89	55.4	122
29.6	107	50.6	89	57.9	135

(Staronka, Ans. Ak. Wiss. Krakau, 1910. 372.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{HgI}_2$  + pyridine containing 10.43%  $\text{HgI}_2$  = 1.1482; containing 7.99% = 1.1053. (Schönrock, Z. phys. Ch. 1893, 11. 770.)

Solubility of  $\text{HgI}_2$  in quinoline.

S = temp. of solidification.

Mols. per 100	S	Mols. per 100	S	Mols. per 100	S
4.7	$100^\circ$	29.8	$151^\circ$	43.0	$165^\circ$
9.1	115.5	31.4	153	46.1	167
13.2	133.5	35.4	156	48.8	170
23.1	138	37.7	160	49.5	169.5
26.7	145	41.6	165	54.4	166.5

(Staronka, Ans. Ak. Wiss. Krakau, 1910. 372.)

Mol. weight determined in pyridine, methyl- and ethyl-sulphide. (Werner, Z. anorg. 1897, 15. 20.)

More or less sol. at high temp. in petroleum (bpt.  $160$ – $230^\circ$ ), bromnaphthalene, pyridine, toluidine and amyl alcohol. (Reinders, Z. phys. Ch. 1900, 32. 503.)

Yellow modification.

100 g. of sat. solution in acetone at  $25^\circ$  contain 3.0 g.  $\text{HgI}_2$ . (Reinders, Z. phys. Ch. 1900, 32. 514.)

Red modification.

Solubility in alcohol equals:

0.717–0.724 g. in 100 g. solution at  $0^\circ$ 1.044–1.084 g. " " "  $25^\circ$ 2.10–2.20 g. " " "  $50^\circ$ 

(Reinders, Z. phys. Ch. 1900, 32. 522.)

100 g. of sat. solution in acetone at  $25^\circ$  contain 1.95 g.  $\text{HgI}_2$ . (Reinders, Z. phys. Ch. 1900, 32. 514.)

$\text{HgI}_2$  is moderately sol. in abs. alcohol at its b.-pt. The solution has a decided yellow color. On cooling, yellow crystals separate out. They soon change to the red modification.

Readily sol. in hot amyl alcohol. Yellow crystals separate from the solution when cooled.

Readily sol. in allyl alcohol, forming a yellow solution, from which yellow crystals separate on cooling.

Sl. sol. in acetone, giving a yellow solution. On cooling yellow plates separate from the solution and rapidly turn red.

Sol in phenol at  $150^\circ\text{C}$ . Solution has yellow color and yellow crystals separate out on cooling.

Readily sol. in boiling benzene. Saturated solution is yellow. The yellow iodide separates out on cooling, and changes rapidly to the red.

Sol. in toluene giving yellow solution, from which yellow crystals separate on cooling. They rapidly change to red.

Readily sol. in naphthalene at temperatures above its transition point. Solution is yellow and on cooling yellow crystals separate out.

Readily sol. in hot pseudo-cumene giving a yellow solution. On cooling gives yellow crystals.

Readily sol. in ethyl iodide giving very

yellow solution, from which yellow crystals separate on cooling, which change to red rapidly.

Only sl. sol. in ethyl bromide, giving yellow solution from which yellow crystals separate on cooling, which change rather slowly to the red.

Sparingly sol. in isopropyl bromide.

Moderately sol. in isobutyl bromide, giving a pink solution from which yellow crystals separate on cooling, which change slowly to red.

Sl. sol. in ethylidene chloride. On sudden cooling at 18° the iodide crystallizes out in yellow plates, which quickly change to red.

Sparingly sol. in propyl chloride, giving a pink solution, from which yellow crystals separate on cooling.

Readily sol. in ethyl cyanide, giving a yellow solution. On cooling yellow crystals separate and rapidly change to red.

Moderately sol. in benzene cyanide, giving a deep yellow solution. On sudden cooling the solution deposits yellow crystals, which rapidly turn red.

Rapidly sol. in benzoic acid at high temperatures.

Sparingly sol. in ethyl acetate, giving yellow solution.

Sol. in ethyl propionate.

Very sol. in ethyl butyrate, giving a yellow solution. On cooling the iodide crystallized from the solution.

Sl. sol. in ethyl isobutyrate.

Readily sol. in methyl salicylate, giving a yellow solution.

Sparingly sol. in phenyl salicylate, giving yellow solution. On cooling yellow crystals separate out, which gradually change to red. (Kastle, *Am. Ch. J.* 1899, 22, 474.)

#### **Mercuriomercuric iodide, $\text{Hg}_4\text{I}_2 = \text{Hg}_2\text{I}_2$ , $2\text{HgI}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. Partially sol. in  $\text{KI} + \text{Aq.}$  in hot  $\text{NaCl}$ , and  $\text{NH}_4\text{Cl} + \text{Aq.}$  and in hot  $\text{HCl} + \text{Aq.}$  though very slowly. (Boullay, *A. ch.* (2) 34, 345.)

#### **Mercury periodide, $\text{HgI}_2$ .**

Sol. in  $\text{KI} + \text{Aq.}$  Decomp. by cold  $\text{H}_2\text{O}$  or alcohol. (Jørgensen, *J. pr.* (2) 2, 347.)

#### **Mercuric hydrogen iodide (Iodomeric acid), $\text{HI}$ , $\text{HgI}_2 = \text{HHgI}_2$ .**

Crystallizes from  $\text{HI} + \text{Aq.}$  (Boullay.)

Easily decomp. (Neumann, *M.* 10, 236.)

$3\text{HgI}_2$ ,  $2\text{HI} + \text{H}_2\text{O}$ . (François, *Dissert.* 1901.)

#### **Mercuric nickel iodide, $\text{HgI}_2$ , $\text{NiI}_2 + 6\text{H}_2\text{O}$ .**

Sol. in alcohol, ether, and acetone; not decomp. by  $\text{H}_2\text{O}$ . (Dobroserdoff, *C. C.* 1901, II, 332.)

$2\text{HgI}_2$ ,  $\text{NiI}_2 + 6\text{H}_2\text{O}$ . Hygroscopic; decomp. by  $\text{H}_2\text{O}$ ; sol. in acetone and ether. (Dobroserdoff, *C. C.* 1901, II, 332.)

#### **Mercuric potassium iodide, $\text{HgI}_2$ , $\text{KI} + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Deliquescent (v. Bonsdorff). Permanent; decomp. by  $\text{H}_2\text{O}$  into  $2\text{KI}$ ,  $\text{HgI}_2$ , and  $\text{HgI}_2$  (Boullay); sol. in alcohol, ether, and conc.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$ , but decomp. by other acids (Berthelot, *J. Pharm.* 14, 186). Sp. gr. of sat. solution in  $\text{H}_2\text{O} = 2.4$  to 3.1.

+ $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. Can be cryst. from alcohol. Very sl. sol. in dry ether. Very sol. in wet ether. (Marsh, *Chem. Soc.* 1910, 97, 2297.)

$\text{HgI}_2$ ,  $2\text{KI}$ . Sol. in  $\text{H}_2\text{O}$ . (Thomsen and Bloxam, *Chem. Soc.* 41, 379.)

Sat. solution of  $\text{KI} + \text{HgI}_2$  in  $\text{H}_2\text{O}$  at 22.9° contains 8.66% K, 22.49% Hg and 52.48% I, corresponding to 0.22 mol. K, 0.11 mol. Hg and 0.45 mol. I. (Dubois, *C. R.* 1905, 141, 385.)

Sp. gr. at 16°/4° of aqueous solution containing 12.2875% salt = 1.10148; containing 12.2371% = 1.1038; containing 7.9843% = 1.06491. (Schönrock, *Z. phys. Ch.* 1893, 11, 782.)

Sol. in methyl acetate. (Bezold, *Dissert.* 1906.)

Sol. in ethyl acetate. (Alexander, *Dissert.* 1899; Hamers, *Dissert.* 1906.)

Sol. in acetone. (Eidmann, *C. C.* 1899, II, 1014; Naumann, *B.* 1904, 37, 4328.)

Sol. in methyl acetate (Naumann, *B.* 1909, 42, 3790); ethyl acetate. (Naumann, *B.* 1904, 37, 3601.)

+ $2\text{H}_2\text{O}$ . Sol. in alcohol, ether and acetone; decomp. by  $\text{H}_2\text{O}$ . (Pawlow, *C. C.* 1901, I, 363.)

Solubility determinations show that  $\text{KHgI}_2$  and  $\text{KHgI}_2 + \text{H}_2\text{O}$  are the only double salts formed at 20°–30°. See  $\text{HgI}_2 + \text{KI}$  under  $\text{HgI}_2$ . (Dunningham, *Chem. Soc.* 1914, 105, 368.)

#### **Mercuric rubidium iodide, $\text{HgI}_2$ , $\text{RbI}$ .**

Sol. in alcohol; decomp. by  $\text{H}_2\text{O}$ .

$\text{HgI}_2$ ,  $2\text{RbI}$ . Very easily sol. in  $\text{H}_2\text{O}$ . (Grossmann, *B.* 1904, 37, 1258.)

Very sol. in acetic acid and alcohol; decomp. by  $\text{H}_2\text{O}$ . Stable in aq. solution in the presence of an excess of  $\text{RbI}$ . (Erdmann, *Arch. Pharm.* 1894, 232, 30.)

#### **Mercuric silver iodide, $\text{HgI}_2$ , $2\text{AgI}$ .**

(Wegelius and Kilpi, *Z. anorg.* 1909, 61, 416.)

#### **Mercuric sodium iodide, $\text{HgI}_2$ , $\text{NaI}$ .**

Deliquescent, and decomp. by much  $\text{H}_2\text{O}$ . (v. Bonsdorff, *Pogg.* 17, 266.)

Sol. in alcohol; decomp. by  $\text{H}_2\text{O}$ .

$\text{HgI}_2$ ,  $2\text{NaI}$ . Deliquescent; sol. in  $\text{H}_2\text{O}$  and alcohol. (Boullay.)

Sat. solution of  $\text{NaI} + \text{HgI}_2$  in  $\text{H}_2\text{O}$  at 24.75° contains 4.59% Na, 25% Hg, and 58.25% I, corresponding to 0.20 mol. Na,

0.12 mol. Hg, and 0.45 mol. I. (Duboin, C. R. 1905, **141**, 385.)

+4H<sub>2</sub>O. Extremely deliquescent. (Duboin, C. R. 1906, **143**, 314.)

**Mercuric strontium iodide**, HgI<sub>2</sub>, SrI<sub>2</sub> (?).

Sol. in H<sub>2</sub>O without decomp. (Boullay.)

+8H<sub>2</sub>O. As Ca salt. (Duboin, C. R. 1906, **142**, 573.)

2HgI<sub>2</sub>, SrI<sub>2</sub> (?). Decomp. by much H<sub>2</sub>O into sol. HgI<sub>2</sub>, SrI<sub>2</sub>, and insol. HgI<sub>2</sub>. (Boullay.)

**Mercuric thorium iodide**, 5HgI<sub>2</sub>, ThI<sub>4</sub>+18H<sub>2</sub>O.

Very deliquescent. Easily decomp. by H<sub>2</sub>O. (Duboin, A. ch. 1909, (8) **16**, 282.)

5HgI<sub>2</sub>, 2ThI<sub>4</sub>+21H<sub>2</sub>O. (Duboin.)

2HgI<sub>2</sub>, ThI<sub>4</sub>+12H<sub>2</sub>O. (Duboin.)

**Mercuric zinc iodide.**

Deliquescent. Decomp. by H<sub>2</sub>O. (v. Bonsdorff.)

**Mercuric iodide ammonia**, HgI<sub>2</sub>, 2NH<sub>3</sub>.

Decomp. by NH<sub>3</sub>, giving NH<sub>4</sub>I and NH<sub>4</sub>I. (François, C. R. 1900, **130**, 333.)

Stable only in the presence of excess of ammonia. Gives off NH<sub>3</sub> in the air. (François, J. Pharm. 1897, (6) **5**, 388; C. C. 1897, I. 1088.)

**Mercuric iodide hydrazine**, HgI<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>.

Decomp. by H<sub>2</sub>O. (Hofmann and Marburg, A. 1899, **305**, 215.)

**Mercuric iodide rubidium bromide**,

HgI<sub>2</sub>, 2RbBr.

Decomp. by H<sub>2</sub>O.

Sol. in alcohol without decomp. (Grosman, B. 1903, **36**, 1603.)

**Mercuric iodide silver chloride**, HgI<sub>2</sub>, 2AgCl.

Insol. in H<sub>2</sub>O. (Lea, Sill. Am. J. (3) **7**, 34.)

**Mercury iodoantimonide**, Hg<sub>2</sub>Sb<sub>2</sub>2HgI<sub>2</sub>.

Sol. in HNO<sub>3</sub>, aqua regia and hot H<sub>2</sub>SO<sub>4</sub>; insol. in HCl. (Granger, C. R. 1901, **132**, 1116.)

**Mercury nitride**, Hg<sub>2</sub>N<sub>2</sub>.

Gradually decomp. by H<sub>2</sub>O. Decomp. by conc. HNO<sub>3</sub>, or HCl+Aq. (Hirzel, J. B. 1852, 419.)

Not attacked by cold, but decomp. by hot dil. H<sub>2</sub>SO<sub>4</sub>.

Sol. in acids+Aq.

Sol. in ammoniacal solutions of ammonium salts.

Insol. in excess of KNH<sub>2</sub>. (Franklin, Z. anorg. 1905, **46**, 18.)

Sol. in ammonia solutions of ammonium salts and in aq. acid solutions.

Very explosive. (Franklin, J. Am. Chem. Soc. 1905, **27**, 835.)

HgN<sub>2</sub>.

See **Mercurous azoimide**.

HgN<sub>2</sub>.

See **Mercuric azoimide**.

**Mercurous oxide**, Hg<sub>2</sub>O.

Insol. in H<sub>2</sub>O. Insol. in dil. HCl or HNO<sub>3</sub>, +Aq. Sol. in warm conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq.

Sol. in 150,000 pts. H<sub>2</sub>O. (Bhaduri, Z. anorg. 1897, **13**, 410.)

Decomp. by H<sub>2</sub>O or weak bases (Rose), (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq (Wittstein), KNO<sub>3</sub>+Aq (Rose), KI+Aq (Berthelot), or conc. NH<sub>4</sub>Cl+Aq (Pagenstecher) into HgO and Hg, or HgCl<sub>2</sub>, etc.

Sl. decomp. by alkali chlorides+Aq with formation of HgCl<sub>2</sub>, which dissolves. (Miahle.)

Sl. sol. in alkali cyanides+Aq. (Jahn.)

Insol. in KOH, and NaOH+Aq.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, **20**, 829.)

Insol. in alcohol and ether.

**Mercuric oxide**, HgO.

Sol. in 20,000 to 30,000 pts. H<sub>2</sub>O. (Bineau, C. R. **41**, 509.)

Sol. in 200,000 pts. H<sub>2</sub>O. (Wallace, Ch. Gaz. 1858, 345.)

Ordinary coarse HgO is sol. in H<sub>2</sub>O to the extent of 50 mg. per l. at 25°, but when finely powdered the solubility increases to 150 mg. per l. (Hulett, Z. phys. Ch. 1901, **37**, 406.)

Red modification is:—

Sol. in 19,500 pts. H<sub>2</sub>O at 25°; in 2,600 pts. H<sub>2</sub>O at 100°. (Schick, Z. phys. Ch. 1903, **42**, 172.)

1 l. H<sub>2</sub>O dissolves 50 mg. red modification of HgO at 25°. (Hulett, Z. phys. Ch. 1901, **37**, 406.)

Yellow modification is:—

Sol. in 19,300 pts. H<sub>2</sub>O at 25°; in 2400 pts. at 100°. (Schick, Z. phys. Ch. 1903, **42**, 172.)

Sol. in acids. Insol. in H<sub>3</sub>PO<sub>4</sub>, or H<sub>2</sub>AsO<sub>4</sub>+Aq. (Haack, A. **262**, 190.)

Scarcely attacked by H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>+Aq. (Millon, A. ch. (3) **18**, 352.)

Solubility of HgO in HF at 25°.

Hg=g-atoms Hg in 1 l. of the solution.

HF normal	Hg
0.12	0.01258
0.24	0.0247
0.57	0.0629
1.11	0.1168
2.17	0.2586

(Jaeger, Z. anorg. 1901, **37**, 26.)

Solubility of  $\text{HgO}$  in  $\text{HF}$  is decreased by the addition of  $\text{KF}$ , which proves the non-existence of complex fluorides. (Jaeger.)

Insol. in  $\text{H}_2\text{AsO}_4$ ,  $\text{H}_2\text{PO}_4$ , and in primary and secondary alkali salts of these acids. (Haack, A. 1891, 262. 190.)

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , less in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$ .

Decomp. by alkali chlorides +  $\text{Aq}$  into  $\text{HgCl}_2$ , which dissolves. (Miahle, A. ch. (3) 5. 177.)

Sol. in  $\text{Fe}(\text{NO}_3)_3$  and  $\text{Bi}(\text{NO}_3)_3 + \text{Aq}$  with pptn. of oxides. Sol. in  $\text{KI} + \text{Aq}$ . (Persoz.)

Very sol. in acid sulphites +  $\text{Aq}$ . (Barth, Z. phys. Ch. 1892, 9. 192.)

Completely sol. in conc.  $\text{CaCl}_2$ ,  $\text{BaCl}_2$ ,  $\text{MgCl}_2$ , and  $\text{SrCl}_2 + \text{Aq}$ . (André, C. R. 1887, 104. 431.)

Solubility in  $\text{Ag}$  salts +  $\text{Aq}$ . 100 g.  $\text{Ag}_2\text{SO}_4$  in aqueous solution dissolve 13 g.  $\text{HgO}$ . Solubility in  $\text{AgNO}_3 + \text{Aq}$  is 15.6 : 100; in  $\text{Ag}$  acetate +  $\text{Aq}$  is 1.137 : 100. (Finci, Gazz. ch. it. 1911, 41. (2) 545.)

Much less sol. in  $\text{KCl}$  and  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Schoch.)

Sol. in  $\text{U}(\text{NO}_3)_4$ ,  $\text{Al}(\text{NO}_3)_3$  and  $\text{Fe}(\text{NO}_3)_3 + \text{Aq}$ . (Mailhe, A. ch. 1902, (7) 27. 373.)

Very sl. sol. in cold  $\text{Hg}(\text{CN})_2 + \text{Aq}$ , abundantly sol. at  $75^\circ$  with evolution of  $\text{HCN}$ . (Barthe, J. Pharm. 1896, (6) 3. 183.)

Sol. in cold or hot alcoholic  $\text{NH}_4\text{SCN}$  in large amounts. (Fleischer, A. 1875, 179. 225.)

Completely sol. in  $\text{KI} + \text{Aq}$ . (Jehn, Arch. Pharm. 1873, 201. 97.)

Solubility of red or yellow modification in  $\text{N}/50 \text{ KCl} + \text{Aq}$  is about 25% greater than in pure  $\text{H}_2\text{O}$ . (Schiek, Z. phys. Ch. 1903, 42. 168.)

Insol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46. 2.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in alcoholic solution of hydroxylamine hydrobromide below  $0^\circ$ . (Adams, Am. Ch. J. 1902, 28. 216.)

Insol. in alcohol.

Sol. in trichloroacetic acid +  $\text{Aq}$ . (Brand, J. pr. 1913, (2) 88. 342.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

When freshly pptd., is insol. in acetone +  $\text{Aq}$ . even on warming, but easily sol. if liquid is made alkaline by  $\text{NaOH}$ . Insol. in acetophenone even after long warming at  $100^\circ$ . Sol. in acetaldehyde and much  $\text{H}_2\text{O}$  and a little  $\text{NaOH}$ . (Auld and Hantzsch, B. 1905, 33. 2680.)

Sol. in formamide. (Fischer, Arch. Pharm. 1894, 232. 329.)

Very sol. in ethylene diamine. For 1 mol.

$\text{HgO}$ , 7-10 mols. ethylene diamine are necessary. (Traube and Löwe, B. 1914, 47. 1910.)

Easily sol. in benzamide. (Deessaignes, A. ch. 1852, (3) 34. 146.)

When freshly pptd., is sol. in picric acid +  $\text{Aq}$ . (Varet, C. R. 1894, 119. 560.)

Sol. in alkaline solution of phenol disulphonic acid. (Lumière and Chevrotier, C. R. 1901, 132. 145.)

Sol. in nucleic acid +  $\text{Aq}$  when freshly pptd. (Schweckerath, Pat. 1899.)

Sol. in gum arabic +  $\text{Aq}$ . (Peschier, J. Pharm. 1896, (6) 3. 509.)

### Mercuric oxybromide, $\text{HgBr}_2$ , $\text{HgO}$ .

(André, A. ch. (6) 3. 123.)

$\text{HgBr}_2$ ,  $2\text{HgO}$ . (André.)

$\text{HgBr}_2$ ,  $3\text{HgO}$ . (a) Yellow. Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . Easily sol. in alcohol. (Löwig.)

(b) Brown. Insol. in alcohol. (Rammelsberg, Pogg. 55. 248.)

$\text{HgBr}_2$ ,  $4\text{HgO}$ . (André.)

Insol. in ord. solvents. Decomp. by alkalis and acids. (Fischer and von Wartenburg, Ch. Z. 1902, 26. 894.)

$2\text{HgBr}_2$ ,  $7\text{HgO}$ . Readily decomp. by acids and alkalis. (Fischer and von Wartenburg.)

### Mercurous oxychloride, $\text{Hg}_2\text{O}$ , $2\text{HgCl}$ .

Min. *Eglestonite*.

Decomp. by hot  $\text{HCl}$  and by  $\text{HNO}_3$ . (Moses, Am. J. Sci. 1903, (4) 16. 253.)

### Mercuric oxychloride,

$\text{HgO}$ ,  $\text{HgCl}_2$ . Less sol. than  $\text{HgCl}_2$ , but not isolated. (Thümmel.) Decomp. by cold  $\text{H}_2\text{O}$ . (André, A. ch. (6) 3. 118.)

$\text{HgO}$ ,  $2\text{HgCl}_2$ . Decomp. by warm  $\text{H}_2\text{O}$  or cold alcohol into  $2\text{HgO}$ ,  $\text{HgCl}_2$ . (Thümmel, Arch. Pharm. (3) 27. 589.)

Decomp. by  $\text{H}_2\text{O}$ . Not decomp. by alcohol. (Arotowski, Z. anorg. 1895, 9. 178.)

$2\text{HgO}$ ,  $\text{HgCl}_2$ . Two modifications.

A. Red. Insol. in  $\text{H}_2\text{O}$ ; decomp. by alkali carbonates, or chlorides +  $\text{Aq}$  into  $4\text{HgO}$ ,  $\text{HgCl}_2$ .

Acted upon by cold alkali carbonates and alkali chlorides +  $\text{Aq}$ . (Schoch, Am. Ch. J. 1903, 29. 335.)

Not decomp. by  $\text{H}_2\text{O}$  at ord. temp. (Thümmel.)

Very sl. sol. in cold, completely sol. in hot  $\text{H}_2\text{O}$ . (Haack, A. 1891, 262. 189.)

A small amt. of  $\text{HNO}_3$  converts it into a white powder; more  $\text{HNO}_3$  dissolves it. (Haack, A. 1891, 262. 189.)

B. Black. Not decomp. by alkali chlorides, or carbonates +  $\text{Aq}$ . (Thümmel.)

Not affected by boiling alkali carbonates or alkali chlorides +  $\text{Aq}$ . (Schoch, Am. Ch. J. 1901, 29. 335.)

Insol. in cold and hot  $\text{H}_2\text{O}$  and alcohol.

Sol. in acid. (Van Nest, Dissert. 1909.)

Not changed by  $\text{H}_2\text{O}$ . (Blaas, Miner. Mitt. (2) 2. 177.)

Sol. in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq.}^*$  (Blaas.)  
 Not changed by alcohol. (Blaas.)  
 $+ \frac{1}{2} \text{H}_2\text{O}$ . (Ray, A. 1901, 316. 255.)  
 $3\text{HgO}$ ,  $\text{HgCl}_2$ . Decomp. by warm  $\text{H}_2\text{O}$ .  
 (Thümmel.)

Not attacked by cold  $\text{H}_2\text{O}$ . (André.)  
 Ppt. (Tarugi, Gazz. ch. it. 1901, 31. 313.)  
 Decomp. by  $\text{H}_2\text{O}$ . Not decomp. by alcohol. (Arcetowski, Z. anorg. 1895, 9. 178.)

Three modifications.

a. Prisms. Decomp. by boiling  $\text{H}_2\text{O}$ .

b. Brick-red, amorphous.

c. Yellow plates.

(Schoch, Am. Ch. J. 1903, 29. 337.)

Yellow plates.

Decomp. by hot  $\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3$  or  $\text{NaOH} + \text{Aq}$ . Sol. in  $\text{KHCO}_3 + \text{Aq}$ . Insol. in cold dil.  $\text{HNO}_3$ . (Tarugi.)

$4\text{HgO}$ ,  $\text{HgCl}_2$ . Decomp. by  $\text{H}_2\text{O}$ . Not decomp. by alcohol. (Arcetowski, Z. anorg. 1895, 9. 178.)

Two modifications.

A. Yellow plates.

Easily sol. in acids. Insol. in alcohol and ether. Decomp. by  $\text{KOH}$ . (Dukelski, Z. anorg. 1906, 49. 336.)

B. Brown, amorphous.

Easily sol. in acids. Decomp. by  $\text{KOH}$ . Insol. in alcohol and ether. (Dukelski, Z. anorg. 1906, 49. 336.)

$5\text{HgO}$ ,  $\text{HgCl}_2$ . (Millon.)

Does not exist. (Thümmel.)

$6\text{HgO}$ ,  $\text{HgCl}_2$ . Does not exist. (T.)

$+ \text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ . (Roucher, A. ch. (3) 27. 353.)

Does not exist. (T.)

$7\text{HgO}$ ,  $4\text{HgCl}_2$ . (Roucher.)

Does not exist. (T.)

**Mercuriomercuric oxychloride**,  $\text{Hg}_2\text{OCl}$ .

Min. *Terlinguinite*.

Decomp. by  $\text{HCl}$  and  $\text{HNO}_3$ .

Slowly decomp. by cold acetic acid when powdered. (Hillebrand and Schaller, J. Am. Chem. Soc. 1907, 29. 1190.)

**Mercuric strontium oxychloride**,  $\text{HgO}$ ,  $\text{SrCl}_2$ ,  $+ 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (André, C. R. 104. 431.)

**Mercuric oxyfluoride**,  $\text{HgO}$ ,  $\text{HgF}_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Finkener.)

**Mercuric oxyiodide**,  $3\text{HgO}$ ,  $\text{HgI}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HI} + \text{Aq}$ . (Weyl, Pogg. 131. 524.)

**Mercuric oxyphosphide**,  $\text{Hg}_3\text{P}_2\text{O}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Partheil and van Haaren, Arch. Pharm. 1900, 238. 35.)

**Mercuric oxyselenide**,  $2\text{HgSe}$ ,  $\text{HgO}$ .

Easily sol. in aqua regia. (Uelsmann, A. 116. 122.)

**Mercury phosphide**,  $\text{Hg}_3\text{P}_2$ .

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . Easily sol. in aqua regia. (Granger, C. R. 115. 229.)  $\text{Hg}_3\text{P}_4$ . (Granger, C. N. 1898, 77. 229.)

**Mercury phosphochloride**,  $\text{P}_2\text{Hg}_3$ ,  $3\text{HgCl}_2 + 3\text{H}_2\text{O}$ .

See Dimercuriphosphonium mercuric chloride.

**Mercury phosphosulphide**,  $2\text{HgS}$ ,  $\text{P}_2\text{S}_3$ .

$\text{HgS}$ ,  $\text{P}_2\text{S}_3$ .

$2\text{HgS}$ ,  $\text{P}_2\text{S}_3$ . (Berzelius.)

$3\text{HgS}$ ,  $\text{P}_2\text{S}_3$ . (Baudrimont, C. R. 55. 323.)

$2\text{HgS}$ ,  $\text{P}_2\text{S}_3$ . (Berzelius, A. 47. 256.)

**Mercuric selenide**,  $\text{HgSe}$ .

Sol. in cold aqua regia when crystalline. When precipitated shows the same properties towards solvents as mercuric sulphide. (Reeb J. Pharm. (4) 9. 173.)

Min. *Tilmannite*. Sol. only in aqua regia.

**Mercuric selenochloride**,  $2\text{HgSe}$ ,  $\text{HgCl}_2$ .

Insol. in boiling  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in aqua regia and a mixture of  $\text{H}_2\text{SO}_4$  and conc.  $\text{HNO}_3 + \text{Aq}$ . (Uelsmann, J. B. 1860. 92.)

**Mercurous sulphide**,  $\text{Hg}_2\text{S}$ .

Insol. in  $\text{H}_2\text{O}$ , dil.  $\text{HNO}_3$ , hot  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sol. in  $\text{KOH} + \text{Aq}$  with separation of  $\text{Hg}$ . (Rose.)

Does not exist; only mixtures of  $\text{Hg}$  and  $\text{HgS}$  are formed. (Barfoed, J. pr. 93. 230.)

See also Baskerville, J. Am. Chem. Soc. 1903, 25. 799.)

Not attacked by  $\text{HNO}_3$  below  $0^\circ$ , but attacked by dil.  $\text{HNO}_3$  and  $\text{HCl} + \text{Aq}$  when temp. is increased. Sol. in  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S}$  but  $\text{Hg}$  soon ppts. (Antony and Sestini, Gazz. ch. it. 1894, 24, (1) 194.)

**Mercuric sulphide**,  $\text{HgS}$ .

Insol. in  $\text{H}_2\text{O}$ .

Pptd. as a brown coloration in presence of 20,000 pts.  $\text{H}_2\text{O}$ , and as a green coloration in presence of 40,000 pts.  $\text{H}_2\text{O}$ . (Lassaigne.)

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{Ag}_2\text{S}$  or  $\text{Cu}_2\text{S}$ . (Bodländer, Z. phys. Ch. 1898, 27. 64.)

1 l.  $\text{H}_2\text{O}$  dissolves  $0.05 \times 10^{-4}$  mols  $\text{HgS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 53. 294.)

Sol. in cold conc., and in hot dil.  $\text{HI} + \text{Aq}$  or  $\text{HBr} + \text{Aq}$ . (Kekulé, A. Suppl. 2. 101.) Very sl. decomp. by hot conc.  $\text{HCl} + \text{Aq}$ . Not attacked by hot  $\text{HNO}_3 + \text{Aq}$ . Sol. in cold aqua regia.

Not attacked by 4-N  $\text{HNO}_3$ , or 4-N  $\text{HNO}_3 + 4\text{-N } \text{H}_2\text{SO}_4$  at ord. temp. even after many days. By action of a mixture of equal volumes of 4-N  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ , there was slight action on pptd.  $\text{HgS}$  after 14, more action after 62 days. If  $\text{HgS}$  is boiled with the 4-N acids, oxidation takes place most rapidly with 4-N  $\text{HNO}_3$ , then the mixture 66.7% 4-N  $\text{H}_2\text{SO}_4 + 33.3\%$  4-N  $\text{HNO}_3$ , then

33.3% 4-N  $\text{H}_2\text{SO}_4$  + 66.7% 4-N  $\text{HNO}_3$ , and lastly 4-N  $\text{H}_2\text{SO}_4$  alone. (Moore, J. Am. Chem. Soc. 1911, **33**, 1094.)

Cold conc.  $\text{H}_2\text{SO}_4$  does not attack red or black  $\text{HgS}$ , but they are attacked by hot acid. (Berthelot, A. ch. 1898, (7) **14**, 198.)

Freshly pptd.  $\text{HgS}$  is insol. in dil.  $\text{KCN}$  +  $\text{Aq}$ . (Berthelot.)

Sol. in  $\text{K}_2\text{S}$  +  $\text{Aq}$ , but readily only in presence of free alkali. (Brunner, Pogg. **15**, 596.) Insol. in boiling  $\text{KOH}$  +  $\text{Aq}$ .

Sol. in  $\text{KSH}$  or  $\text{NaSH}$  +  $\text{Aq}$ . Very sl. sol. in cold yellow  $(\text{NH}_4)_2\text{S}$  +  $\text{Aq}$ . Insol. in  $\text{KCN}$  or  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ . (Fresenius.)

Easily sol. in conc.  $\text{Na}_2\text{S}$  or  $\text{K}_2\text{S}$  +  $\text{Aq}$ , even in absence of  $\text{KOH}$  or  $\text{NaOH}$ . Insol. in  $(\text{NH}_4)_2\text{S}$  +  $\text{Aq}$ . Sol. in  $\text{CaS}$ ,  $\text{BaS}$ , or  $\text{SrS}$  +  $\text{Aq}$ . Insol. in  $\text{NaSH}$  or  $\text{KSH}$  +  $\text{Aq}$ . (de Koninck, Z. angew. Ch. 1891, **51**.)

Solubility in  $\text{NaSH}$  is very small in comparison with that in  $\text{Na}_2\text{S}$  +  $\text{Aq}$ . (Knox, Trans. Faraday Soc. 1908, **4**, 30.)

Solubility in  $\text{BaS}$  is practically equal to that in  $\text{Na}_2\text{S}$ . (Knox.)

All cryst. modifications are sol. in conc.  $\text{K}_2\text{S}$  and in conc.  $\text{Na}_2\text{S}$  +  $\text{Aq}$ . (Allen and Crenshaw, Am. J. Sci. 1912, (4) **34**, 368.)

Sol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenbladt, Z. anal. **26**, 15.)

Sol. in alkali sulpho-molybdates, -tungstates, -vanadates, -arsenates, -antimonates, and -stannates. (Storch, B. **16**, 2015.)

1 l.  $\text{BaS}_2\text{H}_2$  +  $\text{Aq}$  containing 50 g.  $\text{Ba}$  dissolves no  $\text{HgS}$  in the cold, but 50-60 g. at 40-50°.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, **20**, 829.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**, 314.)

Exists in a colloidal state, sol. in  $\text{H}_2\text{O}$ . (Winninger, Bull. Soc. (2) **49**, 452.)

Min. *Cinnabar*. Insol. in  $\text{H}_2\text{O}$ , alcohol, dil. acids, or alkaline solutions.

Decomp. by hot dil.  $\text{HNO}_3$  +  $\text{Aq}$ . Not decomp. by  $\text{HCl}$  +  $\text{Aq}$ , but easily by hot  $\text{H}_2\text{SO}_4$  or aqua regia. Easily sol. in  $\text{CuCl}_2$  +  $\text{Aq}$ . (Karsten.)

Sol. in a mixture of  $\text{Na}_2\text{S}$  and  $\text{NaOH}$  when present in the proportion of  $\text{HgS} : 2\text{Na}_2\text{S}$ .

Sol. in pure  $\text{Na}_2\text{S}$  +  $\text{Aq}$  or in mixtures of  $\text{Na}_2\text{S}$  and  $\text{NaSH}$  +  $\text{Aq}$ . Insol. in cold  $\text{NaSH}$  +  $\text{Aq}$ , but sol. on warming with evolution of  $\text{H}_2\text{S}$ . (Becker, Sill. Am. J. (3) **33**, 199.)

Insol. in acetone. (Krug and M'Elroy.)

*Cinnabar* is easily sol. in 20%  $\text{HBr}$  +  $\text{Aq}$ . (Rising and Lenher, J. Am. Chem. Soc. 1896, **18**, 96.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Smith, J. Am. Chem. Soc. 1898, **20**, 291.)

#### Mercuric platinum sulphide.

See Sulphoplatinate, mercuric.

#### Mercuric potassium sulphide, $\text{K}_2\text{S}$ , $2\text{HgS}$ .

Decomp. into its constituents by  $\text{H}_2\text{O}$ ; decomp. by  $\text{HCl}$  and  $\text{HNO}_3$  +  $\text{Aq}$ , and by hot  $\text{KOH}$  and  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ . (Schneider, Pogg. **127**, 488.)

$\text{K}_2\text{S}$ ,  $\text{HgS}$  +  $5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  or alkalies. (Weber, Pogg. **97**, 76.)

+  $\text{H}_2\text{O}$ . (Ditte.)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{K}_2\text{S}$  +  $\text{Aq}$ . (Ditte, C. R. **98**, 1271.)

$\text{K}_2\text{S}$ ,  $5\text{HgS}$  +  $5\text{H}_2\text{O}$ . Easily decomp. by  $\text{H}_2\text{O}$ . (Ditte.)

#### Mercuric sodium sulphide, $\text{HgS}$ , $\text{Na}_2\text{S}$ + $8\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alkalies.

$5\text{HgS}$ ,  $2\text{Na}_2\text{S}$  +  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Knox, Trans. Faraday Soc. 1908, **4**, 36.)

#### Mercuric sulphobromide, $2\text{HgS}$ , $\text{HgBr}_2$ .

Insol. in  $\text{H}_2\text{O}$ . Not attacked by boiling  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . (Rose.)

#### Mercuric sulphochloride, $2\text{HgS}$ , $\text{HgCl}_2$ .

Insol. in  $\text{H}_2\text{O}$ , cold or hot, dil. or conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl}$  +  $\text{Aq}$ . (Rose, Pogg. **13**, 59.)

Decomp. by hot aqua regia.

By boiling with dil.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ ,  $\text{Hg}$  and  $\text{Cl}$  go into solution. (Hamers, Dissert. 1906.)

Insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ . Partly sol. in  $\text{HCl}$  and  $\text{HNO}_3$ ; easily sol. in aqua regia. (Alexander, Dissert. 1899.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) **17**, 356.)

$3\text{HgS}$ ,  $\text{HgCl}_2$ . Properties as the above comp. (Poleck and Goercki, B. **21**, 2415.)

$4\text{HgS}$ ,  $\text{HgCl}_2$ . As above. (P. and G.)

$5\text{HgS}$ ,  $\text{HgCl}_2$ . As above. (P. and G.)

Insol. in alkali sulphides and in fuming  $\text{HNO}_3$ ; decomp. by  $\text{NaOBr}$  +  $\text{Aq}$  and by  $\text{KOH}$ . (Bodroux, C. R. 1900, **130**, 1399.)

Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides +  $\text{Aq}$ ; slowly sol. in alkalies or alkali hydrosulphides +  $\text{Aq}$ . (Atterberg, J. B. 1873, 258.)

#### Mercurous sulphotetrachloride, $\text{Hg}_2\text{SCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{S}$ ,  $\text{HgCl}_2$  going into solution. (Capitaine, J. Pharm. **25**, 525.)

#### Mercuric sulphofluoride, $2\text{HgS}$ , $\text{HgF}_2$ .

Decomp. by boiling  $\text{H}_2\text{O}$ . Not decomp. by hot  $\text{HCl}$  or  $\text{HNO}_3$  +  $\text{Aq}$ , but gives  $\text{HF}$  with hot  $\text{H}_2\text{SO}_4$  +  $\text{Aq}$ . (Rose, Pogg. **13**, 66.)

#### Mercury sulphoimide, $\text{HgN}_2\text{S}$ , $\text{NH}_3$ .

Ppt. (Ruff, B. 1904, **37**, 1585.)

#### Mercuric sulphoiodide, $\text{HgS}$ , $\text{HgI}_2$ .

Ppt. (Rammelsberg, Pogg. **48**, 175.)

$2\text{HgS}$ ,  $\text{HgI}_2$ . (Palm, C. C. 1863, 121.)

Insol. in min. acids with exception of aqua regia. (Hamers, Dissert. 1906.)

**Mercuric sulphoiodide ammonia**,  $2\text{HgS}$ ,  $\text{HgI}_2$ ,  $\text{NH}_3$ .

(Foerster, Ch. Z. 1895, 19. 1895.)

**Mercuric telluride**,  $\text{HgTe}$ .

Min. *Coloradoite*. Sol. in boiling  $\text{HNO}_3$  + Aq with separation of  $\text{H}_2\text{TeO}_3$ .

**Metastannic acid**.

See Stannic acid.

**Molybdatoiodic acid**.

See Molybdoiodic acid.

**Molybdenum**, Mo.

Not attacked by  $\text{HCl}$ ,  $\text{HF}$ , or dil.  $\text{H}_2\text{SO}_4$  + Aq. Sol. in conc.  $\text{H}_2\text{SO}_4$ . Very easily sol. in aqua regia. Oxidised by  $\text{HNO}_3$  + Aq either to molybdenum oxide, which dissolves in  $\text{HNO}_3$ , or, if  $\text{HNO}_3$  is in excess, to molybdic acid, which remains undissolved.

Attacked by  $\text{HNO}_3$  + Aq containing 3-70%  $\text{HNO}_3$ , but only slowly by 70% acid, with formation of insol. white powder; much more vigorously by 50% acid, in which case a clear solution is formed. (Montemartini, Gazz. ch. it. 22. 384.)

Not attacked by alkalis + Aq. (Bucholz, Scher. J. 9. 485.)

With a sp. gr. 9.01, the metal is malleable and sol. in a mixture of  $\text{HF}$  and  $\text{HNO}_3$ ; sol. in fused  $\text{KClO}_3$ . (Moissan, Bull. Soc. 1895, (3) 13. 966.)

Ductile Mo is moderately quickly attacked by  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and  $\text{HCl}$ . (Fink, Met. Chem. Eng. 1910, 8. 341.)

Not immediately attacked by cold dil.  $\text{HNO}_3$ . Not attacked by dil. and conc.  $\text{H}_2\text{SO}_4$ . Boiling dil.  $\text{HCl}$  + Aq does not attack; conc. dissolves traces by long heating. Sol. in aqua regia. (Lederer, Dissert. 1911.)

Dil.  $\text{HCl}$  dissolves 20.3% Mo at  $110^\circ$  in 18 hrs. More slowly sol. in  $\text{HCl}$  (sp. gr. 1.15).

Insol. in dil.  $\text{H}_2\text{SO}_4$  at  $110^\circ$ . Slowly sol. in conc.  $\text{H}_2\text{SO}_4$  (sp. gr. 1.82) at  $110^\circ$ , rapidly sol. at  $200^\circ$ - $250^\circ$ .

Slowly sol. in conc.  $\text{HNO}_3$  (sp. gr. 1.40), rapidly sol. in dil.  $\text{HNO}_3$  (sp. gr. 1.15).

Rapidly sol. in hot aqua regia. Insol. in hot or cold  $\text{HF}$ . (Ruder, J. Am. Chem. Soc. 1912, 34. 388.)

Insol. in  $\text{KOH}$  + Aq. Sol. in fused  $\text{KOH}$ . (Ruder, J. Am. Chem. Soc. 1912, 34. 389.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

**Molybdenum acichloride**.

See Molybdenyl chloride.

**Molybdenum amide**,  $\text{OH} \cdot \text{MoO}_3 \cdot \text{NH}_3$ .

Very unstable. Insol. in abs. alcohol. (Fleck, Z. anorg. 1894, 7. 353.)

**Molybdenum amide nitride**,  $\text{Mo}_2\text{N}_3\text{H}_4 = 4\text{MoN}_3, \text{Mo}(\text{NH}_2)_2$ .

Not attacked by  $\text{HCl}$ , or dil.  $\text{HNO}_3$  + Aq. (Uhrlaub.)

**Molybdenum amidochloride**,  $\text{Mo}_2(\text{NH}_2)_2\text{Cl}_2$ .

Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Rosenheim, Z. anorg. 1905, 46. 317.)

**Molybdenum amidochloride ammonia**,  $\text{Mo}_2(\text{NH}_2)_2\text{Cl}_2, 10\text{NH}_3$ .

Unstable in the air. (Rosenheim, Z. anorg. 1905, 46. 319.)

**Molybdenum boride**,  $\text{Mo}_2\text{B}_4$ .

Moderately attacked by hot conc. acids and vigorously by hot aqua regia. (Tucker and Moody, Chem. Soc. 1902, 81. 17.)

**Molybdenum dibromide**,  $\text{MoBr}_2 = \text{Mo}_2\text{Br}_4\text{Br}_2$ .

See Bromomolybdenum bromide.

**Molybdenum tribromide**,  $\text{MoBr}_3$ .

Not decomp. by  $\text{H}_2\text{O}$ . Boiling conc.  $\text{HCl}$ , and cold dil.  $\text{HNO}_3$  + Aq do not attack appreciably. Dil. alkalis act slowly, but decomp. with separation of  $\text{Mo}_2\text{O}_3$  on boiling. (Blomstrand, J. pr. 82. 435.)

**Molybdenum tetrabromide**,  $\text{MoBr}_4$ .

Rapidly deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. 82. 433.)

**Molybdenum bromochloride**, etc.

See Bromomolybdenum chloride, etc.

**Molybdenum bronze**.

See Molybdate molybdenum oxide, sodium.

**Molybdenum carbide**,  $\text{Mo}_2\text{C}$ .

Insol. in  $\text{HNO}_3$ . (Moissan, Bull. Soc. 1895, (3) 13. 967.)

$\text{Mo}_2\text{C}$ . Does not decomp.  $\text{H}_2\text{O}$  even at  $500$ - $600^\circ$ . Slowly attacked by hot  $\text{HCl}$ ,  $\text{HF}$  and hot conc.  $\text{H}_2\text{SO}_4$ . Easily decomp. by  $\text{HNO}_3$ . Not attacked by  $\text{NaOH}$  + Aq or  $\text{KOH}$  + Aq. (Moissan and Hoffmann, C. R. 1904, 138. 1559.)

**Molybdenum carbonyl**,  $\text{Mo}(\text{CO})_4$ .

Quickly attacked by bromine. Sol. in ether or benzene. (Mond, Hirts and Cowap, Chem. Soc. 1910, 97. 808.)

**Molybdenum dichloride**,  $\text{MoCl}_2 = \text{Mo}_2\text{Cl}_4\text{Cl}_2$ .

See Chloromolybdenum chloride.

**Molybdenum trichloride,  $\text{MoCl}_3$ .**

Insol. in  $\text{H}_2\text{O}$  or boiling conc.  $\text{HCl} + \text{Aq.}$  Easily sol., especially when heated, in  $\text{HNO}_3 + \text{Aq.}$  Sol. in  $\text{H}_2\text{SO}_4$ . Decomp. by  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq.}$

Sl. sol. in alcohol. (Leichti and Kempe.)

Practically insol. in alcohol and ether. (Hampe, Ch. Z. 1888, 12. 5.)

**Molybdenum tetrachloride,  $\text{MoCl}_4$ .**

Deliquescent. Hisses with little  $\text{H}_2\text{O}$ , but only partly sol. in more  $\text{H}_2\text{O}$ . Only sl. sol. in conc.  $\text{HCl} + \text{Aq.}$  Sol. in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq.}$  Partly sol. in alcohol and ether. (Liechti and Kempe.)

**Molybdenum pentachloride,  $\text{MoCl}_5$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  with extreme evolution of heat. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

When freshly prepared, is incompletely sol. in  $\text{H}_2\text{O}$ , but after standing is easily sol. with hissing. (Kalischer, Dissert. 1902.)

Sol. in a small amt. of conc.  $\text{HCl}$ . (Hampe, Ch. Z. 1888, 12. 5.)

Sol. in absolute alcohol or ether. (Liechti and Kempe.)

Sol. in  $\text{CHCl}_3$  and in  $\text{CCl}_4$ . Sol. with hissing in many organic solvents (ethers, alcohols, ketones, aldehydes, acids, acid esters, acid anhydrides, amines). Sol. in cinnamic aldehyde. (Kalischer, Dissert. 1902.)

**Molybdenum hydroxyl chloride,  $\text{Mo}(\text{OH})_2\text{Cl}_2$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Debray, C. R. 46. 1101.)

**Molybdenum tetrachloride phosphorus pentachloride,  $\text{MoCl}_4, \text{PCl}_5$ .**

Sol. in  $\text{H}_2\text{O}$ .

$\text{MoCl}_4, 2\text{PCl}_5$ . Sol. in  $\text{H}_2\text{O}$ . (Cronander, Bull. Soc. (2) 19. 500.)

**Molybdenum phosphorus pentachloride,**

$\text{MoCl}_5, \text{PCl}_5$ .

Easily decomp. (Smith and Sargent, Z. anorg. 1894, 6. 385.)

**Molybdenum phosphoryl chloride,  $\text{MoCl}_5, \text{POCl}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in  $\text{CS}_2$ ; sol. in  $\text{C}_6\text{H}_6$  and  $\text{CHCl}_3$ .

**Molybdenum trichloride potassium chloride.**

Efflorescent. Decomp. with  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{MoCl}_3, 3\text{KCl}$ . Very sol. in  $\text{H}_2\text{O}$ . Nearly insol. in alcohol and ether. (Chilesotti, C. C. 1903, II. 652.)

$+2\text{H}_2\text{O}$ . Fairly easily sol. in cold  $\text{H}_2\text{O}$  without any apparent decomp. Decomp. in aqueous solution, slowly in the cold but rapidly on boiling. This decomp. is prevented by the presence of  $\text{HCl}$ .

Sl. sol. in conc.  $\text{HCl}$ . (Henderson, Proc. Chem. Soc. 1903, 19. 245.)

**Molybdenum rubidium chloride,  $\text{Rb}_2\text{MoCl}_6 + \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Nearly insol. in alcohol and ether. (Chilesotti, C. C. 1903, II. 652.)

**Molybdenum pentachloride nitrogen sulphide,  $\text{MoCl}_5, \text{N}_2\text{S}_4$ .**

Decomp. in moist air. (Davis, Chem. Soc. 1906, 89, (2) 1575.)

**Molybdenum hexafluoride,  $\text{MoF}_6$ .**

Decomp. by a little  $\text{H}_2\text{O}$  with separation of blue oxide. Sol. in large amount of  $\text{H}_2\text{O}$  forming a colorless solution.

Absorbed by alkalis and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Ruff, B. 1907, 40. 2930.)

**Molybdenum fluoride with  $\text{MF}$ .**

See Fluomolybdate,  $\text{M}$ .

**Molybdenum potassium trifluoride (?).**

Precipitate. Sol. in  $\text{HCl} + \text{Aq.}$

**Molybdenum potassium tetrafluoride (?).**

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Molybdenum sesquihydroxide,  $\text{Mo}_2\text{O}_5\text{H}_4$ .**

Difficultly sol. in acids. Insol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{K}_2\text{CO}_3 + \text{Aq.}$  Somewhat sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  but pptd. on boiling. (Berzelius.)

**Molybdenum hydroxide,  $\text{Mo}_2\text{O}_5, 5\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{CaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , or  $\text{NaCl} + \text{Aq.}$  Sl. sol. in alcohol. (Berzelius.)

**Molybdenum dihydroxide,  $\text{MoO}_3, x\text{H}_2\text{O}$ .**

Slowly and not abundantly sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl}$  and other salts. Gelatinises by standing in closed vessels or by evaporating on the air. Sol. in the ordinary acids. Insol. in  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq.}$  Sol. in alkali carbonates  $+ \text{Aq.}$

**Molybdenum diiodide,  $\text{MoI}_2$ .**

Insol. in  $\text{H}_2\text{O}$  and alcohol. Sl. attacked by cold  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . (Guichard, A. ch. 1901, (7) 23. 567.)

Sl. decomp.  $\text{H}_2\text{O}$  at ordinary temp. Slowly sol. in  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . (Guichard, C. R. 1896, 123. 822.)

**Molybdenum tetraiodide (?).**

Completely sol. in water. (Berzelius.)

**Molybdenum nitride,  $\text{Mo}_2\text{N}_3$ , and  $\text{Mo}_2\text{N}_4$ .**

(Uhrlaub.)

See Molybdenum amide.

$\text{Mo}_2\text{N}_3$ . (Rosenheim, Z. anorg. 1905, 46. 317.)



**Molybdenum monoxide, MoO.**

Known only as hydroxide. (Blomstrand, J. pr. 77. 90.)

**Molybdenum sesquioxide, Mo<sub>2</sub>O<sub>3</sub>.**

Insol. in acids or alkalis.

See **Molybdenum sesquihydroxide**.

**Molybdenum dioxide, MoO<sub>2</sub>.**

Insol. in HCl or HF + Aq. Sl. sol. in conc. H<sub>2</sub>SO<sub>4</sub>. HNO<sub>3</sub> oxidises to MoO<sub>3</sub>. Not attacked by KOH + Aq. (Ullik, A. 144. 227.)

Sl. sol. in KHC<sub>4</sub>H<sub>2</sub>O<sub>6</sub> + Aq.

**Molybdenum trioxide, MoO<sub>3</sub>.**

Sol. in 500 pts. cold, and much less hot H<sub>2</sub>O. (Bucholz.)

Sol. in 960 pts. hot H<sub>2</sub>O. (Hatchett.)

Sol. in 570 pts. cold, and much less hot H<sub>2</sub>O. (Dumas.)

Sol. in acids before ignition. Insol. in acids, but sl. sol. in acid potassium tartrate + Aq after ignition. Sol. in alkalis or alkali carbonates + Aq.

Sol. in NH<sub>4</sub>OH + Aq.

See also **Molybdic acid**.

Min. *Molybdic*. Sol. in HCl + Aq.

**Molybdenum oxide, Mo<sub>2</sub>O<sub>3</sub>.**

Sol. in H<sub>2</sub>SO<sub>4</sub> and HCl; only sl. sol. in H<sub>2</sub>SO<sub>4</sub>. (Klason, B. 1901, 34. 151.)

+ 3H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O (2 g. in 1 l.).

Insol. in NH<sub>4</sub>Cl + Aq. Insol. in caustic alkalis, somewhat sol. in NH<sub>4</sub>OH. Much more sol. in M<sub>2</sub>CO<sub>3</sub> + Aq and in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq. (Klason, B. 1901, 34. 150.)

Mo<sub>2</sub>O<sub>3</sub> + 3H<sub>2</sub>O. (Smith and Oberholtzer, Z. anorg. 1893, 4. 243.)

Mo<sub>2</sub>O<sub>3</sub> + 6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Bailhache, C. R. 1901, 133. 1212.)

Mo<sub>2</sub>O<sub>3</sub> + 6H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Guichard, C. R. 1900, 131. 419.)

Mo<sub>7</sub>O<sub>20</sub>. Sol. in H<sub>2</sub>O. (Junius, Z. anorg. 1905, 46. 447.)

Mo<sub>20</sub>O<sub>41</sub> + 21H<sub>2</sub>O = Mo<sub>2</sub>O<sub>3</sub>, 18MoO<sub>3</sub> + 21H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O. Insol. in NH<sub>4</sub>Cl + Aq. (Klason, B. 1901, 34. 160.)

Mo<sub>20</sub>O<sub>77</sub> + 24H<sub>2</sub>O = Mo<sub>2</sub>O<sub>3</sub>, 24MoO<sub>3</sub> + 24H<sub>2</sub>O. (Klason, B. 1901, 34. 159.)

3Mo<sub>2</sub>O<sub>3</sub>, 2Mo<sub>7</sub>O<sub>24</sub> + 18H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (B.)

It is probable that the five blue oxides of molybdenum described by Klason (B. 34, 148, 158) and Bailhache are either the blue oxide Mo<sub>2</sub>O<sub>3</sub>, prepared by the author or mixtures of this compd. with molybdenum trioxide. (Guichard, C. R. 1902, 134. 173.)

Mo<sub>2</sub>O<sub>3</sub>. Not attacked by ammonia; easily oxidised by HNO<sub>3</sub> + Aq. Not attacked by HCl or H<sub>2</sub>SO<sub>4</sub> + Aq. (Wöhler, A. 110. 275.)

Formula is Mo<sub>2</sub>O<sub>3</sub>, according to Wöhler, but Muthmann (A. 238. 108) has shown that correct formula is Mo<sub>2</sub>O<sub>12</sub>.

Not attacked by boiling alkalis, HCl, or dil. H<sub>2</sub>SO<sub>4</sub> + Aq. Sol. in conc. H<sub>2</sub>SO<sub>4</sub>, with

subsequent decomp. Sol. in aqua regia, and Cl<sub>2</sub> + Aq. (Muthmann.)

Mo<sub>2</sub>O<sub>3</sub>. Sol. in H<sub>2</sub>O. (Muthmann, A. 238. 108.)

Min. *Isemannite* (?).

+ 5H<sub>2</sub>O. Moderately sol. in H<sub>2</sub>O. (Marchetti, Z. anorg. 1899, 19. 393.)

Mo<sub>2</sub>O<sub>7</sub>. (v. d. Pfordten, B. 15. 1925.)

**Molybdenum trioxide ammonia, MoO<sub>3</sub>, 3NH<sub>3</sub>.**

Unstable in air. Very sol. in H<sub>2</sub>O with evolution of ammonia. (Rosenheim, Z. anorg. 1906, 50. 303.)

3MoO<sub>3</sub>, NH<sub>3</sub> + 1/2 H<sub>2</sub>O. True composition of commercial molybdic acid. (Klason, B. 1901, 34. 156.)

NH<sub>4</sub>H<sub>2</sub>MoO<sub>6</sub>. Very sl. sol. in cold, easily sol. in hot H<sub>2</sub>O with partial decomp. (Klason, B. 1901, 34. 156.)

3MoO<sub>3</sub>, 3NH<sub>3</sub> + 7H<sub>2</sub>O = (NH<sub>4</sub>)<sub>2</sub>H<sub>2</sub>MoO<sub>6</sub> + 4H<sub>2</sub>O. True composition of Rammelsberg's 3(NH<sub>4</sub>)<sub>2</sub>O, 7MoO<sub>3</sub> + 12H<sub>2</sub>O. (Klason, B. 1901, 34. 155.)

4MoO<sub>3</sub>, NH<sub>3</sub> + 6H<sub>2</sub>O. Very sl. sol. in cold, very easily sol. in hot H<sub>2</sub>O. An insol. modification with less H<sub>2</sub>O gradually cryst. out. (Mylius, B. 1903, 36. 639.)

4MoO<sub>3</sub>, 2NH<sub>3</sub> + 3H<sub>2</sub>O. (Klason, B. 1901, 34. 156.)

6MoO<sub>3</sub>, 3NH<sub>3</sub> + 5H<sub>2</sub>O. Very sl. sol. in cold, more easily sol. in hot H<sub>2</sub>O, with partial decomp. (Klason, B. 1901, 34. 156.)

12MoO<sub>3</sub>, 3NH<sub>3</sub> + 12H<sub>2</sub>O. (Klason, B. 1901, 34. 158.)

12MoO<sub>3</sub>, 3NH<sub>3</sub>, 12H<sub>2</sub>O + 3MoO<sub>3</sub>, 8H<sub>2</sub>O. Moderately sol. in boiling H<sub>2</sub>O. (Klason.)

15MoO<sub>3</sub>, 3NH<sub>3</sub> + 6H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Klason.)

4MoO<sub>3</sub>, MoO<sub>3</sub>, 2NH<sub>3</sub> + 7H<sub>2</sub>O. Slowly sol. in H<sub>2</sub>O; fairly stable, gradually decomp. by dil. acids. (Hofmann, Z. anorg. 1896, 12. 280.)

**Molybdenum trioxide ammonia hydrogen peroxide, 18MoO<sub>3</sub>, 14NH<sub>3</sub>, 3H<sub>2</sub>O<sub>2</sub> + 18H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. Sp. gr. of sat. solution = 1.486 at 17.4°. (Baerwald, B. 1884, 17. 1206.)

**Molybdenum oxybromide.**

See **Molybdenyl bromide**.

**Molybdenum oxychloride.**

See **Molybdenyl chloride**.

**Molybdenum oxyfluoride.**

See **Molybdenyl fluoride**.

**Molybdenum oxyfluoride with MF.**

See **Fluoxymolybdate, M, and Fluoxyhypomolybdate, M**.

**Molybdenum phosphide, Mo<sub>2</sub>P<sub>2</sub>.**

Gradually sol. in hot HNO<sub>3</sub> + Aq. (Wöhler and Rautenberg, A. 109. 374.)

**Molybdenum selenide,  $\text{MoSe}_3$ .**

Not obtained pure. (Uelsmann, A. 116. 125.)

**Molybdenum silicide.**

Sol. in HF; only very sl. sol. in other acids. (Warren, C. N. 1898, 78. 319.)

$\text{MoSi}_2$ . Insol. in all min. acids; sol. in a warm mixture of HF +  $\text{HNO}_3$ . (Defacqz, C. R. 1907, 144. 1425.)

Insol. in min. acids; sol. in HF +  $\text{HNO}_3$ . Unattacked by 10-20% KOH + Aq. Decomp. by fused NaOH. (Hönigschmid, M. 1907, 28. 1020.)

Not attacked by boiling  $\text{HNO}_3$ , aqua regia or HF. (Watts, Trans. Am. Electrochem. Soc. 1906, 9. 106.)

$\text{Mo}_2\text{Si}_3$ . (Vigouroux, C. R. 129. 1238.)

**Molybdenum disulphide,  $\text{MoS}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in aqua regia. Easily oxidised by  $\text{HNO}_3$ . Sol. in boiling  $\text{H}_2\text{SO}_4$ . Sl. attacked by KOH + Aq. (Berzelius.)

Min. *Molybdenite*. Sol. in  $\text{HNO}_3$  + Aq, with separation of  $\text{MoO}_3$ ; sol. in aqua regia; very sl. sol. in  $\text{H}_2\text{SO}_4$ .

**Molybdenum trisulphide,  $\text{MoS}_3$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ , especially if hot, but pptd. by an acid. Difficultly sol. except when boiled with KOH + Aq. Sl. sol. in solutions of alkali sulphides unless heated. (Berzelius.)

Easily sol. in alkali sulphides + Aq; slowly sol. in alkalies or alkali hydrosulphides + Aq. (Atterberg, J. B. 1873. 258.)

**Molybdenum tetrasulphide,  $\text{MoS}_4$ .**

Not decomp. by hot  $\text{H}_2\text{O}$  or acids.

Sl. sol. in cold alkali sulphides + Aq, but easily by boiling. (Berzelius.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

**Molybdenum sesquisulphide,  $\text{Mo}_2\text{S}_3$ .**

Insol. in HCl and  $\text{H}_2\text{SO}_4$ ; sol. in hot conc.  $\text{HNO}_3$  and aqua regia. (Guichard, C. R. 1900, 130. 138.)

**Molybdenum sulphide with MS.**

See Sulphomolybdate, M.

**Molybdenum sulphochloride,  $\text{Mo}_2\text{S}_2\text{Cl}_2$ .**

Insol. in  $\text{H}_2\text{O}$  and alkalies. Slowly sol. in conc.  $\text{HNO}_3$ . (Smith and Oberholtzer, Z. anorg. 1894, 5. 67.)

**Molybdenyl monamide,  $\text{NH}_4\text{MoO}_4$  or**

(Rosenheim, Z. anorg. 1905, 46. 318.)

**Molybdenyl bromide,  $\text{MoO}_3\text{Br}_2$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$  with slight evolution of heat.

$\text{Mo}_2\text{O}_7\text{Br}_4$ . Unstable in air. (Smith and Oberholtzer, Z. anorg. 4. 236.)

**Molybdenyl potassium bromide,  $\text{MoOBr}_3$ ,  $2\text{KBr}$ .**

(Weinland, Z. anorg. 1905, 44. 109.)

$\text{MoOBr}_3$ ,  $\text{KBr} + 2\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1905, 44. 110.)

**Molybdenyl rubidium bromide,  $\text{MoOBr}_3$ ,  $2\text{RbBr}$ .**

(Weinland, Z. anorg. 1905, 44. 108.)

**Molydenyl chloride,  $\text{MoO}_2\text{Cl}_2$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol.

Abundantly sol. in abs. alcohol. Not very sol. in abs. ether. (Hampe, Ch. Z. 1888, 12. 23.)

+  $\text{H}_2\text{O}$ . Composition settled by mol. wt. determinations. Dissociates in alcohol and in  $\text{H}_2\text{O}$ . (Vaudenberghe, Z. anorg. 1895, 10. 52.)

Very hygroscopic. Sol. in acetone, ether and alcohol. (Vaudenberghe, l. c.)

$\text{MoOCl}_4$ . Deliquescent. Sol. in little  $\text{H}_2\text{O}$  with violent action. More  $\text{H}_2\text{O}$  decomposes. (Püttbach, A. 201. 123.)

Formula is  $\text{Mo}_2\text{O}_5\text{Cl}_2$ , according to Blomstrand (J. pr. 71. 460.)

$\text{Mo}_2\text{O}_5\text{Cl}_4$ . (Püttbach, l. c.)

$\text{Mo}_2\text{O}_5\text{Cl}_4$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  with very slight evolution of heat and subsequent formation of precipitate. (Blomstrand.)

Sol. in acids. (Püttbach, A. 201. 129.)

$\text{Mo}_2\text{O}_5\text{Cl}_4$ . Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

$\text{Mo}_2\text{O}_5\text{Cl}_4$ . Insol. in HCl and cold  $\text{H}_2\text{SO}_4$ . Sol. in hot  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . (Püttbach, A. 201. 123.)

$\text{Mo}_2\text{O}_5\text{Cl}_4$ . Difficultly sol. in HCl. Easily sol. in  $\text{HNO}_3$  and alkalies + Aq. (Püttbach.)

**Molybdenyl potassium chloride,  $\text{MoO}_2\text{Cl}_2$ ,  $\text{KCl} + \text{H}_2\text{O}$ .**

(Weinland, Z. anorg. 1905, 44. 97.)

+  $2\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1905, 44. 96.)

$6\text{MoO}_2\text{Cl}_2$ ,  $2\text{KCl} + 6\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1905, 44. 97.)

$\text{MoOCl}_3$ ,  $2\text{KCl} + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nordenskjöld, B. 1901, 34. 1573.)

Ppt. (Henderson, Proc. Chem. Soc. 1903, 19. 245.)

**Molybdenyl rubidium chloride,  $\text{MoO}_2\text{Cl}_2$ ,  $\text{RbCl} + \text{H}_2\text{O}$ .**

$\text{MoO}_2\text{Cl}_2$ ,  $2\text{RbCl}$ . (Weinland, Z. anorg. 1905, 44. 95.)

$\text{MoOCl}_3$ ,  $2\text{RbCl}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Less sol. than K salt. (Nordenskjöld, B. 1901, 34. 1573.)

**Molybdenyl fluoride,  $\text{MoO}_2\text{F}_2$ .**

Decomp. rapidly in moist air. (Schulze, J. pr. (2) 21, 442.)

Very hygroscopic. Sol. in a little  $\text{H}_2\text{O}$  giving a blue solution; in more  $\text{H}_2\text{O}$  giving a colorless solution.

Sol. in  $\text{AsCl}_3$ ,  $\text{SiCl}_4$ ,  $\text{SO}_2\text{Cl}_2$ , and  $\text{PCl}_5$ . On warming these solutions, gas is evolved.

Insol. in toluene. Nearly insol. in ether,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , and  $\text{CS}_2$ . Sol. in warm pyridine and in ethyl and methyl alcohol. (Ruff, B. 1907, 40, 2934.)

$\text{MoOF}_4$ . Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$  and conc.  $\text{H}_2\text{SO}_4$ . Decomp. by alcohol. Sol. in ether and  $\text{CHCl}_3$  with evolution of gas. Insol. in toluene. Very sl. sol. in benzene and  $\text{CS}_2$ . (Ruff, B. 1907, 40, 2932.)

$\text{Mo}_2\text{O}_5\text{F}_4$ . Deliquescent. Easily sol. in  $\text{HF}$  +  $\text{Aq}$ , not in  $\text{H}_2\text{O}$ . (Smith and Oberholtzer.)

**Molybdenyl fluoride with  $\text{MF}$ .**

See Fluoxymolybdate,  $\text{M}$ , and Fluoxyhypomolybdate,  $\text{M}$ .

**Molybdenyl hydroxide,  $\text{MoO}(\text{OH})_2$ .**

2 g. are sol. in 1000 cc.  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  +  $\text{NH}_4\text{Cl}$ ; only sl. sol. in  $\text{NH}_4\text{OH}$  and alkali carbonates +  $\text{Aq}$ . (Klason, B. 1901, 34, 151.)

**Molybdic acid,  $\text{H}_2\text{MoO}_4$ .**

(Ullik, A. 144, 217.)

Nearly insol. in  $\text{H}_2\text{O}$ . (Vivier, C. R. 106, 601.)

Very sparingly sol. in cold  $\text{H}_2\text{O}$ , more sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim and Berthelm, Z. anorg. 1903, 34, 435.)

 **$\alpha$ -modification.**

Solubility of  $\text{MoO}_3$ ,  $\text{H}_2\text{O}$  ( $\alpha$ -modification) in  $\text{H}_2\text{O}$  at  $t^\circ$ .

1000 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{MoO}_3$ .

$t^\circ$	G. $\text{MoO}_3$	$t^\circ$	G. $\text{MoO}_3$
14.8	2.117	42.0	3.446
15.2	2.131	45.0	3.661
24.6	2.619	52.0	4.184
25.6	2.689	60.0	4.685
30.3	2.973	70.0	4.231
36.0	3.085	80.0	5.212
36.8	3.295	....	...

(Rosenheim and Davidsohn, Z. anorg. 1903, 37, 318.)

( $\beta$  modification),  $\text{MoO}_3$ ,  $\text{H}_2\text{O}$ . From  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  at  $60^\circ$ – $70^\circ$ . (Rosenheim and Davidsohn.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

Easily sol. in  $\text{H}_2\text{SO}_4$ . (Ruegenberg and Smith, J. Am. Chem. Soc. 1900, 22, 772.)

$\text{H}_2\text{MoO}_4$ . Sol. in  $\text{H}_2\text{O}$  and acids. (Millingk.)

Very sol. in  $\text{H}_2\text{O}$ . (Mylius, B. 1903, 36, 638.)

Solubility of  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$ .

1000 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{MoO}_3$  at  $t^\circ$ .

$t^\circ$	G. $\text{MoO}_3$	$t^\circ$	G. $\text{MoO}_3$
18	1.066	59	11.258
23	1.856	60	12.057
30	2.638	66	17.274
40	4.761	70	20.550
48	6.360	74.4	20.904
50.2	6.873	75	20.920
54	7.855	79	21.064

(Rosenheim and Berthelm, Z. anorg. 1903, 34, 430.)

Solubility of  $\text{MoO}_3$ ,  $2\text{H}_2\text{O}$  in ammonium salts +  $\text{Aq}$  at  $t^\circ$ .

1000 g. of the solvent dissolve g.  $\text{MoO}_3$ .

Solvent	$t^\circ$	G. $\text{MoO}_3$
10% $(\text{NH}_4)_2\text{SO}_4$	29.6	19.27
10% $\text{NH}_4\text{HSO}_4$	31.5	27.53
"	41.8	34.36
"	49.7	37.69

(Rosenheim and Davidsohn, Z. anorg. 1903, 37, 315.)

$\text{H}_2\text{MoO}_4$  (?). Known only in solution.

$\text{H}_2\text{Mo}_2\text{O}_7$ . Easily sol. in  $\text{H}_2\text{O}$ . (Ullik.)

$\text{H}_2\text{Mo}_3\text{O}_{12}$ . Easily sol. in  $\text{H}_2\text{O}$ . (U.)

$\text{H}_2\text{Mo}_4\text{O}_{21}$ . Easily sol. in  $\text{H}_2\text{O}$ . (U.)

Molybdic acid also exists in a colloidal modification, sol. in  $\text{H}_2\text{O}$ . (Graham, C. R. 59, 174.)

**Molybdates.**

The normal molybdates of the alkali metals are easily sol. in  $\text{H}_2\text{O}$ , while the others are sl. sol. or insol. therein.

The trimolybdates are sl. sol. in cold, but very easily sol. in hot  $\text{H}_2\text{O}$ .

The tetramolybdates are easily sol. in  $\text{H}_2\text{O}$ .

**Aluminum molybdate,  $\text{Al}_2(\text{MoO}_4)_3$ .**

Precipitate. (Gentile, J. pr. 81, 414.)

Contains aluminum hydroxide and sulphate. (Struve, J. pr. 61, 441.)

**Aluminum ammonium molybdate.**

See Aluminicomolybdate, ammonium.

**Aluminum barium molybdate.**

See Aluminicomolybdate, barium.

**Ammonium molybdate,  $(\text{NH}_4)_2\text{MoO}_4$ .**

Efflorescent through loss of  $\text{NH}_3$ ; decomp. by  $\text{H}_2\text{O}$  into acid salt. (Svanberg and Struve.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 826.)

$(\text{NH}_4)_2\text{Mo}_2\text{O}_7$ . Sol. in  $\text{H}_2\text{O}$ .  
 $+\text{H}_2\text{O}=\text{NH}_4\text{HMoO}_4$ . Sol. in  $\text{H}_2\text{O}$ . Sol.  
 in 2-3 pts.  $\text{H}_2\text{O}$ . (Brandes; Mauro, Gazz.  
 ch. it. 18. 120.)

$(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}+4\text{H}_2\text{O}$ . (Commercial am-  
 monium molybdate.)

Not efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Delafont-  
 taine, N. Arch. Sc. ph. nat. 23. 17.)

According to Struve and Berlin =

$(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}+3\text{H}_2\text{O}$ .

According to Marignac and Delffs =  
 $(\text{NH}_4)\text{HMoO}_4$ . The true composition of  
 commercial ammonium molybdate is  
 $(\text{NH}_4)_{16}\text{Mo}_{15}\text{O}_{41}$ . (Junius, Z. anorg. 1905,  
 46. 428.)

$+12\text{H}_2\text{O}$ . More sol. than the above.  
 (Rammelsberg, Pogg. 127. 298.)

Insol. in acetone. (Krug and M'Elroy, J.  
 Anal. Appl. Ch. 6. 184.)

$(\text{NH}_4)_{16}\text{Mo}_{15}\text{O}_{41}$ . True formula for com-  
 mercial ammonium molybdate (Sand and  
 Eisenlohr, Z. anorg. 1907, 52. 68.)

$+7\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46. 428.)  
 $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24}+\text{H}_2\text{O}$ . (Jean, C. R. 78.  
 436.)

$(\text{NH}_4)_2\text{Mo}_2\text{O}_7+\text{H}_2\text{O}$ . Very difficultly sol.  
 in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Berlin, J. pr.  
 42. 445.)

Easily sol. in  $\text{NH}_4\text{OH}+\text{Aq}$ . (Kämmerer,  
 J. pr. (2) 6. 358.)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{MoO}_3$ . Practically insol. in  
 cold, al. sol. in hot  $\text{H}_2\text{O}$ . (Westphal, Dissert.  
 1905.)

$+2\text{H}_2\text{O}$ . Very difficultly sol. in cold,  
 rather easily sol. in hot  $\text{H}_2\text{O}$ . (Berlin.)

100 cc.  $\text{H}_2\text{O}$  dissolve 3.5200 g. at  $15^\circ$ ; sp.  
 gr. = 1.03; 3.6711 g. at  $18^\circ$ ; sp. gr. = 1.04;  
 4.5961 g. at  $32^\circ$ ; sp. gr. = 1.05. (Wempe, Z.  
 anorg. 1912, 78. 258.)

$+2\frac{1}{2}\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46.  
 440.)

$(\text{NH}_4)_2\text{O}$ ,  $8\text{MoO}_3+13\text{H}_2\text{O}$ . (Rosenheim,  
 Z. anorg. 1897, 15. 188.)

$(\text{NH}_4)_2\text{O}$ ,  $9\text{MoO}_3+17\text{H}_2\text{O}$ . (Westphal,  
 Dissert. 1895.)

See also Molybdenum trioxide ammonia.

**Ammonium barium molybdate**,  
 $3(\text{NH}_4)_2\text{O}$ ,  $3\text{BaO}$ ,  $14\text{MoO}_3+12\text{H}_2\text{O}$ .  
 (Westphal, Dissert. 1895.)

**Ammonium bismuth molybdate**,  
 $\text{NH}_4\text{Bi}(\text{MoO}_4)_2$ .

(Riederer, J. Am. Chem. Soc. 1903, 25.  
 914.)

**Ammonium cadmium molybdate ammonia**,  
 $(\text{NH}_4)_2\text{Cd}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{NH}_4\text{OH}+\text{Aq}$ . (Briggs, Chem.  
 Soc. 1904, 85. 674.)

**Ammonium cerium molybdate**,  
 $(\text{NH}_4)_2\text{Ce}(\text{MoO}_4)_2+24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barbieri, C. A. 1909. 293.)

**Ammonium chromic molybdate.**

See Chromicomolybdate, ammonium.

**Ammonium cobaltous molybdate**,

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3$ ,  $3\text{CoO}$ ,  $7\text{MoO}_3+x\text{H}_2\text{O}$ .

$5[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $7[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$ .

$2[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $3[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$ .

$3[3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3]$ ,  $5[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$ .

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_3$ ,  $5[3\text{CoO}$ ,  $7\text{MoO}_3]+$   
 $x\text{H}_2\text{O}$ .

$9[2(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_3]$ ,  $5[2\text{CoO}$ ,  $5\text{MoO}_3]+$   
 $118\text{H}_2\text{O}$ .

$4(\text{NH}_4)_2\text{O}$ ,  $2\text{CoO}$ ,  $15\text{MoO}_3+20\text{H}_2\text{O}$ .  
 (Marckwald, Dissert. 1895.)

**Ammonium cobaltous molybdate ammonia**,  
 $(\text{NH}_4)_2\text{Co}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{NH}_4\text{OH}+\text{Aq}$ . (Briggs, Chem.  
 Soc. 1904, 85. 674.)

**Ammonium cobaltic molybdate.**

See Cobaltimolybdate, ammonium.

**Ammonium cupric molybdate**,  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuO}$ ,  
 $5\text{MoO}_3+9\text{H}_2\text{O}$ .

Sl. sol. in cold, sol. in boiling  $\text{H}_2\text{O}$  without  
 decomp. (Struve.)

**Ammonium cupric molybdate ammonia**,  
 $(\text{NH}_4)_2\text{Cu}(\text{MoO}_4)_2$ ,  $2\text{NH}_3$ .

Sol. in dil.  $\text{NH}_4\text{OH}+\text{Aq}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Briggs, Chem. Soc.  
 1904, 85. 673.)

**Ammonium ferric molybdate**,  $3(\text{NH}_4)_2\text{Mo}_2\text{O}_7$ ,  
 $\text{Fe}_2(\text{MoO}_4)_3+20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Struve.)

See also Ferricomolybdate, ammonium.

**Ammonium lanthanum molybdate**,  
 $(\text{NH}_4)_2\text{La}_2\text{Mo}_2\text{O}_{14}+24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barbieri, C. A. 1909. 293.)

**Ammonium lithium molybdate**,  $\text{NH}_4\text{LiMoO}_4$ ,  
 $+\text{H}_2\text{O}$ .

(Traube, N. Jahrb. Miner. 1894, I. 194.)

**Ammonium magnesium molybdate**,  $(\text{NH}_4)_2\text{O}$ ,  
 $\text{MgO}$ ,  $2\text{MoO}_3+2\text{H}_2\text{O}=(\text{NH}_4)_2\text{MoO}_4$ ,  
 $\text{MgMoO}_4+2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ullik, A. 144. 344.)

**Ammonium manganous molybdate**,

$2(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $3\text{MoO}_3+5\text{H}_2\text{O}$ .

Decomp. by boiling  $\text{H}_2\text{O}$ . (Marckwald,  
 Dissert. 1895.)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $6\text{MoO}_3+16\text{H}_2\text{O}$ . De-  
 comp. by boiling  $\text{H}_2\text{O}$ . (Marckwald, Dissert.  
 1895.)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{MnO}$ ,  $6\text{MoO}_3 + 16\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Marckwald, Dissert. 1895.)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $12\text{MoO}_3 + 22\text{H}_2\text{O}$ . (Marckwald, Dissert. 1895.)

**Ammonium manganic molybdate.**

See Permanganomolybdate ammonium.

**Ammonium mercuric molybdate.**

Sol. in  $\text{HCl} + \text{Aq}$ . Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ , separating out on cooling. Sol. in hot  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Hirzel.)

**Ammonium molybdenum molybdate,**

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3$ ,  $4\text{MoO}_3 + 9\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , but the solution soon becomes cloudy. (Rammelsberg, Pogg. 127. 291.)

**Ammonium neodymium molybdate,**

$(\text{NH}_4)_2\text{NdMoO}_4 + 12\text{H}_2\text{O}$ .

Ppt. (Barbieri, C. C. 1911, I. 1043.)

**Ammonium nickel molybdate,**

$(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $9\text{MoO}_3 + 25\text{H}_2\text{O}$ .

Very sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{NiO}$ ,  $10\text{MoO}_3 + 14\text{H}_2\text{O}$ . Very sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$5(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $16\text{MoO}_3 + 16\text{H}_2\text{O}$ . (Hall, J. Am. Chem. Soc. 1907, 29, 702.)

$6(\text{NH}_4)_2\text{O}$ ,  $3\text{NiO}$ ,  $16\text{MoO}_3 + 29\text{H}_2\text{O}$ . Very sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$8(\text{NH}_4)_2\text{O}$ ,  $6\text{NiO}$ ,  $31\text{MoO}_3 + 63\text{H}_2\text{O}$ . Very sl. sol. in cold, sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

$3(\text{NH}_4)_2\text{O}$ ,  $9\text{NiO}$ ,  $34\text{MoO}_3 + 120\text{H}_2\text{O}$ . Very sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  without decomp. (Marckwald, Dissert. 1895.)

**Ammonium nickelic molybdate.**

See Nickelimolybdate, ammonium.

**Ammonium nickel hydrogen molybdate,**

$(\text{NH}_4)_2\text{H}_2[\text{Ni}(\text{MoO}_4)_2] + 5\text{H}_2\text{O}$ .

See Nickelomolybdate, ammonium hydrogen.

**Ammonium praseodymium molybdate,**

$(\text{NH}_4)_2\text{PrMoO}_4 + 12\text{H}_2\text{O}$ .

Ppt. (Barbieri, C. A. 1911. 1884.)

**Ammonium samarium molybdate,**

$(\text{NH}_4)_2\text{SmMoO}_4 + 12\text{H}_2\text{O}$ .

Ppt. (Barbieri, C. A. 1911. 1884.)

**Ammonium sodium molybdate,**  $7(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $21\text{MoO}_3 + 15\text{H}_2\text{O}$  (?).

Easily sol. in  $\text{H}_2\text{O}$ . (Delafontaine, J. pr. 95. 136.)

$7(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $25\text{MoO}_3 + 30\text{H}_2\text{O}$  (?). (Delafontaine.)

$(\text{NH}_4, \text{Na})_2\text{O}$ ,  $3\text{MoO}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Mauro, Gazz. ch. it. 11. 214.)

**Ammonium thorium molybdate.**

See Thoromolybdate, ammonium.

**Ammonium titanium molybdate.**

See Titanomolybdate, ammonium.

**Ammonium vanadium molybdate.**

See Vanadiomolybdate, ammonium.

**Ammonium zinc molybdate.**

Sol. in  $\text{H}_2\text{O}$ . (Berselius.)

**Ammonium zirconium molybdate.**

See Zirconomolybdate, ammonium.

**Ammonium molybdate hydrogen dioxide,**

$18\text{MoO}_3$ ,  $7(\text{NH}_4)_2\text{O}$ ,  $3\text{H}_2\text{O}_2 + 11\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Bärwald, B. 17. 1206.)

**Barium molybdate, basic,**  $2\text{BaO}$ ,  $\text{MoO}_3 + \text{H}_2\text{O}$  (?).

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$ . (Heine, J. pr. 9. 204.)

**Barium molybdate,  $\text{BaMoO}_4$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Svanberg and Struve.)

Sol. in 17,200 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . More sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Smith and Bradbury, B. 24. 2930.)

$+3\text{H}_2\text{O}$ . (Westphal, Dissert. 1895.)

$\text{BaMoO}_4 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .

$\text{Ba}_2\text{MoO}_7 + 9\text{H}_2\text{O}$ . Appreciably sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

According to Svanberg and Struve =  $\text{Ba}_2\text{MoO}_7 + 6\text{H}_2\text{O}$ .

$+12\text{H}_2\text{O}$  or  $5\text{BaO}$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46. 433.)

$+22\text{H}_2\text{O}$ . Ppt. (Westphal, Dissert. 1895.)

$\text{BaO}$ ,  $4\text{MoO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ . Ppt. (Wempe, Z. anorg. 1912, 78. 320.)

$+12\text{H}_2\text{O}$ . Ppt. (Rosenheim, Z. anorg. 1913, 79. 299.)

$\text{BaMoO}_4 + 4\text{H}_2\text{O}$ . Insol. in cold or hot  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . Extremely slightly decomp. by  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{SO}_4 + \text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . (Svanberg and Struve.)

**Barium paramolybdate,**  $5\text{BaO}$ ,  $12\text{MoO}_3 + 10\text{H}_2\text{O}$ .

Ppt. Sol. in excess of  $\text{BaCl}_2 + \text{Aq}$ . (Junius, Z. anorg. 1905, 46. 433.)

**Barium tetramolybdate,**  $\text{BaH}_2(\text{MoO}_4)_2 + 17\text{H}_2\text{O}$ .

Insol. in cold, apparently decomp. by hot  $\text{H}_2\text{O}$ , a small part dissolving, and the rest forming an insol. residue. (Ullik, A. 144. 336.)

+14H<sub>2</sub>O. Insol. in cold and hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 320.)

BaO, 8MoO<sub>3</sub>+17H<sub>2</sub>O. (Felix, Dissert. 1912.)

**Barium chromic molybdate.**

See Chromicomolybdate, barium.

**Barium cobaltic molybdate.**

See Cobaltimolybdate, barium.

**Barium manganic molybdate.**

See Permanganomolybdate, barium.

**Barium nickelic molybdate.**

See Nickelimolybdate, barium.

**Barium nickel hydrogen molybdate,**

. Ba<sub>2</sub>H<sub>4</sub>[Ni(MoO<sub>4</sub>)<sub>6</sub>]+10H<sub>2</sub>O.

See Nickelomolybdate, barium hydrogen.

**Barium vanadium molybdate.**

See Vanadiomolybdate, barium.

**Barium molybdate hydrogen dioxide,** 8BaO, 19MoO<sub>3</sub>, 2H<sub>2</sub>O<sub>2</sub>+13H<sub>2</sub>O.

Precipitate. (Bärwald.)

**Bismuth molybdate,** Bi<sub>2</sub>O<sub>3</sub>, 3MoO<sub>3</sub>.

Somewhat sol. in H<sub>2</sub>O. Sol. in 500 pts. H<sub>2</sub>O and in the stronger acids. (Richter.)

**Bromomolybdenum molybdate.**

See under Bromomolybdenum comps.

**Cadmium molybdate,** CdMoO<sub>4</sub>.

Insol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH+Aq, KCN+Aq, or acids. (Smith and Bradbury, B. 24. 2390.)

CdO, H<sub>2</sub>O, 8MoO<sub>3</sub>+6H<sub>2</sub>O. Decomp. by boiling with H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 323.)

**Cæsium molybdate,** Cs<sub>2</sub>O, 3MoO<sub>3</sub>+H<sub>2</sub>O.

(Ephraim and Herschfinkel, Z. anorg. 1909, 64. 270.)

Cs<sub>2</sub>O, 5MoO<sub>3</sub>+3H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 270.)

+3½H<sub>2</sub>O. Very sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

2Cs<sub>2</sub>O, 5MoO<sub>3</sub>+5H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

3Cs<sub>2</sub>O, 10MoO<sub>3</sub>+3H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

Cs<sub>2</sub>O, 16MoO<sub>3</sub>+8H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

3Cs<sub>2</sub>O, 10MoO<sub>3</sub>+3H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 271.)

**Cæsium tetramolybdate,** Cs<sub>2</sub>O, 4MoO<sub>3</sub>.

Only sl. sol. in H<sub>2</sub>O. (Muthmann, B. 1898, 31. 1841.)

+2H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. (Muthmann, B. 1898, 31. 1841.)

+3H<sub>2</sub>O. Easily sol. in cold or hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 317.)

+5H<sub>2</sub>O. Very sol. in cold and hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

Cs<sub>2</sub>O, MoO<sub>3</sub>, Cs<sub>2</sub>O, 3MoO<sub>3</sub>+4.5H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 317.)

**Cæsium paramolybdate,** 5Cs<sub>2</sub>O, 12MoO<sub>3</sub>+11H<sub>2</sub>O.

Efflorescent. Easily sol. in H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 317.)

**Calcium molybdate,** CaMoO<sub>4</sub>.

Insol. precipitate. (Ullik.)

Sl. sol. in H<sub>2</sub>O; insol. in alcohol. (Smith and Bradbury, B. 24. 2930.)

+H<sub>2</sub>O. (Westphal, Dissert. 1895.)

+2H<sub>2</sub>O. (Westphal, Dissert. 1895.)

+6H<sub>2</sub>O. Difficultly sol. in cold, easily in hot H<sub>2</sub>O. (Ullik, A. 144. 231.)

CaMo<sub>3</sub>O<sub>13</sub>+9H<sub>2</sub>O. Easily sol. in cold H<sub>2</sub>O.

CaO, 2H<sub>2</sub>O, 12MoO<sub>3</sub>+21H<sub>2</sub>O. Efflorescent. Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Wempe.)

**Calcium hydrogen tetramolybdate,**

CaH<sub>2</sub>(Mo<sub>4</sub>O<sub>14</sub>)+17H<sub>2</sub>O.

Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O with decomp. (Ullik.)

+16H<sub>2</sub>O. Insol. in cold, difficultly sol. in hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 318.)

**Cerium molybdate,** Ce<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>.

Precipitate. Insol. in H<sub>2</sub>O; sol. in acids. (Cossa, B. 19. 536 R.)

**Chromic molybdate.**

Insol. in H<sub>2</sub>O, but sol. in acids. Sol. in NH<sub>4</sub> molybdate+Aq. (Berzelius.)

See also Chromicomolybdic acid.

**Chromic molybdate, with M. molybdate.**

See Chromicomolybdate. M.

**Cobaltous molybdate,** CoMoO<sub>4</sub>.

Decomp. by alkalis and strong acids. (Berzelius.)

+H<sub>2</sub>O. Sl. sol. in pure, easily sol. in acidified H<sub>2</sub>O. (Coloriano, Bull. Soc. (2) 50. 451.)

CoO, 2MoO<sub>3</sub>+2H<sub>2</sub>O. (Marckwald, Dissert. 1895.)

6½H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. (Marckwald.)

CoMo<sub>3</sub>O<sub>16</sub>+10H<sub>2</sub>O. Very sl. sol. in cold, but very easily sol. in hot H<sub>2</sub>O. (Ullik, W. A. B. 55, 2. 767.)

**Cobaltic potassium molybdate.**

See Cobaltimolybdate, potassium.

**Cobaltous sodium molybdate,**

Na<sub>2</sub>O, 2CoO, 6MoO<sub>3</sub>+18H<sub>2</sub>O.

(Marckwald, Dissert. 1895.)

2Na<sub>2</sub>O, CoO, 7MoO<sub>3</sub>+20H<sub>2</sub>O. Sol. in cold H<sub>2</sub>O without decomp. Decomp. on heating. (Marckwald.)

$3\text{Na}_2\text{O}$ ,  $2\text{CoO}$ ,  $12\text{MoO}_3 + 27\text{H}_2\text{O}$ . (Marckwald.)

$3\text{Na}_2\text{O}$ ,  $3\text{CoO}$ ,  $14\text{MoO}_3 + 50\text{H}_2\text{O}$ . Sol. in much cold  $\text{H}_2\text{O}$ . (Marckwald.)

$4\text{Na}_2\text{O}$ ,  $6\text{CoO}$ ,  $25\text{MoO}_3 + 68\text{H}_2\text{O}$ . (Marckwald.)

**Cobaltous molybdate ammonia**,  $\text{CoMoO}_4$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Sonnenschein, J. pr. 53. 340.)

**Cupric molybdate, basic**,  $4\text{CuO}$ ,  $3\text{MoO}_3 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Struve, J. B. 1854. 350.)

**Cupric molybdate**,  $\text{CuMoO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and alkaline solutions.

$\text{CuMoO}_4 \cdot 6\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ . (Ullik, A. 144. 233.)

+  $9\text{H}_2\text{O}$ . Very sl. sol. in cold, and extraordinarily easily sol. in hot  $\text{H}_2\text{O}$ . (Ullik.)

**Cupric molybdate ammonia**,

$\text{CuMoO}_4$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$ .

Gives off  $\text{NH}_3$  at ord. temp. Decomp. by  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$  from which it can be cryst. (Briggs, Chem. Soc. 1904. 85. 674.)

$\text{CuMoO}_4$ ,  $4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jørgensen, Ch. Z. Repert. 1896, 20. 225.)

**Didymium molybdate**,  $\text{Di}_2(\text{MoO}_4)_3$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Cossa, B. 19. 536R.)  $\text{Di}_2\text{O}_3$ ,  $6\text{MoO}_3 + 3\text{H}_2\text{O}$  (?). Precipitate. (Smith.)

**Glucinum molybdate, basic**,  $2\text{GfO}$ ,  $\text{MoO}_3 + 3\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Atterberg, J. B. 1873. 258.)

**Glucinum molybdate**,  $\text{GfO}$ ,  $\text{MoO}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Rosenheim, Z. anorg. 1897, 15. 307.)

$\text{GfMoO}_4$ ,  $\text{MoO}_3 + x\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Atterberg.)

**Gold (auric) molybdate** (?).

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Richter.)

**Hydroxylamine potassium molybdate**.

$\text{MoO}_4\text{H}_2(\text{NH}_2\text{O})_3(\text{NH}_2\text{OK})$ .

Easily sol. in  $\text{H}_2\text{O}$ ; pptd. by alcohol. (Hofmann, A. 1899, 309. 324.)

**Indium molybdate**,  $\text{In}_2(\text{MoO}_4)_3 + 2\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ .

Easily sol. in  $\text{HCl}$ . (Renz, B. 1901, 34. 2765.)

**Iron (ferrous) molybdate**,  $\text{FeMoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Schultze, A. 126. 55.)

**Iron (ferric) molybdate**,  $\text{Fe}_2\text{O}_3$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Slowly sol. in cold, easily in hot  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Dil. acids gradually dissolve out  $\text{Fe}_2\text{O}_3$  in the cold. When ignited, difficultly sol. in all solvents. (Steinacker.)

$\text{Fe}_2\text{O}_3$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Struve, J. B. 1854. 346.)

$2\text{Fe}_2\text{O}_3$ ,  $7\text{MoO}_3 + 34\text{H}_2\text{O}$ . Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 704.)

**Ferric potassium molybdate**,  $\text{Fe}_2\text{O}_3$ ,  $3\text{K}_2\text{O}$ ,  $12\text{MoO}_3 + 20\text{H}_2\text{O} = 3\text{K}_2\text{Mo}_2\text{O}_7$ ,  $\text{Fe}_2(\text{Mo}_2\text{O}_7)_3 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Struve.)

**Lanthanum molybdate**,  $\text{LaH}_3(\text{MoO}_4)_3 = \text{La}_2\text{O}_3$ ,  $\text{MoO}_3 + 3\text{H}_2\text{O}$ . (?)

Precipitate. (Smith.)

**Lead molybdate**,  $\text{PbMoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in warm  $\text{HNO}_3 + \text{Aq}$ ; decomp. by  $\text{H}_2\text{SO}_4$ ; sol. in conc.  $\text{HCl} + \text{Aq}$ , or  $\text{KOH} + \text{Aq}$ .

Min. *Wulfenite*. As above.

**Lithium molybdate**,  $\text{Li}_2\text{MoO}_4$ .

Moderately sol. in cold, and only sl. more sol. in hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 259.)

+  $\frac{2}{3}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

$5\text{Li}_2\text{O}$ ,  $5\text{MoO}_3 + 2\text{H}_2\text{O}$ . 46.13 g. are present in 100 cm. of the aqueous solution at  $20^\circ$ , and sp. gr. of the solution = 1.44. (Wempe, Z. anorg. 1912, 78. 309.)

$\text{Li}_2\text{O}$ ,  $2\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

$\text{Li}_2\text{O}$ ,  $3\text{MoO}_3 + \text{H}_2\text{O}$ . Easily sol. in warm  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

+  $4\text{H}_2\text{O}$ . (Wempe.)

+  $4\frac{1}{2}\text{H}_2\text{O}$ . (Wempe.)

+  $7\text{H}_2\text{O}$ . Nearly insol. in cold, sol. in hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

$2\text{Li}_2\text{O}$ ,  $3\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

**Lithium paramolybdate**,  $3\text{Li}_2\text{O}$ ,  $7\text{MoO}_3 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1897, 15. 181.)

+  $28\text{H}_2\text{O}$ . Easily sol. in cold and hot  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

**Lithium tetramolybdate**,  $\text{Li}_2\text{O}$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 258.)

$\text{Li}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 10\text{H}_2\text{O}$ . Easily sol.

in hot  $H_2O$ . (Wempe, Z. anorg. 1912, 78. 308.)

$Li_2O$ ,  $3H_2O$ ,  $16MoO_3 + 6\frac{1}{2}H_2O$ . Easily sol. in warm  $H_2O$ . (Wempe, Z. anorg. 1912, 78. 308.)

**Lithium potassium molybdate**,  $KLiMoO_4 + H_2O$ .

(Traube, N. Jahrb. Miner, 1894, I. 194.)

**Magnesium molybdate**,  $MgMoO_4$ .

Min. *Belonesia*.

Insol. in  $HCl + Aq$ . (Scacchi, Zeit. Kryst. 1888, 14. 523.)

+  $5H_2O$ . Easily sol. in cold, but still more sol. in hot  $H_2O$ . (Delafontaine.)

Sol. in 12-15 pts. cold  $H_2O$ . (Brandes.)

+  $7H_2O$ . Easily sol. in hot or cold  $H_2O$ . (Ullik.)

$MgMo_2O_7 + 10H_2O$ . Difficultly sol. in cold, very easily in hot  $H_2O$ . (Ullik.)

**Magnesium paramolybdate**,  $Mg_2Mo_7O_{24} + 20H_2O$ .

Quite sol. in cold, more easily in hot  $H_2O$ . (Ullik.)

**Magnesium tetramolybdate**,

$MgO$ ,  $H_2O$ ,  $8MoO_3 + 19H_2O$ .

**Magnesium hydrogen tetramolybdate**,

$MgH_2(Mo_4O_{11})_2 + 19H_2O$ .

Easily sol. in cold  $H_2O$ . (Ullik, A. 144. 335.)

Sl. sol. in cold, easily sol. in hot  $H_2O$ . (Wempe, Dissert. 1911.)

+  $20H_2O$ . Ppt. (Wempe, Z. anorg. 1912, 78. 323.)

**Magnesium hydrogen octamolybdate**,

$MgH_2(Mo_8O_{21})_2 + 29H_2O$ .

Very difficultly sol. in cold, very easily sol. in hot  $H_2O$ . (Ullik, W. A. B. 60, 2. 314.)

**Magnesium potassium molybdate**,  $MgMoO_4$ ,  $K_2MoO_4 + 2H_2O$ .

Slowly sol. in cold, easily in hot  $H_2O$ . (Ullik, A. 144. 343.)

**Manganous molybdate**,  $MnMoO_4 + H_2O$ .

Insol. in  $H_2O$ . Sl. sol. in pure, easily sol. in acidified  $H_2O$ . Decomp. by alkalis or alkali carbonates +  $Aq$ . (Coloriano, Bull. Soc. (2) 50. 451.)

+  $\frac{1}{2}H_2O$ . (Marckwald, Dissert. 1895.)

+  $10H_2O$ . (Marckwald.)

**Manganic potassium molybdate**.

See Permanganomolybdate, potassium.

**Manganic silver molybdate**.

See Permanganomolybdate, silver.

**Mercurous molybdate**,  $Hg_2Mo_7O_{21}$ .

Decomp. by  $H_2O$ . (Struve, J. B. 1754. 350.)

Sol. in 500-600 pts.  $H_2O$ ; decomp. by  $HNO_3 + Aq$ . (Hatchett.)

**Molybdenum molybdate**.

See Molybdenum oxides,  $Mo_2O_7$ ,  $Mo_2O_6$ , etc.

**Neodymium molybdate**,  $Nd_2(MoO_4)_3$ .

Very sl. sol. in  $H_2O$ .

1 pt. is sol. in 53790 pts.  $H_2O$  at  $28^\circ$ .

1 " " " " 32466 "  $H_2O$  "  $75^\circ$ .

(Hitchcock, J. Am. Chem. Soc. 1895, 17. 532.)

**Nickel molybdate**,  $NiMoO_4 + \frac{2}{3}H_2O + \frac{1}{3}H_2O$  and +  $5H_2O$ .

(Marckwald, Dissert. 1895.)

$NiO$ ,  $3MoO_3 + 18H_2O$ . Sl. sol. in cold; easily sol. in hot  $H_2O$ . (Marckwald.)

$5NiO$ ,  $14MoO_3 + 57H_2O$ , and +  $70H_2O$ . Sl. sol. in cold; easily sol. in hot  $H_2O$ . (Marckwald.)

**Nickel potassium molybdate**,  $3NiO$ ,  $5K_2O$ ,  $16MoO_3 + 21H_2O$ .

Can be cryst. from  $H_2O$ . (Hall, J. Am. Chem. Soc. 1907, 29. 701.)

**Nickelic potassium molybdate**.

See Nickelomolybdate, potassium.

**Nickel potassium hydrogen molybdate**,

$K_4H_4[Ni(MoO_4)_4] + 5H_2O$ .

See Nickelomolybdate, potassium hydrogen.

**Nickel sodium molybdate**,  $2NiO$ ,  $Na_2O$ ,  $6MoO_3 + 17H_2O$ .

Sol. in cold  $H_2O$  without decomp. but decomp. on warming. (Marckwald, Dissert. 1895.)

**Nickel molybdate ammonia**,  $NiMoO_4$ ,  $2NH_3 + H_2O$ .

Decomp. by  $H_2O$ . (Soanenschein, J. pr. 53. 341.)

**Potassium molybdate**,  $K_2MoO_4$ .

Deliquescent in moist air. Very sol. in  $H_2O$ . Insol. in alcohol. (Svanberg and Struve, J. pr. 44. 265.)

184.6 grams are sol. in 100 grams  $H_2O$  at  $25^\circ$ . (Amadori, C. A. 1912. 2878.)

Solubility of  $K_2MoO_4 + K_2SO_4$  at  $25^\circ$ .

G. per 100 g. $H_2O$		G. per 100 g. $H_2O$	
$K_2SO_4$	$K_2MoO_4$	$K_2SO_4$	$K_2MoO_4$
0	184.6	1.50	99.49
0.46	180.7	2.13	45.89
0.72	177.	3.95	17.48
0.98	127.2	8.55	4.73
1.27	107.5	12.10	0

(Amadori, Att. acc. Linc. 1912, 21, I. 467, 667.)



+ $\frac{3}{4}$ H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O. (Wempe, Dissert. 1911.)

K<sub>2</sub>O, 8MoO<sub>3</sub>+13H<sub>2</sub>O. Easily sol. in warm H<sub>2</sub>O. (Wempe, Dissert. 1911.)

K<sub>2</sub>O, 10MoO<sub>3</sub>+9H<sub>2</sub>O. Nearly insol. in hot and cold H<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 0.682 g. at 100°. (Felix, Dissert. 1912.)

+15H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Felix.)

5K<sub>2</sub>O, 12MoO<sub>3</sub>+8H<sub>2</sub>O. Sl. sol. in cold H<sub>2</sub>O. (Junius, Z. anorg. 1905, 46. 439.)

**Potassium trimolybdate, K<sub>3</sub>Mo<sub>3</sub>O<sub>10</sub>.**

Difficultly sol. in cold, but much more easily in hot H<sub>2</sub>O. When ignited is absolutely insol. in H<sub>2</sub>O. (Svanberg and Struve.)

+2H<sub>2</sub>O. (Junius, Z. anorg. 1905, 46. 439.)

Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

+2 $\frac{3}{4}$ H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O. (Wempe, Dissert. 1911.)

+3H<sub>2</sub>O. Very sl. sol. in cold, more easily sol. in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

+11H<sub>2</sub>O. Practically insol. in H<sub>2</sub>O. (Westphal, Dissert. 1895.)

**Potassium hydrogen tetramolybdate,**

K<sub>4</sub>H<sub>4</sub>(Mo<sub>4</sub>O<sub>27</sub>)<sub>3</sub>+18H<sub>2</sub>O.

Sl. sol. in cold H<sub>2</sub>O. Decomp. by boiling H<sub>2</sub>O. (Rosenheim, Z. anorg. 1913, 79. 298.)

KHMo<sub>4</sub>O<sub>13</sub>+6H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Ullik.)

**Potassium paramolybdate, K<sub>4</sub>Mo<sub>7</sub>O<sub>24</sub>+4H<sub>2</sub>O.**

Decomp. even by cold H<sub>2</sub>O. (Delafontaine.)

Formula is K<sub>4</sub>Mo<sub>7</sub>O<sub>24</sub>+6H<sub>2</sub>O, according to Svanberg and Struve (?).

**Potassium selenium molybdate.**

See Selenomolybdate, potassium.

**Potassium sodium molybdate, K<sub>2</sub>MoO<sub>4</sub>, 2Na<sub>2</sub>MoO<sub>4</sub>+14H<sub>2</sub>O.**

Very easily sol. in cold, still more easily in hot H<sub>2</sub>O. (Delafontaine.)

**Potassium vanadium molybdate.**

See Vanadiomolybdate, potassium.

**Potassium zinc molybdate.**

Sol. in H<sub>2</sub>O. (Berzelius.)

**Potassium molybdate hydrogen dioxide,**  
6K<sub>2</sub>O, 16MoO<sub>3</sub>, 4H<sub>2</sub>O<sub>2</sub>+13H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Bärwald, C. C. 1885. 424.)

**Potassium molybdate sulphocyanide, KSCN, K<sub>3</sub>Mo<sub>3</sub>O<sub>10</sub>+4H<sub>2</sub>O.**

Decomp. by H<sub>2</sub>O. Sol. in dil. HCl+Ag. (Péchar, C. R. 1894, 118. 806.)

**Praseodymium molybdate, Pr<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>.**

Very sl. sol. in H<sub>2</sub>O.

1 pt. is sol. in 65820 pts. H<sub>2</sub>O at 23°.

1 " " " " 69800 " " " 75°.

(Hitchcock, J. Am. Chem. Soc. 1895, 17. 530.)

**Rubidium molybdate, Rb<sub>2</sub>O, MoO<sub>3</sub>.**

Hygroscopic. (Ephraim, Z. anorg. 1909, 64. 263.)

Rb<sub>2</sub>O, 2MoO<sub>3</sub>+2H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O. (Ephraim, Z. anorg. 1909, 64. 263.)

Rb<sub>2</sub>Mo<sub>7</sub>O<sub>24</sub>+4H<sub>2</sub>O. Very sl. sol. in cold, much more easily sol. in hot H<sub>2</sub>O. (Delafontaine, N. Arch. Sc. phys. nat. 30. 233.)

(Ephraim, Z. anorg. 1909, 64. 263.)

+4 $\frac{1}{2}$ H<sub>2</sub>O. (Wempe, Dissert. 1911.)

2Rb<sub>2</sub>O, 7MoO<sub>3</sub>+5H<sub>2</sub>O. Very sl. sol. in cold, very easily sol. in hot H<sub>2</sub>O. (Wempe.)

5Rb<sub>2</sub>O, 7MoO<sub>3</sub>+14H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 268.)

3Rb<sub>2</sub>O, 8MoO<sub>3</sub>+6H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 269.)

5Rb<sub>2</sub>O, 12MoO<sub>3</sub>+H<sub>2</sub>O. 100 cc. H<sub>2</sub>O dissolve 1.941 g. at 24°. (Wempe, Z. anorg. 1912, 78. 258.)

Rb<sub>2</sub>O, 3MoO<sub>3</sub>. Insol. in H<sub>2</sub>O. (Muthmann, B. 1898, 31. 1839.)

+H<sub>2</sub>O. (Muthmann, B. 1898, 31. 1839.)

+3H<sub>2</sub>O. Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

6 $\frac{1}{2}$ H<sub>2</sub>O. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 269.)

2Rb<sub>2</sub>O, 3MoO<sub>3</sub>+4H<sub>2</sub>O. Sl. sol. in cold, easily in hot H<sub>2</sub>O. (Wempe, Dissert. 1911.)

Rb<sub>2</sub>O, 4MoO<sub>3</sub>. Difficultly sol. in cold, easily in hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 312.)

+ $\frac{1}{2}$ H<sub>2</sub>O. Practically insol. in H<sub>2</sub>O. Very sol. by addition of NH<sub>3</sub>. (Ephraim and Herschfinkel, Z. anorg. 1909, 64. 266.)

+2.5H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Ephraim, Z. anorg. 1909, 64. 263.)

+4H<sub>2</sub>O. Sol. in cold, more easily sol. in hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 312.)

Rb<sub>2</sub>O, MoO<sub>3</sub>, Rb<sub>2</sub>O, 3MoO<sub>3</sub>+5H<sub>2</sub>O. Sol. in cold or hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 312.)

Rb<sub>2</sub>O, H<sub>2</sub>O, 8MoO<sub>3</sub>+3H<sub>2</sub>O. Difficultly sol. in cold, easily in hot H<sub>2</sub>O. (Wempe, Z. anorg. 1912, 78. 312.)

Rb<sub>2</sub>O, 11MoO<sub>3</sub>+5.5H<sub>2</sub>O. Ppt. (Ephraim, Z. anorg. 1909, 64. 263.)

Rb<sub>2</sub>O, 13MoO<sub>3</sub>+4H<sub>2</sub>O. Ppt. (Ephraim.)

Rb<sub>2</sub>O, 18MoO<sub>3</sub>. Ppt. (Ephraim.)

**Samarium molybdate, Sm<sub>2</sub>(MoO<sub>4</sub>)<sub>3</sub>.**

Insol. in H<sub>2</sub>O. (Cleve.)

**Samarium sodium molybdate,**

Na<sub>2</sub>Sm<sub>2</sub>(MoO<sub>4</sub>)<sub>4</sub>.

Insol. in H<sub>2</sub>O. Easily sol. in warm dil. HNO<sub>3</sub>+Aq. (Cleve.)

**Silver (argentous) molybdate,  $\text{Ag}_2\text{O}$ ,  $2\text{MoO}_3$ .**

Sol. in  $\text{HNO}_3 + \text{Aq.}$   $\text{KOH} + \text{Aq.}$  dissolves  $\text{MoO}_3$  and  $\text{Ag}_2\text{O}$  separates out. Not decomp. by dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Wöhler and Rautenberg, A. 114. 119.)

Does not exist. (Muthmann, B. 20. 983.)

**Silver (argentic) molybdate,  $\text{Ag}_2\text{MoO}_4$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ ; less when  $\text{HNO}_3$  is present. (Richter.)

Very sl. sol. in pure  $\text{H}_2\text{O}$ ; easily sol. in  $\text{H}_2\text{O}$  acidulated with  $\text{HNO}_3$ . (Struve and Svanberg.)

Sol. in  $\text{KCN}$  or  $\text{NaOH} + \text{Aq.}$  (Smith and Bradbury.)

$\text{Ag}_2\text{O}$ ,  $2\text{MoO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KCN} + \text{Aq.}$  (Junius, Dissert. 1905.)

$2\text{Ag}_2\text{O}$ ,  $5\text{MoO}_3$ . Somewhat sol. in  $\text{H}_2\text{O}$ . (Svanberg and Struve, J. B. 1847-48. 412.)

$\text{Ag}_2\text{O}$ ,  $4\text{MoO}_3 + 6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Wempe, Z. anorg. 1912, 78. 322.)

**Silver thorium molybdate.**

See Thoromolybdate, silver.

**Silver molybdate ammonia,  $\text{Ag}_2\text{MoO}_4$ ,  $4\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with rapid decomposition. (Widmann, Bull. Soc. (2) 20. 64.)

**Silver molybdate hydrogen dioxide,  $13\text{Ag}_2\text{O}$ ,  $2\text{H}_2\text{O}_2$ ,  $32\text{MoO}_3$ .**

Ppt. (Bärwald, B. 17. 1206.)

**Sodium molybdate,  $\text{Na}_2\text{MoO}_4$ .**

Anhydrous. Easily and completely sol. in  $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

+  $10\text{H}_2\text{O}$ . Efflorescent.

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

Solid phase	$t^\circ$ .	Per cent of anhydrous salt	Mols. $\text{H}_2\text{O}$ to 1 mol. of anhydrous salt	Mols. of anhydrous salt to 100 mols. $\text{H}_2\text{O}$
$\text{Na}_2\text{MoO}_4$ , $10\text{H}_2\text{O}$	0	30.63	25.92	3.86
"	4	33.83	22.38	4.47
"	6	35.58	20.72	4.83
"	90	38.16	18.54	5.39
$\text{Na}_2\text{MoO}_4$ , $2\text{H}_2\text{O}$	10	39.28	17.70	5.65
"	15.5	39.27	17.70	5.65
"	32.	39.82	17.30	5.78
"	51.5	41.27	16.28	6.14
"	100	45.57	13.67	7.32

(Funk, B. 1900, 33. 3699.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

$\text{Na}_2\text{Mo}_2\text{O}_7$ . After ignition, very difficultly sol. in cold, and very slowly sol. in hot  $\text{H}_2\text{O}$ . (Svanberg and Struve.)

+  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

+  $3\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in cold or hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

+  $4\text{H}_2\text{O}$ . Easily and completely sol. in cold  $\text{H}_2\text{O}$ . (Ullik.)

+  $6\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

+  $7\text{H}_2\text{O}$ . Difficultly sol. in cold  $\text{H}_2\text{O}$ , but more easily than the corresponding K salt. 100 pts.  $\text{H}_2\text{O}$  dissolve 3.878 pts. at  $20^\circ$  and 13.7 pts. at  $100^\circ$ . (Ullik, A. 144. 244.)

+  $9\text{H}_2\text{O}$ . Easily sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . (Wempe.)

+  $11\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46. 437.)

$3\text{Na}_2\text{O}$ ,  $7\text{MoO}_3$ . Easily sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . (Ott, Dissert. 1911.)

+  $20\text{H}_2\text{O}$ . (Westphal, Dissert. 1895.)

+  $22\text{H}_2\text{O}$ . Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Ullik, A. 144. 219.)

$\text{Na}_2\text{O}$ ,  $8\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Very sol. in cold or hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

+  $4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Ullik, W. A. B. 60, 2. 312.)

+  $15\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1897, 15. 188.)

$\text{Na}_2\text{O}$ ,  $10\text{MoO}_3 + 6\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve 0.842 g. at  $100^\circ$ . (Felix, Dissert. 1912.)

+  $7\text{H}_2\text{O}$ . (Felix.) Nearly insol. in hot and cold  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1903, 37. 323.)

+  $12\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ .

+  $21\text{H}_2\text{O}$ . Abundantly but slowly sol. in cold  $\text{H}_2\text{O}$ . =  $\text{NaHN}_2\text{O}_{11} + 10\text{H}_2\text{O}$ . (Ullik.)

$5\text{Na}_2\text{O}$ ,  $12\text{MoO}_3 + 8\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

+  $20\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

+  $36\text{H}_2\text{O}$ . (Junius, Z. anorg. 1905, 46. 436.)

+  $44\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

**Sodium tetramolybdate,  $\text{Na}_2\text{Mo}_4\text{O}_{13} + 6\text{H}_2\text{O}$ .**

Difficultly sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Ullik.)

100 cc.  $\text{H}_2\text{O}$  dissolve at  $21^\circ$ , 28.39 g. of the salt. Sp. gr. of the solution = 1.47. (Wempe, Z. anorg. 1912, 78. 306.)

+  $17\text{H}_2\text{O}$ . (Felix, Dissert. 1912.)

$\text{Na}_4\text{H}_4(\text{H}_3(\text{Mo}_2\text{O}_7)_3) + 21\text{H}_2\text{O}$ . Slowly sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1913, 79. 298.)

$\text{NaHM}_2\text{O}_{11} + 8\text{H}_2\text{O}$ . Very sol. in hot or cold  $\text{H}_2\text{O}$ . (Ullik, A. 144. 333.)

$\text{NaHM}_2\text{O}_{11} + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Ullik.)

**Sodium manganous molybdate,  $2\text{Na}_2\text{O}$ ,  $\text{MnO}$ ,  $6\text{MoO}_3 + 19\text{H}_2\text{O}$ .**

(Marckwald, Dissert. 1895.)

**Sodium molybdate molybdenum oxide,**

$\text{Na}_2\text{Mo}_2\text{O}_{11}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  and aqua regia. Insol. in  $\text{HCl}$  and in  $\text{H}_2\text{SO}_4$ . Sol. in

alkalies. (Stavenhagen and Engels, B. 1895, 28. 2280.)

#### Strontium molybdate, $\text{SrMoO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Schultze.)  
Sol. in 9600 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . (Smith and Bradbury, B. 24. 2930.)

$\text{SrO}$ ,  $3\text{MoO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Scarcely sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

$\text{SrO}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 6\text{H}_2\text{O}$ . Scarcely sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Wempe, Dissert. 1911.)

$2\text{SrO}$ ,  $3\text{H}_2\text{O}$ ,  $20\text{MoO}_3 + 21\text{H}_2\text{O}$ . Ppt. (Wempe, Z. anorg. 1912, 78. 321.)

#### Thallous molybdate, $\text{Tl}_2\text{MoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in alkalies. Insol. in alcohol. (Oettinger, J. B. 1864, 254.)

Sl. sol. in hot or cold  $\text{H}_2\text{O}$ . (Ullik, J. B. 1867, 234.)

$8\text{Tl}_2\text{O}$ ,  $11\text{MoO}_3$ . Sol. in hot  $\text{H}_2\text{O}$ . (Fleming, J. B. 1868, 250.)

$3\text{Tl}_2\text{O}$ ,  $8\text{MoO}_3$ . (Fleming.)

#### Thallous tetramolybdate, $\text{Tl}_2\text{O}$ , $4\text{MoO}_3 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Wempe, Z. anorg. 1912, 78. 322.)

#### Thallous paramolybdate, $5\text{Tl}_2\text{O}$ , $12\text{MoO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in mineral acids and in alkali hydroxides and carbonates. (Junius, Z. anorg. 1905, 46. 432.)

#### Tin (stannic) molybdate.

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. or conc.  $\text{HCl} + \text{Aq}$ , or in  $\text{KOH} + \text{Aq}$ . Not decomp. by  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)

#### Uranous molybdate.

Precipitate. Sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$ .

$\text{U}(\text{MoO}_4)_2$ . (Lancien, C. C. 1908, I. 1763.)

#### Uranyl molybdate, $(\text{UO}_2)\text{MoO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , methyl and ethyl alcohol, ether, acetic acid,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$  and  $\text{C}_2\text{H}_5$ . Sol. in mineral acids. (Lancien, C. C. 1907, I. 784.)

$2\text{UO}_3$ ,  $3\text{MoO}_3$  (?). Insol. in  $\text{H}_2\text{O}$ . Sol. in strong acids and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Berzelius.)

$3\text{UO}_3$ ,  $7\text{MoO}_3$ . Insol. in hot and cold  $\text{H}_2\text{O}$ . Insol. in  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in all min. acids and decomp. by an excess of  $\text{H}_2\text{O}$ . Insol. in acetic acid. (Lancien, C. C. 1908, I. 1763.)

$\text{UO}_3$ ,  $8\text{MoO}_3$ . (Lancien.)

$+13\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$ . (Lancien.)

#### Ytterbium molybdate, $\text{Yb}_2\text{O}_3$ , $7\text{MoO}_3 + 6\text{H}_2\text{O}$ .

Insol. in hot  $\text{H}_2\text{O}$ . (Cleve, Z. anorg. 1902, 32. 152.)

$2\text{Yb}_2\text{O}_3$ ,  $\text{MoO}_3$ . Ppt. (Cleve.)

#### Yttrium molybdate.

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Berlin.)

#### Zinc molybdate, $\text{ZnMoO}_4$ .

Difficultly sol. in  $\text{H}_2\text{O}$ ; easily in acids. (Schultze, A. 126. 49.)

$+ \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Coloriano, Bull. Soc. (2) 50. 451.)

$\text{ZnMo}_2\text{O}_7 + 10\text{H}_2\text{O}$ . Very difficultly sol. in cold, but extraordinarily easily sol. in hot  $\text{H}_2\text{O}$ . (Ullik, W. A. B. 55, 2. 767.)

#### Zinc tetramolybdate, $\text{ZnMo}_4\text{O}_{13} + 8\text{H}_2\text{O}$ .

Easily sol. in cold  $\text{H}_2\text{O}$ . (Ullik.)

$\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $8\text{MoO}_3 + 14\text{H}_2\text{O}$ . Ppt. (Wempe, Z. anorg. 1912, 78. 324.)

#### Zinc molybdate ammonia, $\text{ZnMoO}_4$ , $2\text{NH}_3 + \text{H}_2\text{O}$ .

(Sonnenschein, J. pr. 53. 339.)

#### Permolybdic acid.

See Permolybdic acid.

#### Molybdic sulphuric acid, $\text{MoO}_3$ , $\text{SO}_3$ .

Deliquescent. (Schultz-Sellack, B. 4. 14.)

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Muthmann, A. 1886, 238. 126.)

$\text{MoO}_3$ ,  $3\text{SO}_3 + 2\text{H}_2\text{O}$  (?).

#### Molybdocyanhydric acid, $\text{H}_2\text{Mo}(\text{CN})_6 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and abs. alcohol. Solutions are stable at ord. temp. (Rosenheim and Garfunkel, Z. anorg. 1910, 65. 168.)

#### Cadmium molybdocyanide, $\text{Cd}_2\text{Mo}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

#### Cadmium molybdocyanide ammonia,

$\text{Cd}_2\text{Mo}(\text{CN})_8$ ,  $4\text{NH}_3 + 2\text{H}_2\text{O}$ .

(Rosenheim.)

#### Cupric molybdocyanide ammonia,

$\text{Cu}_2\text{Mo}(\text{CN})_8$ ,  $4\text{NH}_3 + 7\text{H}_2\text{O}$ .

(Rosenheim.)

#### Potassium molybdocyanide, $\text{K}_4\text{Mo}(\text{CN})_8 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

#### Thallous molybdocyanide, $\text{Tl}_4\text{Mo}(\text{CN})_8$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

#### Molybdoiodic acid, $\text{HIO}_3$ , $\text{H}_2\text{MoO}_4 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 40. 320.)

$\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3 + 2\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Insol. in cold, sol. in hot  $\text{HNO}_3$ . Sol. in alcohol. (Chrétien, A. ch. 1898, (7) 15. 402.)

**Ammonium molybdoiodate,  $\text{NH}_4\text{IO}_3$ ,  $\text{H}_2\text{MoO}_4$ .**

Somewhat more sol. than K salt. (Blomstrand.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ . Very sl. sol. in cold  $\text{H}_2\text{O}$ . More sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim and Liebknecht, A. 1899, 308. 50.)

+ $\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolves 5.39 g. salt at  $15^\circ$ ; 30.94 g. at  $100^\circ$ . More sol. in dil.  $\text{HNO}_3$  + Aq. (Chrétien, A. ch. 1898, (7) 15. 409.)

$3(\text{NH}_4)_2\text{O}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ , + $6\text{H}_2\text{O}$ . (Chrétien.)

**Barium molybdoiodate,  $\text{BaO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $2\text{H}_2\text{O}$ .**

4.23 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at ord. temp. (Chrétien.)

**Cadmium molybdoiodate, acid,  $3\text{CdO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ , + $16\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Calcium molybdoiodate,  $\text{CaO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 7.8 g. of the salt at  $15^\circ$ ; 20.89 g. at  $90^\circ$ . (Chrétien.)

**Cobaltous molybdoiodate,  $\text{CoO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

5.11 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ ; 22.27 g. at  $100^\circ$ . (Chrétien.)

**Cobaltous molybdoiodate acid,  $\text{CoO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ , + $18\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Cupric molybdoiodate,  $\text{CuO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $3\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 10.63 g. of the salt at  $15^\circ$ ; 25.55 g. at  $100^\circ$ . (Chrétien.)

**Lithium molybdoiodate,  $\text{Li}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $2\frac{1}{2}\text{H}_2\text{O}$ .**

197.83 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ . Sol. in dil.  $\text{HNO}_3$  + Aq. (Chrétien.)

**Magnesium molybdoiodate,  $\text{MgO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 3.85 g. of the salt at  $15^\circ$ ; 18.2 g. at  $100^\circ$ . (Chrétien.)

**Manganous molybdoiodate,  $3\text{MnO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ , + $9\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 17.05 g. of the salt at  $15^\circ$ ; 55.06 g. at  $100^\circ$ . (Chrétien.)

**Nickel molybdoiodate,  $\text{NiO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $6\text{H}_2\text{O}$ .**

5.43 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ ; 21.8 g. at  $100^\circ$ . (Chrétien.)

$2\text{NiO}$ ,  $2\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$  +  $23\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Not decomp. by acids. (Maass, Dissert. 1901.)

**Nickel molybdoiodate, acid,  $2\text{NiO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ , + $15\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Potassium molybdoiodate,  $\text{KHO}$ ,  $\text{IO}_3$ ,  $\text{MoO}_3$ , OH, or  $\text{KIO}_3$ ,  $\text{MoO}_3$  +  $2\text{H}_2\text{O}$ .**

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Blomstrand, J. pr. (2) 40. 320.)

$\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$ . Only sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. on long boiling. 4.48 gra. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Compare Blomstrand: not identical.) (Rosenheim, A. 1899, 306. 50.)

+ $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . 3.45 g. are sol. in 1 l.  $\text{H}_2\text{O}$  at  $15^\circ$ ; 28.38 g. at  $100^\circ$ . More sol. in dil.  $\text{HNO}_3$  + Aq. (Chrétien, A. ch. 1898, (7) 15. 404.)

**Potassium molybdoiodate, acid.**

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $4\text{K}_2\text{O}$  +  $7\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $2\text{K}_2\text{O}$  +  $13\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $\text{K}_2\text{O}$  +  $4\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $\text{K}_2\text{O}$  +  $7\text{H}_2\text{O}$ .

$(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ ,  $\text{K}_2\text{O}$  +  $5\text{H}_2\text{O}$ .

(Chrétien.)

**Silver molybdoiodate,  $\text{Ag}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $1\frac{1}{2}\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ .

$4\text{Ag}_2\text{O}$ ,  $4\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$ . Sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Chrétien.)

**Sodium molybdoiodate,  $\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  with decomp. (Chrétien, C. R. 1896, 123. 178.)

1 l.  $\text{H}_2\text{O}$  dissolves 6.97 g. of the salt at  $15^\circ$ ; 22.75 g. at  $90^\circ$ .

1 l.  $\text{HNO}_3$  + Aq (1 : 10) dissolves 23.78 g. of the salt at ord. temp. (Chrétien, A. ch. 1898, (7) 15. 410.)

+ $2\text{H}_2\text{O}$ . Only sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. on long boiling. 3.35 grams are sol. in 1 l.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Rosenheim, A. 1899, 306. 50.)

**Strontium molybdoiodate,  $\text{SrO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $3\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien, A. ch. 1898, (7) 15. 415.)

**Strontium molybdoiodate, acid,  $3\text{SrO}$ ,  $(\text{I}_2\text{O}_5)_2$ ,  $2\text{MoO}_3$ , + $15\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 2.94 g. of the salt at  $15^\circ$ ; 13.64 g. at  $100^\circ$ . (Chrétien.)

**Uranyl molybdoiodate,  $2\text{UO}_3$ ,  $4\text{I}_2\text{O}_5$ ,  $3\text{MoO}_3$  +  $3\text{H}_2\text{O}$ . (Chrétien.)****Zinc molybdoiodate,  $\text{ZnO}$ ,  $\text{I}_2\text{O}_5$ ,  $2\text{MoO}_3$  +  $5\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 4.08 g. of the salt at  $15^\circ$ ; 16.25 g. at  $100^\circ$ . (Chrétien.)

**Zinc molybdoiodate acid**,  $\text{ZnO}$ ,  $(\text{I}_2\text{O}_5, 2\text{MoO}_3)_2$ ,  $+16\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Chrétien.)

**Molybdoperiodic acid,**

**Ammonium molybdoperiodate**,  $5(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Blomstrand, Sv. V. A. H. Bih. 1892. No. 6.)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $8\text{MoO}_3+7\text{H}_2\text{O}$ . Very sl. sol. in cold  $\text{H}_2\text{O}$ . (Blomstrand.)

**Ammonium sodium** —,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $2\text{MoO}_3+10\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (B.)

**Barium sodium** —,  $9\text{BaO}$ ,  $\text{Na}_2\text{O}$ ,  $2\text{I}_2\text{O}_7$ ,  $24\text{MoO}_3+28\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (B.)

**Calcium** —,  $5\text{CaO}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+26\text{H}_2\text{O}$ .

Extremely sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

$4\text{CaO}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+21\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than above salt.

**Lithium** —,  $5\text{Li}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+30\text{H}_2\text{O}$ .

Not so efflorescent as Na salt. Sol. in  $\text{H}_2\text{O}$ . (B.)

$+18\text{H}_2\text{O}$ .) (B.)

**Manganous sodium** —,  $2\text{MnO}$ ,  $3\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+32\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (B.)

**Potassium** —,  $5\text{K}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+12\text{H}_2\text{O}$ .

Not efflorescent. (Blomstrand.)

**Sodium** —,  $5\text{Na}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+34\text{H}_2\text{O}$ .

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Blomstrand, Sv. V. A. H. Bih. 1892. No. 6. 24.)

$+26\text{H}_2\text{O}$ . Not efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

**Sodium strontium** —,  $\text{Na}_2\text{O}$ ,  $4\text{SrO}$ ,  $\text{I}_2\text{O}_7$ ,  $12\text{MoO}_3+20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (B.)

**Molybdophosphoric acid.**

See Phosphomolybdic acid.

**Molybdosubphosphoric acid.**

**Sodium molybdosubphosphate**,  $\text{Na}_2[\text{P}(\text{Mo}_2\text{O}_7)_3]+8\text{H}_2\text{O}$ .

Ppt. (Rosenheim, Z. anorg. 1913, 84. 222.)

**Molybdophosphorous acid.**

**Potassium molybdophosphite**,  $\text{K}_2[\text{HP}(\text{Mo}_2\text{O}_7)_3]+11\text{H}_2\text{O}$ .

Difficultly sol. in cold  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1913, 84. 219.)

**Sodium molybdophosphite**,  $\text{Na}_2[\text{HP}(\text{Mo}_2\text{O}_7)_3]+11\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1913, 84. 218.)

**Molybdophosphovanadic acid.**

See Phosphovanadiomolybdic acid.

**Molybdoselenious acid.**

**Ammonium molybdoselenite**,  $4(\text{NH}_4)_2\text{O}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+4\text{H}_2\text{O}$ .

More sol. in hot than cold  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar, A. ch. (6) 30. 403.)

**Ammonium potassium molybdoselenite**,  $2(\text{NH}_4)_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+5\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar.)

**Barium molybdoselenite**,  $4\text{BaO}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+3\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in warm  $\text{H}_2\text{O}$ . (Péchar.)

**Potassium molybdoselenite**,  $4\text{K}_2\text{O}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+5\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar.)

**Sodium molybdoselenite**,  $4\text{Na}_2\text{O}$ ,  $3\text{SeO}_2$ ,  $10\text{MoO}_3+15\text{H}_2\text{O}$ .

Very efflorescent, and sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar.)

**Molybdosilicic acid.**

See Silicomolybdic acid.

**Molybdosilicovanadic acid.**

See Silicovanadiomolybdic acid.

**Molybdosulphuric acid.**

Appreciably sol. in  $\text{H}_2\text{O}$ . (Hoffmann, Dissert. 1903.)

**Ammonium molybdosulphate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{SO}_3+4\text{H}_2\text{O}$ , and  $+9\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1907, 84. 261.)

$(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3$ ,  $3\text{SO}_3+10\text{H}_2\text{O}$ . (Weinland.)

**Ammonium molybdenyl molybdosulphate**,  $(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+x\text{H}_2\text{O}$ .

$1\frac{1}{2}(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+5\text{H}_2\text{O}$ .

$2(\text{NH}_4)_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+14\text{H}_2\text{O}$ . (Hoffmann, Dissert. 1903.)

$3\text{NH}_3$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+10\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{NH}_4$  salts + Aq.

Very stable toward alkali + Aq. (Péchar, C. R. 1893, 116. 1441.)

$5\text{NH}_3$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+8\text{H}_2\text{O}$ . (Pé-  
chard, C. R. 1893, 116. 1441.)

**Potassium molybdosulphate**,  $\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  
 $\text{SO}_3+2\text{H}_2\text{O}$ .

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{SO}_3+6\text{H}_2\text{O}$ .

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $3\text{SO}_3+6\text{H}_2\text{O}$ . (Weinland, Z.  
anorg. 1907, 54. 260.)

**Potassium molybdenyl molybdosulphate**,  
 $\text{K}_2\text{O}$ ,  $\text{MoO}_3$ ,  $7\text{MoO}_3$ ,  $\text{SO}_3+8\text{H}_2\text{O}$ .

(Hoffmann, Dissert. 1903.)

**Molybdosulphurous acid.**

**Ammonium molybdosulphite**,  $4(\text{NH}_4)_2\text{O}$ ,  
 $3\text{SO}_3$ ,  $10\text{MoO}_3+6\text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .  
Insol. in alcohol. (Péchard, A. ch. (6) 30.  
396.)

$3(\text{NH}_4)_2\text{O}$ ,  $8\text{MoO}_3$ ,  $2\text{SO}_3+5\text{H}_2\text{O}$ . Sl. sol.  
in cold, easily sol. in warm  $\text{H}_2\text{O}$ . Easily de-  
comp. by  $\text{H}_2\text{O}$ , and can be recryst. only in  
presence of an excess of sulphurous acid.  
(Rosenheim, Z. anorg. 1894, 7. 177.)

**Ammonium potassium molybdosulphite**,  
 $2(\text{NH}_4)_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SO}_3$ ,  $10\text{MoO}_3+9\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. on warming.  
(Péchard.)

**Barium molybdosulphite**,  $2\text{BaO}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+10\text{H}_2\text{O}$ .

(Rosenheim, Z. anorg. 1897, 15. 185.)

**Cæsium molybdosulphite**,  $2\text{Cs}_2\text{O}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+6\text{H}_2\text{O}$ .

Unstable. As K salt. (Rosenheim.)

**Potassium molybdosulphite**,  $4\text{K}_2\text{O}$ ,  $3\text{SO}_3$ ,  
 $10\text{MoO}_3+10\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , but decomp. on warm-  
ing. (Péchard.)

$2\text{K}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{SO}_3+\text{H}_2\text{O}$ . (Rosenheim.)

**Rubidium molybdosulphite**,  $2\text{Rb}_2\text{O}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+\frac{1}{2}\text{H}_2\text{O}$ .

As K salt. (Rosenheim.)

**Sodium molybdosulphite**,  $4\text{Na}_2\text{O}$ ,  $3\text{SO}_3$ ,  
 $10\text{MoO}_3+12\text{H}_2\text{O}$ .

Very sl. sol. in cold  $\text{H}_2\text{O}$ ; insol. in alcohol.  
(Péchard.)

$+16\text{H}_2\text{O}$ . Very efflorescent. (Péchard.)

$2\text{Na}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{SO}_3+8\text{H}_2\text{O}$ . In dry state  
it gradually gives off  $\text{SO}_3$  and soon effloresces.  
(Rosenheim.)

**Strontium molybdosulphite**,  $2\text{SrO}$ ,  $5\text{MoO}_3$ ,  
 $2\text{SO}_3+12\text{H}_2\text{O}$ .

(Rosenheim.)

**Molybdotitanic acid.**

See Titanomolybdic acid.

**Molybdous acid.**

**Magnesium molybdite**,  $\text{Mg}_2\text{Mo}_2\text{O}_7=2\text{MgO}$ ,  
 $3\text{MoO}_3$ .

Not attacked by  $\text{KOH}$ , and  $\text{HCl}+\text{Aq}$ .  
(Muthmann, A. 238. 108.)

**Zinc molybdite**,  $\text{Zn}_2\text{Mo}_2\text{O}_7=2\text{ZnO}$ ,  $3\text{MoO}_3$ .

Easily sol. in aqua regia. (Muthmann, A.  
238. 108.)

**Molybdovanadates.**

See Vanadiomolybdates.

**Neodymicotungstic acid.**

**Ammonium neodymicotungstate**,  $3(\text{NH}_4)_2\text{O}$ ,  
 $\text{Nd}_2\text{O}_3$ ,  $16\text{WO}_3+20\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J.  
Am. Chem. Soc. 1904, 26. 1480.)

**Barium neodymicotungstate**,  $6\text{BaO}$ ,  $\text{Nd}_2\text{O}_3$ ,  
 $16\text{WO}_3+17\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Neodymium.**

See also under Didymium.

**Neodymium bromide**,  $\text{NdBr}_3$ .

(Matignon, C. R. 1905, 140. 1638.)

**Neodymium carbide**,  $\text{NdC}_2$ .

Decomp. by  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HNO}_3$ ;  
decomp. by dil.  $\text{HNO}_3$ . (Moissan, C. R.  
1900, 131. 597.)

**Neodymium chloride**,  $\text{NdCl}_3$ .

100 g.  $\text{H}_2\text{O}$  dissolve 98.68 g.  $\text{NdCl}_3$  at  $13^\circ$ ;  
140.4 g. at  $100^\circ$ .

Sp. gr. at  $15^\circ/4^\circ$  of the solution sat. at  $13^\circ =$   
1.74. (Matignon, A. ch. 1906, (8) 8. 249.)

44.5 g. are sol. in 100 g. abs. alcohol at  $20^\circ$ .  
1.8 g. " " " " pyridine at  $15^\circ$ .

Insol. in ether,  $\text{CHCl}_3$ , quinoline, toluidine,  
etc. Sl. sol. in aniline and in phenylhydra-  
zine. (Matignon, A. ch. 1906, (8) 8. 266.)  
 $+6\text{H}_2\text{O}$ . Deliquescent.

At  $13^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolve 246.2 pts. of  
the hydrated salt.

At  $100^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolve 511 pts. of  
hydrated salt.

Sat. solution at  $13^\circ$  has a sp. gr.  $15^\circ/4^\circ =$   
1.741. (Matignon, C. R. 1901, 133. 289.)

**Neodymium chloride ammonia**,  $\text{NdCl}_3$ ,  
 $12\text{NH}_3$ .

Decomposes on heating into  $\text{NdCl}_3+\text{NH}_3$ ;  
 $+2\text{NH}_3$ ;  $+4\text{NH}_3$ ;  $+5\text{NH}_3$ ;  $+8\text{NH}_3$ ; and  
 $+11\text{NH}_3$ . (Matignon, C. R. 1906, 142. 1043.)

**Neodymium hydroxide.**

Sol. in citric acid. (Baskerville, J. Am.  
Chem. Soc. 1904, 26. 49.)

Solubility in glycerine+Aq containing about 60% by vol. of glycerine. 100 cm. of the solution contain 4.5 g. neodymium oxide. (Müller, Z. anorg. 1905, 43. 322.)

### Neodymium hydride, NdH<sub>2</sub> (?).

Slowly attacked by boiling H<sub>2</sub>O. Sol. in acids with violent evolution of H<sub>2</sub>. (Muthmann, A. 1904, 331. 58.)

### Neodymium iodide, NdI<sub>3</sub>.

(Matignon, C. R. 1905, 140. 1638.)

### Neodymium nitride, NdN.

Decomp. in moist air with evolution of NH<sub>3</sub>. (Muthmann, A. 1904, 331. 59.)

### Neodymium oxide, Nd<sub>2</sub>O<sub>3</sub>.

Easily sol. in acids. (v. Welsbach, M. 6. 477.)

### Neodymium oxychloride, NdOCl.

(Matignon, C. R. 1905, 140. 1638.)

### Neon, Ne.

Less sol. than argon in H<sub>2</sub>O; sol. in liquid oxygen. (Ramsay, B. 1898, 31. 3118.)

#### Absorption by H<sub>2</sub>O at t°.

t°	Coefficient of absorption
0	0.0114
10	0.0118
20	0.0147
30	0.0158
40	0.0203
50	0.0317

(Antropoff, Roy. Soc. Proc. 1910, 83. A, 480.)

### Nickel, Ni.

Not attacked by H<sub>2</sub>O. Very slowly sol. in dilute H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>, or HCl+Aq. (Tupputi, A. ch. 78. 133.)

Very easily attacked by HNO<sub>3</sub>+Aq, and difficultly by hot H<sub>2</sub>SO<sub>4</sub>. When pure, is converted into passive condition by conc. HNO<sub>3</sub>. (Nickles, C. R. 38. 284.)

Very sl. attacked by cold acids, except HNO<sub>3</sub>+Aq. (Tissier, C. R. 60. 106.)

Not attacked by NaOH+Aq. (Venator, Dinkl. 261. 133.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 828.)

### Nickel amide, Ni(NH<sub>2</sub>)<sub>2</sub>.

Decomp. by H<sub>2</sub>O; slowly sol. in min. acids. Insol. in liquid NH<sub>3</sub>. (Bohart, J. phys. Chem. 1915, 19. 560.)

### Nickel antimonide, NiSb.

Insol. in HCl+Aq; easily sol. in HNO<sub>3</sub>+Aq. (Christoffe, 1863.)

Min. *Breithauptite*. Insol. in acids; easily sol. in aqua regia.

Ni<sub>2</sub>Sb<sub>3</sub>. (Christoffe.)

### Nickel antimonide sulphide, NiSb<sub>2</sub>, NiS<sub>2</sub>=NiSbS.

Min. *Nickel glance*, *Ullmannite*.

Decomp. by HNO<sub>3</sub>+Aq; completely sol. in aqua regia with separation of S.

### Nickel arsenide, NiAs.

Min. *Niccolite*. Sol. in conc. HNO<sub>3</sub>+Aq with separation of As<sub>2</sub>O<sub>3</sub>; more easily sol. in aqua regia.

NiAs<sub>2</sub>. Min. *Chloanthite*, *Rammelsbergite*. Sol. in HNO<sub>3</sub>+Aq.

Ni<sub>2</sub>As<sub>3</sub>. Sol. in HNO<sub>3</sub> and in aqua regia. Readily attacked by fused alkali. (Granger, C. R. 1900, 130. 915.)

### Nickel arsenide sulphide, NiAs<sub>2</sub>, NiS<sub>2</sub>.

Min. *Gersdorffite*. Partly sol. in HNO<sub>3</sub>+Aq with separation of S and As<sub>2</sub>O<sub>3</sub>; not attacked by KOH+Aq.

### Nickel azoimide, basic, Ni(OH)N<sub>2</sub>.

Insol. in H<sub>2</sub>O. (Curtius, J. pr. 1898, (2) 53. 300.)

### Nickel azoimide, NiN<sub>2</sub>+H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; insol. in alcohol and ether. (Curtius, J. pr. 1900, (2) 61. 418.)

Nickel potassium azoimide, Ni(N<sub>2</sub>)<sub>2</sub>, KN<sub>2</sub> (?). Sol. in H<sub>2</sub>O. (Curtius, J. pr. 1898, (2) 53. 302.)

### Nickel boride, Ni<sub>2</sub>B.

Attacked by HNO<sub>3</sub>. Slowly sol. in hot HCl. (Jassoneix, C. R. 1907, 145. 240.)

NiB. Decomp. by moist air and by alkali nitrates, chlorates, hydroxides and carbonates; decomp. by steam at red heat. Not attacked by HCl. Easily attacked by HNO<sub>3</sub> and aqua regia; by H<sub>2</sub>SO<sub>4</sub> only on heating. (Moissan, C. R. 1896, 122. 425.)

NiB<sub>2</sub>. (Jassoneix, C. R. 1907, 145. 241.)

### Nickel bromide, NiBr<sub>2</sub>.

Deliquescent. Slowly sol. in H<sub>2</sub>O.

Sat. NiBr<sub>2</sub>+Aq contains at:

-21°	-6°	+19°	38°
47.1	51.7	56.6	58.9% NiBr <sub>2</sub> ,
58°	77°	98°	100° 140°
60.5	60.3	61.0	61.0 60.7% NiBr <sub>2</sub> .

(Étard, A. ch. 1894, (7) 2. 542.)

Somewhat hygroscopic. Nearly insol. in cold H<sub>2</sub>O but begins to dissolve appreciably at 50°, and somewhat more rapidly at 90°, but even at that temp. 1 g. requires 1-2 hours for solution. HNO<sub>3</sub> does not appreciably hasten solution. (Richards and Cushman, Z. anorg. 1898, 16. 169.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

+3H<sub>2</sub>O. Deliquescent. Very sol. in H<sub>2</sub>O, HCl+Aq, NH<sub>4</sub>OH+Aq, alcohol, and ether. (Berthelot, A. ch. 44. 389.)

+6H<sub>2</sub>O. (Bolschakoff, C. C. 1897, II. 331 and 726.)

+9H<sub>2</sub>O. (Bolschakoff, C. C. 1897, II. 726 and 331.)

### Nickel stannic bromide.

See Bromostannate, nickel.

### Nickel bromide ammonia, NiBr<sub>3</sub>, 6NH<sub>4</sub>.

Sol. in little H<sub>2</sub>O, but decomp. by more. (Rammelsberg, Pogg. 55. 243.)

Sol. in warm conc. NH<sub>4</sub>OH+Aq; insol. in cold. (Richards and Cushman, Z. anorg. 1898, 16. 175.)

### Nickel bromide cupric oxide, NiBr<sub>3</sub>, 3CuO+4H<sub>2</sub>O.

Not decomp. by H<sub>2</sub>O. (Mailhe, A. ch. 1902, (7) 27. 377.)

### Nickel bromide hydrazine, NiBr<sub>3</sub>, 2N<sub>2</sub>H<sub>4</sub>.

Easily sol. in dil. acids and NH<sub>4</sub>OH+Aq. NiBr<sub>3</sub>, 3N<sub>2</sub>H<sub>4</sub>. Sol. in dil. acids. (Fransen, Z. anorg. 1908, 60. 263-4.)

### Nickel carbonyl, Ni(CO)<sub>4</sub>.

Insol. in H<sub>2</sub>O; not attacked by dil. acids or alkalis or conc. HCl+Aq. Easily sol. in conc. HNO<sub>3</sub>+Aq and in aqua regia. Sol. in alcohol, benzene, and chloroform. (Mond, Langer, and Quincke, Chem. Soc. 57. 749.)

Sol. in hydrocarbons, especially oil of turpentine. (Berthelot, C. R. 1891, 112. 1346.)

Sol. in acetone, toluene, methyl and ethyl alcohol, etc. (Lenher and Loos, J. Am. Chem. Soc. 1900, 22. 114.)

### Nickel chloride, NiCl<sub>2</sub>.

*Anhydrous.* Not immediately sol. in H<sub>2</sub>O, but gradually dissolves on boiling or by addition of HCl+Aq. Deliquesces on air, and is then easily sol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+Aq. Sol. in alcohol. Sol. in hot HCl+Aq only slowly.

Sp. gr. of NiCl<sub>2</sub>+Aq containing:

	5	10	15	20	25% NiCl <sub>2</sub>
	1.0493	1.0995	1.1578	1.2245	1.3000
(B. Franz, J. pr. (2) 5. 285.)					

Sp. gr. of NiCl<sub>2</sub>+Aq containing, in 1000 grms. H<sub>2</sub>O, g. NiCl<sub>2</sub>+7H<sub>2</sub>O at 23.1°:

128 g. (= ½ mol.)	256	384	512
1.057	1.107	1.149	1.187
640	768	896	1024
1.220	1.249	1.276	1.301

Containing g. NiCl<sub>2</sub> (anhydrous):

65 g. (= ½ mol.)	130	195	260	325	390
1.061	1.119	1.176	1.230	1.284	1.335
(Gerlach, Z. anal. 28. 468.)					

Sp. gr. of NiCl<sub>2</sub>+Aq at room temp. containing:

11.449	22.69	30.40% NiCl <sub>2</sub>
1.1093	1.2264	1.3371

(Wagner, W. Ann. 1883, 18. 269.)

Sp. gr. of NiCl<sub>2</sub>+Aq at 25°.

Concentration of NiCl <sub>2</sub> +Aq	Sp. gr.
1-normal	1.0591
1/5 " "	1.0308
1/6 " "	1.0144
1/8 " "	1.0067

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)

100 pts. absolute alcohol dissolve at room temperature 10.05 pts. NiCl<sub>2</sub>. (Bödtker, Z. phys. Ch. 1897, 22. 511.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Solubility in glycol=16.1-16.3%. (de Coninck, C. C. 1905, II. 1234.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Anhydrous NiCl<sub>2</sub> is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

+H<sub>2</sub>O. (Baubigny.)

1 l. sat. HCl+Aq at 12° contains 40 g. NiCl<sub>2</sub> dissolved from NiCl<sub>2</sub>, H<sub>2</sub>O. (Ditte.)

+2H<sub>2</sub>O. (Sabatier, Bull. Soc. (3) 1. 88.)

+6H<sub>2</sub>O. Deliquescent in moist, efflorescent in dry air; sol. in H<sub>2</sub>O with evolution of heat. Sol. in 1.5 to 2 pts. H<sub>2</sub>O. Easily sol. in alcohol. (Tupputi.)

1 l. H<sub>2</sub>O dissolves 600 g. NiCl<sub>2</sub>+6H<sub>2</sub>O. (Ditte, A. ch. 1879, (5) 22. 551.)

Sat. aq. solution contains at:

-17°	-16°	+10°	18°
29.7	31.0	37.3	38.5% NiCl <sub>2</sub>

38°	59°	78°	96°
41.9	45.0	46.6	46.7% NiCl <sub>2</sub>

(Étard, A. ch. 1894, (7) 2. 539.)

Solubility of NiCl<sub>2</sub>+6H<sub>2</sub>O=37.53% NiCl<sub>2</sub> at 25°. (Foote, J. Am. Chem. Soc. 1912, 34. 882.)

100 pts. absolute alcohol dissolve at room temperature 53.71 pts. NiCl<sub>2</sub>+6H<sub>2</sub>O. (Bödtker, Z. phys. Ch. 1897, 22. 511.)



+7H<sub>2</sub>O. 100 g. absolute alcohol dissolve 2.16 g. NiCl<sub>2</sub>+7H<sub>2</sub>O at 17° and 1.4 g. at 3°. (de Bruyn, R. t. c. 1892, 11. 156.)

**Nickel hydrogen chloride**, 3NiCl<sub>2</sub>, 2HCl+1½H<sub>2</sub>O.  
(Reitzenstein, Z. anorg. 1898, 18. 270.)

**Nickel rubidium chloride**, NiCl<sub>2</sub>, 2RbCl.  
Easily sol. in H<sub>2</sub>O and HCl+Aq. (Godefroy, B. 8. 9.)

**Nickel thallic chloride**, NiCl<sub>2</sub>, 2TlCl<sub>3</sub>+8H<sub>2</sub>O.  
Deliquescent. Can be cryst. from H<sub>2</sub>O. (Gewecke, A. 1909, 366. 221.)

**Nickel tin (stannous) chloride**, NiCl<sub>2</sub>, SnCl<sub>2</sub>+6H<sub>2</sub>O.  
Sol. in H<sub>2</sub>O. (Jørgensen.)

**Nickel tin (stannic) chloride.**  
See Chlorostannate, nickel.

**Nickel chloride ammonia**, NiCl<sub>2</sub>, 2NH<sub>3</sub>.  
Sol. in H<sub>2</sub>O, decomp. on boiling; insol. in alcohol.  
NiCl<sub>2</sub>, 3NH<sub>3</sub>+3H<sub>2</sub>O. (André, C. R. 1888, 106. 937.)

NiCl<sub>2</sub>, 6NH<sub>3</sub>. Sol. in cold H<sub>2</sub>O without decomp. Insol. in alcohol. Very sl. sol. in conc. NH<sub>4</sub>OH+Aq.

Nearly insol. in a sat. solution of NH<sub>4</sub>Cl in NH<sub>4</sub>OH+Aq. (Sørensen, Z. anorg. 1894, 5. 363.)

**Nickel chloride cupric oxide**, NiCl<sub>2</sub>, 3CuO+4H<sub>2</sub>O.

Not decomp. by H<sub>2</sub>O. (Mailhe, A. ch. 1902, (7) 27. 377.)

**Nickel chloride hydrazine**, NiCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.  
Sol. in dil. acids and NH<sub>3</sub>+Aq. (Franzen, Z. anorg. 1908, 60. 262.)

NiCl<sub>2</sub>, 3N<sub>2</sub>H<sub>4</sub>. Sol. in dil. acids. (F.)

**Nickel fluoride**, NiF<sub>2</sub>.

Sol. in about 5000 pts. H<sub>2</sub>O; insol. in alcohol and ether. Not attacked by HCl, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>, even when hot. (Poulenc, C. R. 114. 1426.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 828.)

+2H<sub>2</sub>O. Decomp. by pure H<sub>2</sub>O. Sol. in H<sub>2</sub>O acidulated with HF. (Berzelius.)

+3H<sub>2</sub>O. (Clarke, Sill. Am. J. (3) 13. 291.)

**Nickel hydrogen fluoride**, NiF<sub>2</sub>, 5HF+6H<sub>2</sub>O.  
Easily sol. in H<sub>2</sub>O and dil. acids. Sol. in NH<sub>4</sub>OH+Aq with decomp. (Böhm, Z. anorg. 1905, 43. 330.)

**Nickel potassium fluoride**, NiF<sub>2</sub>, KF.

+H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Wagner, B. 19. 896.)

NiF<sub>2</sub>, 2KF. Sl. sol. in H<sub>2</sub>O. Scarcely sol. in methyl or ethyl alcohol or benzene. (Poulenc, C. R. 114. 747.)

**Nickel potassium zirconium fluoride.**  
See Fluozirconate, nickel potassium.

**Nickel manganic fluoride.**  
See Fluomanganate, nickel.

**Nickel sodium fluoride**, NiF<sub>2</sub>, NaF+H<sub>2</sub>O.  
Sol. in H<sub>2</sub>O. (Wagner, B. 19. 896.)

**Nickel stannic fluoride.**  
See Fluostannate, nickel.

**Nickel titanium fluoride.**  
See Fluotitanate, nickel.

**Nickel tungstyl fluoride.**  
See Fluoxytungstate, nickel.

**Nickel vanadium fluoride.**  
See Fluovanadate, nickel.

**Nickel zirconium fluoride.**  
See Fluozirconate, nickel.

**Nickel fluoride ammonia**, 5NiF<sub>2</sub>, 6NH<sub>3</sub>+8H<sub>2</sub>O.

Insol. in cold H<sub>2</sub>O. Decomp. by hot H<sub>2</sub>O. Easily sol. in dil. acids. (Böhm, Z. anorg. 1905, 43. 334.)

**Nickelous hydroxide**, 4NiO.H<sub>2</sub>, H<sub>2</sub>O.

Very sl. sol. in H<sub>2</sub>O. Sol. in acids. Insol. in KOH or NaOH+Aq. Somewhat difficultly sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> or NH<sub>4</sub>OH+Aq, but easily sol. in presence of NH<sub>4</sub> salts. Sol. in NH<sub>4</sub> salts+Aq. Sol. in KCN+Aq. (Rodgers, 1834.)

Sol. in boiling NH<sub>4</sub>Cl+Aq.

NiO.H<sub>2</sub>.

Solubility in NH<sub>4</sub>OH+Aq at 25°.

NH <sub>3</sub> norm.	G. Ni per l.	G. NiO.H <sub>2</sub> per l.
1	0.084	0.00287
2	0.170	0.00579
3	0.257	0.00875
4	0.360	0.01227
4.911	2.580	0.0879
3.900	1.780	0.0607
2.101	0.835	0.0284
0.602	0.158	0.0054

The non-agreement of the results is due to the formation of different modifications of NiO.H<sub>2</sub>.

(Bonsdorff, Z. anorg. 1904, 41. 185.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq.}$   
 Conc. of  $\text{Ni} = 0.014\text{N}$  in  $1\text{N } \text{NH}_4\text{OH} + \text{Aq.}$   
 " " "  $= 0.036\text{N}$  "  $2\text{N } \text{NH}_4\text{OH} + \text{Aq.}$   
 (Starck, B. 1903, 36. 3840.)  
 Sol. in hot  $\text{NH}_4\text{F} + \text{Aq.}$  (von Helmolt, Z. anorg. 1893, 3. 133.)  
 Insol. in methyl or amyl amine. (Wurtz.)  
 Not pptd. in presence of  $\text{Na citrate}$ . (Spiller.)  
 Not pptd. in presence of a large number of non-volatile organic substances, particularly  $\text{H}_2\text{C}_4\text{H}_6\text{O}_6$ . (Rose.)

#### Nickelonickelic hydroxide, $\text{Ni}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ .

Sol. in acids; insol. in  $\text{H}_2\text{O}$  and alkalies. (Dudley, J. Am. Chem. Soc. 1896, 18. 901.)

#### Nickelic hydroxide, $\text{Ni}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ (?).

(Wernicke, Pogg. 141. 122.)  
 $\text{Ni}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  (?). Sol. in acids as nickelous salts. Not attacked by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$  Slowly sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  Sol. in  $\text{NH}_4\text{OH}$ , and  $\text{NH}_4$  salts +  $\text{Aq.}$  (Odling.)

#### Nickel iodide, $\text{NiI}_2$ .

Deliquescent and sol. in  $\text{H}_2\text{O}$ . (Erdmann, J. pr. 7. 254.)

Sat.  $\text{NiI}_2 + \text{Aq}$  contains at:

$-23^\circ$	$-6^\circ$	$+11^\circ$	$16^\circ$
51.8	54.3	57.8	59.0% $\text{NiI}_2$ ,

$43^\circ$	$80^\circ$	$85^\circ$	$90^\circ$
64.1	65.0	65.2	65.7% $\text{NiI}_2$ .

(Étard, A. ch. 1894, (7) 2. 546.)

+  $6\text{H}_2\text{O}$ . Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Erdmann.)

#### Nickel iodide ammonia, $\text{NiI}_2 \cdot 4\text{NH}_3$ .

(Rammelsberg, Pogg. 48. 119.)  
 $\text{NiI}_2 \cdot 6\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  Very sl. sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Erdmann.)

#### Nickel iodide hydrazine, $\text{NiI}_2 \cdot (\text{N}_2\text{H}_4)_2$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Franzen, Z. anorg. 1911, 70. 150.)

#### Nickel suboxide, $\text{Ni}_2\text{O}_3 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ ; also in  $\text{KCN} + \text{Aq.}$  (Moore, C. N. 1895, 71. 81.)

#### Nickelous oxide, $\text{NiO}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc. acids, except when crystalline, when it is scarcely attacked by acids. (Ebelmen, C. R. 33. 256.)

Very sl. sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Demarçay.)

Very slowly sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Insol. in  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq.}$

Sol. in min. acids, especially  $\text{HCl} + \text{Aq.}$  when warmed; insol. in  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{NH}_4\text{Cl}$ ,

and  $\text{NH}_4\text{SCN} + \text{Aq.}$  Insol. in conc.  $\text{NaOH} + \text{Aq.}$  (Zimmerman, A. 232. 324.)

1 l. solution containing 418.6 g. sugar and 34.3 g.  $\text{CaO}$  dissolves 0.29 g.  $\text{NiO}$ . (Bodenbender, J. B. 1865. 600.)

Min. *Bunsenite*.

#### Nickelonickelic oxide, $\text{Ni}_2\text{O}_4$ .

Sol. in acids. (Baubigny, C. R. 87. 1082.)  
 +  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , and in alkalies +  $\text{Aq.}$  Sol. in acids. (Dudley, J. Am. Chem. Soc. 1896, 18. 901.)  
 $6\text{NiO}, \text{Ni}_2\text{O}_3 + \text{H}_2\text{O}$ . (Schönbein, J. pr. 93. 35.)

#### Nickelic oxide, $\text{Ni}_2\text{O}_3$ .

Sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HCl} + \text{Aq}$  with decomp., also in  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (Winkelblech, A. 13. 259.)

#### Nickel peroxide, $\text{Ni}_2\text{O}_4$ (?).

(Bayley, C. N. 39. 81.)  
 Correct composition is  $\text{Ni}_2\text{O}_3$ . (Carnot, C. R. 108. 610.)  
 $\text{Ni}_2\text{O}_7$  (?). (Wicke, Zeit. Ch. 1865. 303.)  
 $\text{NiO}_4$ . (Hollard, C. R. 1903, 136. 230.)

#### Nickel oxychloride.

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
 $\text{NiCl}_2, 8\text{NiO} + 13\text{H}_2\text{O}$ . (Raoult, C. R. 69. 826.)

#### Nickel oxyiodide, $\text{NiI}_2, 9\text{NiO} + 15\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$  or acetic acid. Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Alcohol dissolves out  $\text{NiI}_2$ . (Erdmann.)

#### Nickel oxyselenide.

Almost insol. in boiling  $\text{HCl}$ ; decomp. by  $\text{HNO}_3$ . (Fonzees-Diacon, C. R. 1900, 131. 557.)

#### Nickel phosphide, $\text{Ni}_2\text{P}$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$  and aqua regia; insol. in  $\text{HCl} + \text{Aq.}$  (Struve, J. pr. 79. 321.)

Sol. in aqua regia and in  $\text{HNO}_3$ ; sol. in fused alkali. (Granger, Bull. Soc. 1896, (3) 15. 1089.)

Easily sol. in  $\text{HNO}_3$ . (Granger, C. N. 1898, 77. 229.)

When prepared by heating phosphorus, copper and nickel in electric furnace, is insol. in all acids except a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Maronneau, C. R. 1900, 130. 657.)

$\text{Ni}_2\text{P}_1$ . Sol. in  $\text{HNO}_3$ ; decomp. by fused  $\text{NaOH}$ . (Jolibois, C. R. 1910, 150. 107.)

$\text{Ni}_2\text{P}_1$ . Sol. in  $\text{HNO}_3$ ; decomp. by fused  $\text{NaOH}$ . (J.)

$\text{Ni}_2\text{P}_1$ . Insol. in  $\text{HNO}_3$ ,  $\text{HCl}$  and aqua regia; stable in the air even when heated (Granger, Bull. Soc. 1896, (3) 15. 1086.)

$\text{Ni}_2\text{P}_2$ . Not attacked by  $\text{HCl}$ . Easily attacked by  $\text{HNO}_3$ . (Rose, Pogg. 1832, 24. 232.)

$\text{Ni}_3\text{P}_2$ . Sol. in  $\text{HNO}_3$ , aqua regia and in fused alkali. (Granger, C. R. 1896, 123. 177.)

**Nickel phosphosulphide,  $\text{Ni}_3\text{PS}_2$ .**

Decomp. by hot  $\text{H}_2\text{O}$  or by aqua regia. Sl. attacked by  $\text{HNO}_3$ . (Ferrand, A. ch. 1899, (7) 17. 417.)

**Nickel semiselenide,  $\text{Ni}_2\text{Se}$ .**

Almost insol. in boiling  $\text{HCl}$ ; decomp. by  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 131. 557.)

**Nickel selenide,  $\text{NiSe}$ .**

Insol. in  $\text{H}_2\text{O}$ , dil. or conc.  $\text{HCl} + \text{Aq}$ ; slowly sol. in  $\text{HNO}_3 + \text{Aq}$ ; easily in aqua regia. (Little, A. 112. 211.)

Almost insol. in boiling  $\text{HCl}$ ; decomp. by  $\text{HNO}_3$ . (Fonze-Diacon, C. R. 1900, 131. 557.)

$\text{NiSe}_2$ . (Fonze-Diacon.)

$\text{Ni}_2\text{Se}_3$   
 $\text{Ni}_3\text{Se}_4$  } Almost insol. in boiling  $\text{HCl}$ ; decomp. by  $\text{HNO}_3$ . (Fonze-Diacon.)

**Nickel silicide,  $\text{Ni}_2\text{Si}$ .**

Sol. in  $\text{HF}$  and aqua regia; insol. in cold  $\text{H}_2\text{O}$ ; decomp. by steam at red heat; sol. in fused alkali carbonates. (Vigouroux, C. R. 1895, 121. 687.)

**Nickel semisulphide,  $\text{Ni}_2\text{S}$ .**

Sol. in  $\text{HNO}_3 + \text{Aq}$ , with residue of  $\text{S}$ . Difficultly sol. in conc.  $\text{HCl} + \text{Aq}$ ; insol. in dil.  $\text{HCl} + \text{Aq}$ . (Arfvedson, Pogg. 1. 65; Gautier, C. R. 108. 1111.)

Does not exist. (Bornemann, C. A. 1903. 1686.)

**Nickel monosulphide,  $\text{NiS}$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$  or aqua regia.

*Min. Millerite.*

$+x\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. by  $\text{H}_2\text{O}$  in contact with the air (Clermont and Guio, C. R. 84. 714), or by boiling with  $\text{H}_2\text{O}$ . (Geitner, A. 139. 354.)

When pptd. with  $(\text{NH}_4)_2\text{S}$ , is somewhat sol. in  $\text{H}_2\text{O}$ . 1 l.  $\text{H}_2\text{O}$  dissolves  $39.87 \times 10^{-6}$  moles  $\text{NiS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Very sl. sol. in dil.  $\text{HCl} + \text{Aq}$ , and still less in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Fresenius.)

More sol. in  $\text{HNO}_3 + \text{Aq}$ , and easily in aqua regia.

Somewhat sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or solutions of alkali sulphides. Insol. in  $\text{NH}_4\text{SH} + \text{Aq}$ . (Fresenius.)

Sol. at moment of formation in  $\text{Na}_2\text{S}$  but not in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . (Villiers, C. R. 1894, 119. 1264.)

Sol. while yet moist in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Berthier.)

When recently pptd., sol. in  $\text{KCN} + \text{Aq}$ . (Haidlen.)

Pptd. in presence of non-volatile organic substances as tartaric acid, etc. (Rose.)

Sol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26. 15.)

Exists in a colloidal form in a very dil. solution. (Winninger, Bull. Soc. (2) 49. 452.)

$\alpha$  modification:

Very sol. in  $2\text{N-HCl} + \text{Aq}$  sat. with  $\text{H}_2\text{S}$ .

$\beta$  modification:

0.033 g. is sol. in 1 l.  $2\text{N-HCl} + \text{Aq}$  sat. with  $\text{H}_2\text{S}$ ; very sol. in  $2\text{N-HCl} + \text{Aq}$ .

$\gamma$  modification:

Insol. in  $2\text{N-HCl} + \text{Aq}$  sat. with  $\text{H}_2\text{S}$ . 0.013 g. is sol. in  $2\text{N-HCl} + \text{Aq}$ . (Thiel, C. C. 1914, I. 19.)

**Nickel sulphide,  $\text{Ni}_3\text{S}_2$ .**

(Bornemann, C. A. 1903. 1686.)

$\text{Ni}_3\text{S}_4$ . (Bornemann.)

$\text{Ni}_2\text{S}_3$ . (Bornemann.)

$\text{Ni}_3\text{S}_2$ . Min. *Polydymite*. Insol. in  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$  with separation of  $\text{S}$ .  $\text{Ni}_2\text{S}_7$ . Min. *Beyrichite*. Sol. in  $\text{HCl} + \text{Aq}$ .

**Nickel disulphide,  $\text{NiS}_2$ .**

(Fellenberg, Pogg. 50. 75.)

Does not exist. (Bellucci, C. A. 1900. 293.)

**Nickel potassium sulphide,  $3\text{NiS}, \text{K}_2\text{S}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Schneider, J. pr. (2) 9. 209.)

$\text{K}_2\text{Ni}_{11}\text{S}_{10}$ . Not attacked by hot  $(\text{NH}_4)_2\text{S}$ ; slowly attacked by  $\text{HCl}$  or cold aqua regia; quickly by hot aqua regia.  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  dissolve only on heating. Insol. in organic acids, alkalies and 12%  $\text{HCl}$ , also in  $\text{KCN}$ ,  $\text{AgNO}_3$ , or  $\text{CuSO}_4 + \text{Aq}$ . (Milbauer, Z. anorg. 1904, 42. 447.)

**Nickel telluride,  $\text{Ni}_2\text{Te}_3$ .**

Min. *Melonite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

$\text{NiTe}$ . (Fabre, C. R. 105. 277.)

**Nickelicotungstic acid.**

**Ammonium nickelicotungstate,  $2(\text{NH}_4)_2\text{O}, 2\text{Ni}_2\text{O}_3, 8\text{WO}_3 + 14\text{H}_2\text{O}$ .**

(Rogers and Smith, J. Am. Chem. Soc. 1904, 26. 1476.)

$3(\text{NH}_4)_2\text{O}, \text{Ni}_2\text{O}_3, 16\text{WO}_3 + 22\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Rogers and Smith.)

**Barium nickelicotungstate,  $19\text{BaO}, \text{Ni}_2\text{O}_3, 16\text{WO}_3$ .**

Ppt. Very insol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Nickelimolybdic acid.**

**Barium nickelimolybdate,  $3\text{BaO}, \text{NiO}_3, 9\text{MoO}_3 + 12\text{H}_2\text{O}$ .**

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 702.)

**Potassium nickelomolybdate**,  $3K_2O, NiO_3, 9MoO_3 + 6\frac{1}{2}H_2O$ .

Very insol. even in hot  $H_2O$ . (Hall.)

**Nickelomolybdic acid.**

**Ammonium hydrogen nickelomolybdate**,  $(NH_4)_4H_4[Ni(MoO_4)_6] + 5H_2O$ .

Sl. sol. in  $H_2O$ , easily in dil. acids. (Barbieri, C. A. 1915. 897.)

**Barium hydrogen nickelomolybdate**,  $Ba_2H_4[Ni(MoO_4)_6] + 10H_2O$ .

Ppt. (Barbieri.)

**Potassium hydrogen nickelomolybdate**,  $K_4H_4[Ni(MoO_4)_6] + 5H_2O$ .

Sl. sol. in  $H_2O$ , easily in acids. (Barbieri.)

**Silver hydrogen nickelomolybdate**,  $Ag_4H_4[Ni(MoO_4)_6] + 3H_2O$ .

Insol. in  $H_2O$ ; sol. in  $NH_4OH$ , or  $HNO_3 + Aq$ . (Barbieri.)

**Nickelonickelous acid.**

**Potassium nickelonickelite**,  $K_2Ni_2O_4$  or  $K_2O, NiO, NiO_2$ .

(Hofmann and Hiendlmaier, B. 1906, 39. 3186.)

**Sodium nickelonickelite**,  $Na_2Ni_2O_4 = Na_2O, NiO, 2NiO_2$ .

(Bellucci and Rubegni, C. C. 1907, I. 794.)

**Nickelous acid.**

**Barium dinickelite**,  $BaO, 2NiO_2$ .

Unstable; decomp. by cold  $H_2O$ ; slowly and very rapidly by hot  $H_2O$ . (Dufau, C. R. 1896, 123. 496.)

**Niobium, Nb.**

For niobium and its compounds, see columbium, Cb, and the corresponding compounds.

**Nitramide**,  $NH_2NO_2$ .

Decomp. by conc.  $H_2SO_4$ . Easily sol. in  $H_2O$ , alcohol, ether and acetone. Less sol. in benzol. Almost insol. in ligroin. (Thiele and Lachman, A. 1895, 288. 297.)

Sol. in ether, insol. in petroleum ether. Very unstable; decomp. by hot  $H_2O$ . (Thiele and Lachman, B. 1894, 27. 1909.)

**Nitratochloroplatinamine comps.**

See Chloronitratoplatinamine comps.

**Nitratocobalt octamine comps.**

See Nitratooctamine cobaltic comps.

**Nitratooctamine cobaltic carbonate**,

$(NO_2)_2Co_2(NH_3)_8(CO_3)_2 + H_2O$ .

Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. 22. 2650.)

— **chloride**,  $(NO_2)_2Co_2(NH_3)_8Cl_4 + 4H_2O$ . (Vortmann and Blasberg, B. 22. 2652.)

— **iodide**,  $(NO_2)_2Co_2(NH_3)_8I_4 + 2H_2O$ . (Vortmann and Blasberg.)

— **nitrate**.

See Octamine cobaltic nitrate.

— **sulphate**,  $(NO_2)_2Co_2(NH_3)_8(SO_4)_2 + 2H_2O$ .  
+  $4H_2O$ . (Vortmann and Blasberg, B. 22. 2652.)

**Nitratoplatinamine nitrate**,

$(NO_2)_2Pt(NH_2NO_2)_2$ .

Sl. sol. in cold, more easily in hot  $H_2O$ ; easily sol. in dil.  $HNO_3 + Aq$ . (Cleve.)

— **nitrite**,  $(NO_2)_2Pt(NH_2NO_2)_2$ .  
Easily sol. in  $H_2O$ . (Cleve.)

**Nitratoplatindiamine chloride**,  $(NO_2)_2Pt(N_2H_4Cl)_2 + H_2O$ .

Moderately sol. in cold, very easily in hot  $H_2O$ .

— **chloroplatinate**,  $(NO_2)_2Pt(N_2H_4Cl)_2$ ,  
 $PtCl_4 + 2H_2O$ .  
Ppt.

— **chromate**,  $(NO_2)_2Pt(N_2H_4)_2CrO_4$ .  
Nearly insol. in  $H_2O$ . (Cleve.)

— **dichromate**,  $(NO_2)_2Pt(N_2H_4)_2Cr_2O_7$ .  
Sl. sol. in  $H_2O$ .

— **nitrate**,  $(NO_2)_2Pt(N_2H_4NO_2)_2$ .  
Sol. in  $H_2O$ . Insol. in  $HNO_3 + Aq$ .

— **phosphate**,  $NO_2Pt(N_2H_4)_2 + H_2O$ .  
 $\begin{array}{c} \diagup \quad \diagdown \\ PO_4 \end{array}$   
Very sl. sol. in  $H_2O$ . (Cleve.)

**Nitratodiplatindiamine nitrate**,  $(NO_2)_2Pt_2(N_2H_4)_4(CO_3)_4$ .

Sol. in  $H_2O$  with decomp.

**Nitratopurpureocobaltic bromide**,  $Co(NO_2)(NH_3)_4Br_2$ .

Resembles the chloride in its properties. (Jorgensen, J. pr. (2) 23. 227.)

**Nitratopurpureocobaltic carbonate,**  
 $\text{Co}(\text{NO}_3)(\text{NH}_3)_5(\text{CO}_3) + \text{H}_2\text{O}.$

Less sol. in  $\text{H}_2\text{O}$  than other purpureocarbonates. (Vortmann and Blasberg, B. 22. 2648.)

— **chloride,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2.$

Sl. sol. in cold  $\text{H}_2\text{O}$ , but more than nitrate; more easily sol. in hot  $\text{H}_2\text{O}$ , but is converted into roseo salt. Insol. in  $\text{HCl} + \text{Aq}$  or alcohol. (Jörgensen, J. pr. (2) 23. 227.)

— **mercuric chloride,**  
 $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2, \text{HgCl}_2.$

Not wholly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

— **chloroplatinate,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{Cl}_2,$   
 $\text{PtCl}_4.$

Ppt. Nearly insol. in cold  $\text{H}_2\text{O}$ . (Jörgensen.)

— **chromate,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{CrO}_4.$

Nearly insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)

— **dichromate.**

Sl. sol. in  $\text{H}_2\text{O}$ , but more easily than the neutral salt. (Jörgensen.)

— **dithionate,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{S}_2\text{O}_8.$

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Jörgensen.)

— **nitrate,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5(\text{NO}_3)_2.$

Sol. in 273 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . Much more sol. in hot  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Jörgensen, J. pr. (2) 23. 227.)

— **cobaltic nitrite,**  $3\text{Co}(\text{NO}_3)(\text{NH}_3)_5,$   
 $2\text{Co}(\text{NO}_2)_6 + 2\text{H}_2\text{O}.$

Very sl. sol. in  $\text{H}_2\text{O}$ . (Jörgensen, Z. anorg. 5. 176.)

— **diamine cobaltic nitrite,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_4,$   
 $(\text{NO}_2)_4\text{Co}(\text{NH}_3)_2.$

Ppt. (Jörgensen.)

— **oxalate,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{C}_2\text{O}_4.$

Ppt.

— **sulphate,**  $\text{Co}(\text{NO}_3)(\text{NH}_3)_5\text{SO}_4 + \text{H}_2\text{O}.$

Rather difficultly sol. in cold  $\text{H}_2\text{O}$ . (Jörgensen.)

**Nitratopurpureorhodium chloride,**  
 $(\text{NO}_3)\text{Rh}(\text{NH}_3)_5\text{Cl}_2.$

Sl. sol. in cold  $\text{H}_2\text{O}$ , but more easily than the nitrate. (Jörgensen, J. pr. (2) 34. 394.)

— **dithionate,**  $(\text{NO}_3)\text{Rh}(\text{NH}_3)_5\text{S}_2\text{O}_8 + \text{H}_2\text{O}.$

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Jörgensen.)

**Nitratopurpureorhodium nitrate,**  
 $(\text{NO}_3)\text{Rh}(\text{NH}_3)_5(\text{NO}_3)_2.$

Very sl. sol. in cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Jörgensen.)

**Nitric acid,  $\text{HNO}_3$ .**

Miscible with  $\text{H}_2\text{O}$ . When  $\text{HNO}_3 + \text{Aq}$  is distilled at 760 mm. pressure, an acid containing 68%  $\text{HNO}_3$  is formed, which boils at  $120.5^\circ$  under 735 mm. pressure. By distilling at 150 mm. pressure the acid contains 67.6%  $\text{HNO}_3$ ; at 70 mm. (b.-pt.  $65-70^\circ$ ) the acid contains 66.7%  $\text{HNO}_3$ . The percentage of  $\text{HNO}_3$  in the liquid obtained by passing dry air into  $\text{HNO}_3 + \text{Aq}$  containing 64-68%  $\text{HNO}_3$  varies with the temp.; the higher the temp. the greater the percentage of  $\text{HNO}_3$ . (Roscoe, Chem. Soc. 13. 150.)

$\text{HNO}_3 + \text{Aq}$ of 1.51	sp. gr. contains 67% $\text{N}_2\text{O}_5$ .
" 1.42	" " 54
" 1.35	" " 44.4
" 1.315	" " 38.6

(Dalton.)

$\text{HNO}_3 + \text{Aq}$ of 1.52	sp. gr. contains 88.82% $\text{N}_2\text{O}_5$ .
" 1.522	" " 86.17% "
" 1.4	" " 44

(Mitscherlich.)

$\text{HNO}_3 + \text{Aq}$  of 1.298 sp. gr. contains 36.73%  $\text{N}_2\text{O}_5$ . (Kirwan.)

$\text{HNO}_3 + \text{Aq}$  of 1.298 sp. gr. contains 48%. (Davy.)

$\text{HNO}_3 + \text{Aq}$  of 1.298 sp. gr. contains 32-33%. (Berthollet.)

For Ure's table of sp. gr. of  $\text{HNO}_3 + \text{Aq}$ , see Watt's Dict.. 1st ed.

Sp. gr. of  $\text{HNO}_3 + \text{Aq}$  at  $0^\circ$  and  $15^\circ$ .

% $\text{HNO}_3$	% $\text{N}_2\text{O}_5$	Sp. gr. at $0^\circ$	Sp. gr. at $15^\circ$
100.00	85.71	1.559	1.530
99.84	85.57	1.559	1.530
99.72	85.47	1.558	1.530
99.52	85.30	1.557	1.529
97.89	83.90	1.551	1.523
97.00	83.14	1.548	1.520
96.00	82.28	1.544	1.516
95.27	81.66	1.542	1.514
94.00	80.57	1.537	1.509
93.01	79.72	1.533	1.506
92.00	78.85	1.529	1.503
91.00	78.00	1.526	1.499
90.00	77.15	1.522	1.495
89.56	76.77	1.521	1.494
88.00	75.43	1.514	1.488
87.45	74.95	1.513	1.486
86.17	73.86	1.507	1.482
85.00	72.86	1.503	1.478
84.00	72.00	1.499	1.474
83.00	71.14	1.495	1.470
82.00	70.28	1.492	1.467
80.96	69.39	1.488	1.463
80.00	68.77	1.484	1.460
79.00	67.71	1.481	1.456
77.66	66.56	1.476	1.451
76.00	65.14	1.469	1.445
75.00	64.28	1.465	1.442
74.01	63.44	1.462	1.438

Sp. gr. of  $\text{HNO}_3$ , etc.—Continued.

$\% \text{HNO}_3$	$\% \text{N}_2\text{O}_5$	Sp. gr. at $0^\circ$	Sp. gr. at $15^\circ$
73.00	62.57	1.457	1.435
72.39	62.05	1.455	1.432
71.24	61.06	1.450	1.429
69.96	60.00	1.444	1.423
69.20	59.31	1.441	1.419
68.00	58.29	1.435	1.414
67.00	57.43	1.430	1.410
66.00	56.57	1.425	1.405
65.07	55.77	1.420	1.400
64.00	54.84	1.415	1.395
63.59	54.50	1.413	1.393
62.00	53.14	1.404	1.386
61.21	52.46	1.400	1.381
60.00	51.43	1.393	1.374
59.59	51.08	1.391	1.372
58.88	50.47	1.387	1.368
58.00	49.71	1.382	1.363
57.00	48.86	1.376	1.358
56.10	48.08	1.371	1.353
55.00	47.14	1.365	1.346
54.00	46.29	1.359	1.341
53.81	46.12	1.358	1.339
53.00	45.40	1.353	1.335
52.33	44.85	1.349	1.331
50.99	43.70	1.341	1.323
49.97	42.83	1.334	1.317
49.00	42.00	1.328	1.312
48.00	41.14	1.321	1.307
47.18	40.44	1.315	1.308
46.64	39.97	1.312	1.295
45.00	38.57	1.300	1.284
43.53	37.31	1.291	1.274
42.00	36.00	1.280	1.264
41.00	35.14	1.274	1.257
40.00	34.28	1.267	1.251
39.00	33.43	1.260	1.244
37.95	32.53	1.253	1.237
36.00	30.86	1.240	1.225
35.00	29.99	1.234	1.218
33.86	29.02	1.226	1.211
32.00	27.43	1.214	1.198
31.00	26.57	1.207	1.192
30.00	25.71	1.200	1.185
29.00	24.85	1.194	1.179
28.00	24.00	1.187	1.172
27.00	23.14	1.180	1.166
25.71	22.04	1.171	1.157
23.00	19.71	1.153	1.138
20.00	17.14	1.132	1.120
17.47	14.97	1.115	1.105
15.00	12.85	1.099	1.089
13.00	11.14	1.085	1.077
11.41	9.77	1.075	1.067
7.72	6.62	1.050	1.045
4.00	3.42	1.026	1.022
2.00	1.71	1.013	1.010
0.00	0.00	1.000	0.999

(Kolb, A. ch. (4) 10. 140.)

Sp. gr. of  $\text{HNO}_3 + \text{Aq}$  at  $15^\circ$ . a = %; b = sp. gr. if % is  $\text{N}_2\text{O}_5$ ; c = sp. gr. if % is  $\text{HNO}_3$ .

a	b	c	a	b	c
1	1.007	1.006	51	1.372	1.323
2	1.014	1.012	52	1.378	1.329
3	1.021	1.018	53	1.385	1.335
4	1.027	1.024	54	1.390	1.341
5	1.034	1.029	55	1.396	1.346
6	1.040	1.035	56	1.401	1.356
7	1.047	1.040	57	1.407	1.358
8	1.053	1.045	58	1.413	1.363
9	1.061	1.051	59	1.418	1.369
10	1.069	1.057	60	1.423	1.374
11	1.076	1.064	61	1.427	1.380
12	1.083	1.070	62	1.432	1.386
13	1.091	1.077	63	1.436	1.390
14	1.098	1.083	64	1.440	1.395
15	1.104	1.089	65	1.445	1.400
16	1.112	1.095	66	1.449	1.405
17	1.120	1.100	67	1.452	1.410
18	1.126	1.106	68	1.457	1.414
19	1.134	1.112	69	1.461	1.419
20	1.141	1.120	70	1.466	1.422
21	1.149	1.126	71	1.470	1.427
22	1.156	1.132	72	1.474	1.430
23	1.165	1.138	73	1.478	1.435
24	1.172	1.145	74	1.482	1.439
25	1.180	1.151	75	1.486	1.442
26	1.187	1.159	76	1.490	1.445
27	1.195	1.166	77	1.494	1.449
28	1.202	1.172	78	1.499	1.452
29	1.211	1.179	79	1.503	1.456
30	1.218	1.185	80	1.507	1.460
31	1.225	1.192	81	1.511	1.463
32	1.232	1.198	82	1.515	1.467
33	1.240	1.204	83	1.519	1.470
34	1.248	1.210	84	1.523	1.474
35	1.255	1.218	85	1.527	1.478
36	1.264	1.225	86	1.530	1.481
37	1.271	1.230	87	...	1.484
38	1.280	1.236	88	...	1.488
39	1.286	1.244	89	...	1.491
40	1.295	1.251	90	...	1.495
41	1.304	1.257	91	...	1.499
42	1.312	1.264	92	...	1.503
43	1.318	1.270	93	...	1.506
44	1.325	1.276	94	...	1.509
45	1.332	1.284	95	...	1.512
46	1.340	1.290	96	...	1.516
47	1.346	1.298	97	...	1.520
48	1.352	1.304	98	...	1.523
49	1.360	1.312	99	...	1.526
50	1.366	1.316	100	...	1.530

(Kolb, calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of  $\text{HNO}_3 + \text{Aq}$  at  $17.5^\circ$ .

$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.	$\% \text{N}_2\text{O}_5$	Sp. gr.
5	1.032	9	1.060	13	1.089
6	1.038	10	1.068	14	1.096
7	1.045	11	1.075	15	1.104
8	1.053	12	1.082	16	1.111

Sp. gr. of  $\text{HNO}_3$ , etc.—Continued.

% $\text{N}_2\text{O}_5$	Sp. gr.	% $\text{N}_2\text{O}_5$	Sp. gr.	% $\text{N}_2\text{O}_5$	Sp. gr.
17	1.118	40	1.294	63	1.434
18	1.125	41	1.301	64	1.438
19	1.132	42	1.308	65	1.442
20	1.140	43	1.315	66	1.447
21	1.147	44	1.323	67	1.451
22	1.155	45	1.330	68	1.456
23	1.163	46	1.338	69	1.460
24	1.170	47	1.345	70	1.465
25	1.178	48	1.352	71	1.469
26	1.186	49	1.358	72	1.472
27	1.194	50	1.364	73	1.476
28	1.201	51	1.371	74	1.480
29	1.209	52	1.377	75	1.484
30	1.217	53	1.383	76	1.488
31	1.224	54	1.389	77	1.492
32	1.232	55	1.394	78	1.496
33	1.239	56	1.400	79	1.500
34	1.247	57	1.406	80	1.504
35	1.255	58	1.412	81	1.508
36	1.263	59	1.416	82	1.512
37	1.271	60	1.421	83	1.516
38	1.279	61	1.426	84	1.519
39	1.287	62	1.430	85	1.523

(Hager, Comm. 1883.)

Sp. gr.  $\text{HNO}_3$  + Aq at  $17.5^\circ$ .

% $\text{N}_2\text{O}_5$	Sp. gr.	% $\text{N}_2\text{O}_5$	Sp. gr.	% $\text{N}_2\text{O}_5$	Sp. gr.
10	1.068	40	1.293	70	1.465
15	1.104	50	1.361	80	1.500
20	1.140	60	1.417	85	1.514
30	1.217	..	...	..	...

(Hager, Adjumenta varia, Leipzig, 1876.)

Sp. gr. of  $\text{HNO}_3$  + Aq at  $15^\circ$ .

% $\text{HNO}_3$	Sp. gr.	% $\text{HNO}_3$	Sp. gr.
1	1.00581	26	1.15869
2	1.01136	27	1.16660
3	1.01713	28	1.17371
4	1.02286	29	1.18073
5	1.02851	30	1.18830
6	1.03439	31	1.19552
7	1.04019	32	1.20276
8	1.04592	33	1.20635
9	1.05234	34	1.21300
10	1.05746	35	1.22013
11	1.06330	36	1.22675
12	1.06951	37	1.23347
13	1.07581	38	1.23980
14	1.08126	39	1.24510
15	1.08843	40	1.25235
16	1.09500	41	1.25850
17	1.10102	42	1.26475
18	1.10725	43	1.27125
19	1.11321	44	1.28895
20	1.12024	45	1.28450
21	1.12714	46	1.29110
22	1.13349	47	1.29780
23	1.13890	48	1.30443
24	1.14460	49	1.31101
25	1.15164	50	1.31722

(Squires, Pharm. Era, Jan. 1891.)

## Most accurate table.

Sp. gr. of  $\text{HNO}_3$  + Aq at  $15^\circ$ ;  $\text{H}_2\text{O}$  at  $4^\circ = 1$ .

Sp. gr.	% $\text{N}_2\text{O}_5$	% $\text{HNO}_3$	Kg. $\text{HNO}_3$ in 1 l.
1.000	0.08	0.10	0.001
1.005	0.85	1.00	0.010
1.010	1.62	1.90	0.019
1.015	2.39	2.80	0.028
1.020	3.17	3.70	0.038
1.025	3.94	4.60	0.047
1.030	4.71	5.50	0.057
1.035	5.47	6.38	0.066
1.040	6.22	7.26	0.075
1.045	6.97	8.13	0.085
1.050	7.71	8.99	0.094
1.055	8.43	9.84	0.104
1.060	9.15	10.68	0.113
1.065	9.87	11.51	0.123
1.070	10.57	12.33	0.132
1.075	11.27	13.15	0.141
1.080	11.96	13.95	0.151
1.085	12.64	14.74	0.160
1.090	13.31	15.53	0.169
1.095	13.99	16.32	0.179
1.100	14.67	17.11	0.188
1.105	15.34	17.89	0.198
1.110	16.00	18.67	0.207
1.115	16.67	19.45	0.217
1.120	17.34	20.23	0.227
1.125	18.00	21.00	0.236
1.130	18.66	21.77	0.246
1.135	19.32	22.54	0.256
1.140	19.98	23.31	0.266
1.145	20.64	24.08	0.276
1.150	21.29	24.84	0.286
1.155	21.94	25.60	0.296
1.160	22.60	26.36	0.306
1.165	23.25	27.12	0.316
1.170	23.90	27.88	0.326
1.175	24.54	28.63	0.336
1.180	25.18	29.38	0.347
1.185	25.83	30.13	0.357
1.190	26.47	30.88	0.367
1.195	27.10	31.62	0.378
1.200	27.74	32.36	0.388
1.205	28.56	33.09	0.399
1.210	28.99	33.82	0.409
1.215	29.61	34.55	0.420
1.220	30.24	35.28	0.430
1.225	30.88	36.03	0.441
1.230	31.53	36.78	0.452
1.235	32.17	37.53	0.463
1.240	32.82	38.29	0.475
1.245	33.47	39.05	0.486
1.250	34.13	39.82	0.498
1.255	34.78	40.58	0.509
1.260	35.44	41.34	0.521
1.265	36.09	42.10	0.533
1.270	36.75	42.87	0.544
1.275	37.41	43.64	0.556
1.280	38.07	44.41	0.568
1.285	38.73	45.18	0.581
1.290	39.39	45.95	0.593
1.295	40.05	46.72	0.605

Sp. gr. of  $\text{HNO}_3$ , etc.—Continued.

Sp. gr.	% $\text{N}_2\text{O}_5$	% $\text{HNO}_3$	Kg. $\text{HNO}_3$ in 1 l.
1.300	40.71	47.49	0.617
1.305	41.37	48.26	0.630
1.310	42.06	49.07	0.643
1.315	42.76	49.89	0.656
1.320	43.47	50.71	0.669
1.325	44.17	51.53	0.683
1.330	44.89	52.37	0.697
1.335	45.62	53.22	0.710
1.340	46.35	54.07	0.725
1.345	48.07	54.93	0.739
1.350	47.82	55.79	0.753
1.355	48.57	56.66	0.768
1.360	49.35	57.57	0.783
1.365	50.13	58.48	0.798
1.370	50.91	59.39	0.814
1.375	51.69	60.30	0.829
1.380	52.52	61.27	0.846
1.385	53.35	62.24	0.862
1.390	54.20	63.23	0.879
1.395	55.07	64.25	0.896
1.400	55.97	65.30	0.914
1.405	56.92	66.40	0.933
1.410	57.86	67.50	0.952
1.415	58.83	68.63	0.971
1.420	59.83	69.80	0.991
1.425	60.84	70.98	1.011
1.430	61.86	72.17	1.032
1.435	62.91	73.39	1.053
1.440	64.01	74.68	1.075
1.445	65.13	75.98	1.098
1.450	66.24	77.28	1.121
1.455	67.38	78.60	1.144
1.460	68.56	79.98	1.168
1.465	69.79	81.42	1.193
1.470	71.06	82.90	1.219
1.475	72.39	84.45	1.246
1.480	73.76	86.05	1.274
1.485	75.18	87.70	1.302
1.490	76.80	89.60	1.335
1.495	78.57	91.60	1.369
1.500	80.65	94.09	1.411
1.501	81.09	94.60	1.420
1.502	81.50	95.08	1.428
1.503	81.91	95.55	1.436
1.504	82.29	96.00	1.444
1.505	82.63	96.39	1.451
1.506	82.94	96.76	1.457
1.507	83.26	97.13	1.464
1.508	83.58	97.50	1.470
1.509	83.87	97.84	1.476
1.510	84.09	98.10	1.481
1.511	84.28	98.32	1.486
1.512	84.46	98.53	1.490
1.513	84.63	98.73	1.494
1.514	84.87	98.90	1.497
1.515	84.92	99.07	1.501
1.516	85.04	99.21	1.504
1.517	85.15	99.34	1.507
1.518	85.26	99.46	1.510
1.519	85.35	99.57	1.512
1.520	85.44	99.67	1.515

Sp. gr. of  $\text{N-HNO}_3$  + Aq at  $18^\circ/4^\circ = 1.0324$ .  
(Loomis, W. Ann. 1896, 60. 550.)

Sp. gr. (reduced to a vacuum) of  $\text{HNO}_3$  from  
78–100% concentration at  $4^\circ/4^\circ$ ,  
 $14.2^\circ/4^\circ$  and  $24.2^\circ/4^\circ$ .

% $\text{HNO}_3$	Sp. gr.		
	$4^\circ/4^\circ$	$14.2^\circ/4^\circ$	$24.2^\circ/4^\circ$
78.22	1.47129	1.45504	1.43964
79.14	.....	1.46011	1.44372
79.59	1.47496	.....	.....
81.97	1.48391	1.46680	1.45092
84.90	1.49495	.....	.....
85.21	1.49581	.....	.....
85.80	.....	1.47826	1.46224
87.55	1.50211	.....	.....
87.90	.....	1.48491	1.46891
89.73	1.50898	1.49125	.....
92.34	1.51804	1.49968	1.48264
94.04	1.51949	1.50149	1.48516
95.62	1.52192	1.50358	1.48677
96.64	1.52510	1.50632	1.48887
97.33	.....	1.50911	1.49137
98.07	1.53212	1.51298	1.49543
99.97	1.54212	1.52236	1.50394

(Veley and Manley, Chem. Soc. 1903, 83.  
1016.)

Sp. gr. at  $20^\circ$  of  $\text{HNO}_3$  + Aq containing M  
g. mols.  $\text{HNO}_3$  per liter.

M 0.025 0.05 0.075 0.10  
Sp. gr. 1.000926 1.001798 1.002653 1.003496

M 0.25 0.5 0.75 1.0  
Sp. gr. 1.008481 1.01686 1.02503 1.0336

M 2.0  
Sp. gr. 1.0670

(Jones and Pearce, Am. Ch. J. 1907, 38. 732.)

For sp. gr. of  $\text{HNO}_3 + \text{H}_2\text{SO}_4$ , see under  
 $\text{H}_2\text{SO}_4$ .

Partition coefficient for  $\text{HNO}_3$  between  
ether and  $\text{H}_2\text{O}$  is increased by the addition  
of nitrates. (Tanret, C. R. 1897, 124. 464.)

The hydrates described by Erdmann do  
not exist. There are only two authentic hy-  
drates, the mono- and the tri-hydrate.  
(Küster, Ch. Z. 1904, 28. 132.)

The composition of the hydrates formed  
by  $\text{HNO}_3$  at different dilutions is calculated  
from determinations of the lowering of the  
fr.-pt. produced by  $\text{HNO}_3$  and of the con-  
ductivity and sp. gr. of  $\text{HNO}_3$  + Aq. (Jones,  
Am. Ch. J. 1905, 34. 328.)

**Dinitric acid,  $\text{H}_2\text{N}_2\text{O}_{11} = 2\text{N}_2\text{O}_5, \text{H}_2\text{O}$ .**

Fumes on air. Miscible with  $\text{H}_2\text{O}$ , with  
evolution of much heat. (Weber, J. pr. (2)  
6. 342.)

**Nitrates.**

All nitrates are sol. in  $\text{H}_2\text{O}$  except a few  
basic compounds. Most nitrates are insol. in



conc.  $\text{HNO}_3 + \text{Aq}$ ; many are sol. in alcohol; some are sol. in glycerine.

**Aluminum nitrate, basic,  $2\text{Al}_2\text{O}_3, 3\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Ordway, Sill. Am. J. (2) 26. 203.)

Basic aluminum nitrates containing 2 mols. or less of  $\text{Al}_2\text{O}_3$  to one of  $\text{N}_2\text{O}_5$  may be obtained sol. in  $\text{H}_2\text{O}$ , but the compounds containing more than 2 mols.  $\text{Al}_2\text{O}_3$  are insol. in  $\text{H}_2\text{O}$ . (Ordway, l. c.)

$2\text{Al}_2\text{O}_3, \text{N}_2\text{O}_5 + 10\text{H}_2\text{O}$ . (Ditte, C. R. 110. 782.)

$\text{Al}_2\text{O}_3, \text{H}_2\text{O}$ ,  $\text{HNO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Schlumberger, Bull. Soc. 1895, (3) 13. 59.)

**Aluminum nitrate,  $\text{Al}(\text{NO}_3)_3 + 9\text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3 + \text{Aq}$ , or alcohol. (Berzelius.)

Melts in its crystal  $\text{H}_2\text{O}$  at  $72.7^\circ$ . (Ordway.

Sol. in 1 pt. strong alcohol. (Wenzel.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Ammonium nitrate,  $\text{NH}_4\text{NO}_3$ .**

Deliquescent.

Sol. in 0.502 pt.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Karsten.)

Sol. in 0.54 pt.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Harris, C. R. 24. 816.)

Much more sol. is hot than cold  $\text{H}_2\text{O}$ . (Harris.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  and 0.5 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)

Sol. in 1 pt. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)

Sol. in 0.5 pt.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Berzelius.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Abl.)

Decomp. by boiling  $\text{H}_2\text{O}$ .

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{NH}_4\text{NO}_3$	$t^\circ$	Pts. $\text{NH}_4\text{NO}_3$	$t^\circ$	Pts. $\text{NH}_4\text{NO}_3$
0	97	24	205	48	351
1	101	25	210	49	358
2	105	26	216	50	365
3	109	27	221	51	372
4	113	28	226	52	379
5	117	29	232	53	387
6	121	30	238	54	395
7	125	31	244	55	402
8	130	32	250	56	410
9	134	33	256	57	418
10	139	34	262	58	425
11	143	35	268	59	433
12	148	36	274	60	441
13	152	37	280	61	449
14	157	38	286	62	457
15	161	39	292	63	465
16	166	40	298	64	473
17	170	41	304	65	481
18	175	42	311	66	490
19	180	43	317	67	499
20	185	44	324	68	508
21	190	45	331	69	517
22	195	46	337	70	526
23	200	47	344	...	...

(Mulder, Scheik. Verhand. 1864. 95.)

100 pts.  $\text{H}_2\text{O}$  dissolve 183 pts.  $\text{NH}_4\text{NO}_3$  at  $19.5^\circ$ . (Mulder.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Specific gravity of the saturated solution	Mols. of $\text{NH}_4\text{NO}_3$ soluble in 100 mols. of water
12.2	1.2945	34.50
20.2	1.3116	43.30
23.0	1.3159	46.57
25.0	1.3197	48.19
27.7	1.3257	51.67
28.0	1.3260	51.86
30.0	1.3299	54.40
30.2	1.3308	54.61
31.9	1.3348	57.20
32.1	1.3344	57.60
32.7	1.3356	57.90
34.0	1.3375	58.89
35.0	1.3394	59.80
35.1	1.3397	60.00
35.6	1.3408	60.62
36.0	1.3412	61.00
36.6	1.3420	.....
37.5	1.3432	62.90
38.0	1.3438	63.60
38.5	1.3440	64.10
39.0	1.3448	65.09
39.5	1.3460	65.88
40.0	1.3464	66.80

(Müller and Kaufmann, Z. phys. Ch. 1903, 42. 499.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{NH}_4\text{NO}_3$ per 100 g.		Solid phase
	solution	water	
0	54.19	118.3	$\text{NH}_4\text{NO}_3$ , rhomb. $\beta$
12.2	60.53	153.4	"
20.2	65.80	192.4	"
25.0	68.17	214.2	"
30.0	70.73	241.8	"
32.1	71.97	256.9	$\text{NH}_4\text{NO}_3$ , rhomb. $\beta +$ rhomb. $\alpha$
35	72.64	265.8	$\text{NH}_4\text{NO}_3$ , rhomb. $\alpha$
40	74.82	297.0	"
50	77.49	344.0	"
60	80.81	421.0	"
70	83.32	499.0	"
80	85.25	580.0	"
90	88.08	740.0	$\text{NH}_4\text{NO}_3$ , rhomb. (?)
100	89.71	871.0	"

(Seidell's Solubilities 1st ed. 28. Calc. from Müller & Kaufmann, see above, and Schwarz, Ostwald's Lehrb., p. 425.)

100 g.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  contain:

54.19 g.  $\text{NH}_4\text{NO}_3$  at  $0^\circ$ .

70.10 g. " "  $30^\circ$ .

84.03 g. " "  $70^\circ$ .

(de Waal, Dissert. Leiden, 1910.)

70.19 g.  $\text{NH}_4\text{NO}_3$  are contained in 100 g.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  sat. at  $30^\circ$ . (Schreinemakers and de Baat, Arch. neer. Sc. 1911, (2) 15. 415.)

60 pts.  $\text{NH}_4\text{NO}_3$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temperature from  $13.6^\circ$  to  $-13.6^\circ$ , that is  $27.2^\circ$ , but if the initial temperature is  $0^\circ$  it will fall only to  $-16.7^\circ$ , the freezing-point of the mixture. (Rüddorf, B. 2. 68.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $18^\circ$ .

Pts. $\text{NH}_4\text{NO}_3$	Pts. $\text{H}_2\text{O}$	Sp. gr.
80	1800	1.0180
80	900	1.0331
80	360	1.0743

(Thomsen and Gerlach, Z. anal. 23. 520.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $15^\circ$ .

% $\text{NH}_4\text{NO}_3$	Sp. gr.	% $\text{NH}_4\text{NO}_3$	Sp. gr.
5	1.0201	30	1.1304
10	1.0419	40	1.1780
20	1.0860	50	1.2279

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{NH}_4\text{NO}_3$	Sp. gr.	% $\text{NH}_4\text{NO}_3$	Sp. gr.
1	1.0042	33	1.1454
2	1.0085	34	1.1502
3	1.0127	35	1.1550
4	1.0170	36	1.1598
5	1.0212	37	1.1646
6	1.0255	38	1.1694
7	1.0297	39	1.1742
8	1.0340	40	1.1790
9	1.0382	41	1.1841
10	1.0425	42	1.1892
11	1.0468	43	1.1942
12	1.0512	44	1.1994
13	1.0555	45	1.2045
14	1.0599	46	1.2096
15	1.0642	47	1.2147
16	1.0686	48	1.2198
17	1.0729	49	1.2249
18	1.0773	50	1.2300
19	1.0816	51	1.2353
20	1.0860	52	1.2407
21	1.0905	53	1.2460
22	1.0950	54	1.2514
23	1.0995	55	1.2567
24	1.1040	56	1.2621
25	1.1085	57	1.2674
26	1.1130	58	1.2728
27	1.1175	59	1.2781
28	1.1220	60	1.2835
29	1.1265	61	1.2888
30	1.1310	62	1.2942
31	1.1358	63	1.3005
32	1.1406	64	1.3059

(Gerlach, Z. anal. 27. 310.)

Sp. gr. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .

% $\text{NH}_4\text{NO}_3$	Sp. gr. $16^\circ/16^\circ$
0	1.000000
0.6419	1.000271
1.4101	1.000593
2.7501	1.001153
5.4890	1.002300
11.7981	1.004916
23.4480	1.009758
47.9500	1.019952

(Dijken, Z. phys. Ch. 1897, 24. 107.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{NH}_4\text{NO}_3$  = 1.030435; of a 0.5-normal solution = 1.014505. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

B.-pt. of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  containing pts.  $\text{NH}_4\text{NO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. 26. 445); L = according to Legrand (A. ch. (2) 59. 426.)

B.-pt.	G	L	B.-pt.	G	L
101°	10	10	140°	682	770.5
102	20	20.5	141	719	.....
103	30	31.3	142	737	840.6
104	41	42.4	143	765	.....
105	52	53.8	144	793	915.5
106	63	65.4	145	823	.....
107	74	77.3	146	853	995.5
108	85	89.4	147	883	.....
109	96	101.9	148	914	1081.5
110	106	114.9	149	945	.....
111	120	128.4	150	977	1173.5
112	132	142.4	151	1009	.....
113	145	156.9	152	1043	1273
114	158	172	153	1079	.....
115	172	188	154	1116	1383
116	187	204.4	155	1155	.....
117	202	221.4	156	1196	1504
118	217	238.4	157	1238	.....
119	232	256.8	158	1281	1637
120	248	275.3	159	1325	.....
121	265	...	160	1370	1775
122	283	314	161	1417	.....
123	301	...	162	1464	1923
124	319	354	163	1511	.....
125	337	...	164	1558	2084
126	356	396	165	1606	.....
127	376	...	166	1653	.....
128	396	440.2	167	1700	.....
129	417	...	168	1748	.....
130	439	487.4	169	1796	.....
131	461	...	170	1844	.....
132	484	537.3	180	2400	∞
133	507	...	190	3112	.....
134	530	590	200	4099	.....
135	554	...	210	5618	.....
136	578	645	220	8547	.....
137	603	...	230	16950	.....
138	629	705.5	240	∞	.....
139	655	...			

Very sol. in  $\text{HNO}_3 + \text{Aq.}$  (Schulz, Zeit. Ch. 1869, 531.)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{HNO}_3$ .

Solution temp.	% by wt. $\text{NH}_4\text{NO}_3$	Solid phase
+8°	21.1	$\text{NH}_4\text{NO}_3$ , 2 $\text{HNO}_3$ (solution in $\text{HNO}_3$ )
23.0	28.7	"
28.5	34.5	"
29.5*	38.8	(solution in $\text{NH}_4\text{NO}_3$ )
27.5	44.6	"
27.0	45.8	"
23.5	49.4	"
23.0	50.0	"
17.5	54.0	"
16.5	54.3	"
4.0	45.8	$\text{NH}_4\text{NO}_3$ , $\text{HNO}_3$ labile (solution in $\text{HNO}_3$ )
9.5	49.4	"
11.0	51.7	"
11.5	52.7	"
12.0	54.3	"
12.0	54.7	"
11.5	57.6	(solution in $\text{NH}_4\text{NO}_3$ )
11.5	54.0	$\text{NH}_4\text{NO}_3$ (labile)
14.5	54.3	"
17.0	54.7	stable
26.0	55.9	"
27.0	56.2	"
33.5	57.5	"
49.0	60.4	"
79.0	68.1	"

\* Mpt. of  $\text{NH}_4\text{NO}_3$ , 2 $\text{HNO}_3$ .

(Groschuff. Z. anorg. 1904, 40. 6.)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{NH}_4\text{OH} + \text{Aq.}$

Grams of $\text{NH}_4\text{NO}_3$	Grams of $\text{NH}_3$	Molecules of $\text{NH}_4\text{NO}_3$ in 100 molecules $\text{NH}_4\text{NO}_3 + \text{NH}_3$	Temperature at which the solutions are in equilibrium with the solid phase
.....	.....	100.	about 168°
0.7578	0.0588	74.2	109.8
0.6439	0.0665	67.3	94.0
4.2615	0.7747	53.8	68.8
0.7746	0.1857	47.0	35.9
0.9358	0.2352	45.9	33.3
0.7600	0.2607	38.3	0
0.9675	0.3515	36.9	-10.5
0.8308	0.3700	32.3	-30.0
0.9526	1.2457	13.9	-44.5
1.3918	4.4327	6.25	-60
0	100	0	about -80

(Kuriloff, Z. phys. Ch. 1898, 25. 109.)

$\text{NH}_4\text{NO}_3 + \text{NH}_4\text{Cl.}$

100 pts.  $\text{H}_2\text{O}$  dissolve 29.1 pts.  $\text{NH}_4\text{Cl}$  and 173.8 pts.  $\text{NH}_4\text{NO}_3$ . (Rüdorff, B. 6. 484.)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  with pptn. of  $\text{NH}_4\text{Cl}$  until a state of equilibrium is reached. (Karsten.)

Addition of  $\text{KClO}_3$  to  $\text{NH}_4\text{Cl} + \text{Aq}$  prevents pptn. of  $\text{NH}_4\text{Cl}$ , and dissolves any  $\text{NH}_4\text{Cl}$  that may have been pptd. (Margueritte, C. R. 38. 306.)

See also under Ammonium chloride.

$\text{NH}_4\text{NO}_3 + \text{KNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve:

	At 9°		At 11°		At 15°	
	(1)	(2)	(3)	(4)	(5)	(6)
KNO <sub>3</sub> ...	20.2	40.6		26.0	46.2	
NH <sub>4</sub> NO <sub>3</sub> ....	....	88.8	143	....	130.4	161

2, Sat. at 11° with  $\text{NH}_4\text{NO}_3$  and then at 9° with  $\text{KNO}_3$ ; 5, sat. at 11° with  $\text{NH}_4\text{NO}_3$  and then at 15° with  $\text{KNO}_3$ . (Mulder.)

Sol. in sat.  $\text{HNO}_3 + \text{Aq}$  without causing ppt. (Karsten); with separation of  $\text{KNO}_3$  (Rüdorff).

Composition of solution is dependent on the relative excess of the salts present. (Rüdorff.) 100 pts.  $\text{H}_2\text{O}$  dissolve 77.1 pts.  $\text{NaNO}_3$  and 162.9 pts.  $\text{NH}_4\text{NO}_3$  at 16°. (Rüdorff, B. 6. 484.)

If a sat. solution of  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at 11° is sat. with  $\text{Ba}(\text{NO}_3)_2$  at 9°, 100 pts.  $\text{H}_2\text{O}$  dissolve:

	At 11°	At 9°
$\text{NH}_4\text{NO}_3$ ....	143	101.3
$\text{Ba}(\text{NO}_3)_2$ ...	...	6.2
		6.8

(Mulder.)

Solubility of  $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$  in  $\text{H}_2\text{O}$  at t°.

t°	% $\text{AgNO}_3$	% $\text{NH}_4\text{NO}_3$	Solid phase
-7.3°	47.1	0	$\text{Ice} + \text{AgNO}_3$ , rhomb.
-10.7	44.52	8.43	"
-14.9	42.0	16.80	$\text{Ice} + \text{AgNO}_3$ , $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$ rb.
-14.8	39.51	18.79	$\text{Ice} + \text{AgNO}_3$ , $\text{NH}_4\text{NO}_3$
-18.7	15.99	37.30	$\text{Ice} + \text{AgNO}_3$ , $\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$ , $\beta$ . rb.
-17.4	0	41.2	$\text{Ice} + \text{NH}_4\text{NO}_3$ , $\beta$ . rb.
0	50.36	19.59	$\text{AgNO}_3$ , $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$ , rb.
18	55.36	22.06	"
30	58.89	23.42	"
55	63.32	26.12	"
109.6	67.9	32.1	"
0	22.13	44.87	$\text{AgNO}_3$ , $\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$ , $\beta$ . rb.
18	27.07	49.22	"
30	29.76	52.50	"
40	32.68	52.22	$\text{AgNO}_3$ , $\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$ , $\alpha$ rb.
55	36.60	52.38	"
101.5	47.5	52.5	$\text{AgNO}_3$ , $\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$ , rbd.

(Schreinemakers and de Baat, Arch. néer. Sc.

1911 (2) 15. 414.)

Solubility in  $\text{NH}_4\text{NO}_3$  and  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

Composition of the solution		Solid phase
$\text{NH}_4\text{NO}_3$	$\text{AgNO}_3$	
0	73.0	$\text{AgNO}_3$
6.59	69.08	"
15.62	63.27	"
23.40	58.84	$\text{AgNO}_3 + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
23.45	58.93	"
24.33	57.93	$\text{AgNO}_3, \text{NH}_4\text{NO}_3$
26.22	55.32	"
28.86	52.45	"
34.47	45.85	"
39.60	41.09	"
45.44	35.62	"
52.49	29.77	$\text{NH}_4\text{NO}_3 + \text{AgNO}_3, \text{NH}_4\text{NO}_3$
52.11	29.86	"
52.89	29.66	"
54.12	27.75	$\text{NH}_4\text{NO}_3$
58.64	21.31	"
63.59	12.51	"
70.10	0	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, 65. 572.)

Solubility of  $\text{NH}_4\text{NO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. per 100 g. $\text{H}_2\text{O}$		Sp. gr.
	$\text{NH}_4\text{NO}_3$	$\text{NaNO}_3$	
0	0	73.33	1.354
	105.5	66	1.407
	118.4	0	1.264
15	0	83.9	1.375
	24.03	81.21	1.388
	42.81	79.34	1.392
	64.6	78.06	1.401
	110.9	75.81	1.417
	152.	75.35	1.428
	155.3	75.38	1.429
	156.1	60.76	1.405
	159	36.50	1.364
	160	27.79	1.350
	162.3	17.63	1.330
	167.4	0	1.298
30	0	96.12	1.401
	220.8	88.31	1.450
	232.6	0	1.329

(Fedotieff and Koltunoff, Z. anorg. 1914, 85. 251.)

Solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
70.1	0	$\text{NH}_4\text{NO}_3$
67.63	2.38	"
66.93	3.46	$\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
		$3\text{NH}_4\text{NO}_3$
63.84	4.96	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
58.06	8.22	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 +$
		$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
52.75	11.42	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
49.80	13.27	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 +$
		$(\text{NH}_4)_2\text{SO}_4$
37.20	19.48	"
19.91	28.83	"
12.05	34.7	"
0	44.1	"

(Schreinemakers and Haenen, Chem. Weekbl. 1909, 6. 51.)

Solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{O}$ .

Temp. $=0^\circ$		
$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	41.4	$(\text{NH}_4)_2\text{SO}_4$
5.61	37.89	"
29.58	41.64	$(\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
29.81	21.33	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
31.04	20.40	"
30.87	20.43	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
		$3\text{NH}_4\text{NO}_3$
31.61	19.50	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
45.99	9.63	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$
49.12	6.00	$\text{NH}_4\text{NO}_3$
54.19	0	"

Temp. $=70^\circ$		
$\text{NH}_4\text{NO}_3$	$(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	47.81	$(\text{NH}_4)_2\text{SO}_4$
11.10	40.81	"
70.15	6.71	$(\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
71.58	5.82	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3$
73.48	5.14	$(\text{NH}_4)_2\text{SO}_4, 2\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$
		$3\text{NH}_4\text{NO}_3$
76.01	3.96	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3$
80.25	2.68	"
81.01	2.45	$(\text{NH}_4)_2\text{SO}_4, 3\text{NH}_4\text{NO}_3 + \text{NH}_4\text{NO}_3$
81.38	2.41	$\text{NH}_4\text{NO}_3$
84.03	0	"

(de Waal, Dissert. Leiden, 1910.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

1 pt.  $\text{NH}_4\text{NO}_3$  dissolves in 2.29 pts. alcohol of 66.8% at 25°. (Pohl, W. A. B. 6. 599.)

1 pt.  $\text{NH}_4\text{NO}_3$  dissolves in 1.1 pt. boiling alcohol. (Wenzel.)

100 pts. absolute methyl alcohol dissolve 17.1 pts. at 20.5°. (de Bruyn, Z. phys. Ch. 10. 783.)

100 g. absolute methyl alcohol dissolve 14.6 g.  $\text{NH}_4\text{NO}_3$  at 14° and 16.3 g. at 18.5°. (Schiff and Monsacchi, Z. phys. Ch. 1896, 21. 277.)

100 pts. absolute ethyl alcohol dissolve 3.8 pts. at 20.5°. (de Bruyn, Z. phys. Ch. 10. 783.)

100 g. absolute ethyl alcohol dissolve 4.6 g. at 14°. (Schiff and Monsacchi, Z. phys. Ch. 1896, 21. 277.)

Solubility of  $\text{NH}_4\text{NO}_3$  in  $\text{H}_2\text{O}$  is decreased by presence of ethyl alcohol but increased by presence of methyl alcohol.  $\text{NH}_4\text{NO}_3$  is only very sl. sol. in abs. ethyl alcohol and the solubility increases slowly with rise in temp.; it is more sol. in abs. methyl alcohol and the solubility increases rapidly with rise in temp. (Fleckenstein, Phys. Zeit. 1905, 6. 419.)

#### Solubility in methyl alcohol + Aq. at 30°.

% by wt. $\text{H}_2\text{O}$	% by wt. alcohol	% by wt. $\text{NH}_4\text{NO}_3$
29.9	0	70.1
21.6	24.5	53.9
20.6	31.3	48.1
16.5	46.0	37.5
11.5	59.4	29.1
0	83.3	16.7

(Schreinemakers, Z. phys. Ch. 1909, 65. 556.)

#### Solubility of $\text{NH}_4\text{NO}_3$ in ethyl alcohol + Aq. at 30°. Composition of sat. solution.

% by wt. $\text{H}_2\text{O}$	% by wt. alcohol	% by wt. $\text{NH}_4\text{NO}_3$
29.9	0	70.1
26.9	18.6	54.5
23.2	39.3	37.5
18.3	58.5	23.2
11.6	76.5	11.9
5.8	86.2	8.0
0	96.4	3.6

(Schreinemakers, Z. phys. Ch. 1909. 65. 555.)

#### Solubility of $\text{NH}_4\text{NO}_3$ in alcohol.

t°	% $\text{NH}_4\text{NO}_3$	% Alcohol	% $\text{H}_2\text{O}$
0	54.19	0	45.81
"	42.69	12.70	44.61
"	1.96	97.93	0.11
30	70.10	0	29.90
"	59.83	10.60	29.57
"	8.06	85.30	6.64
"	3.60	96.51	0
70	84.03	0	15.97
"	72.37	11.12	16.51
"	61.11	22.87	16.02
"	41.25	44.64	14.11
"	24.71	67.23	8.06
"	7.51	92.49	0

(de Waal. Dissert. Leiden, 1910.)

#### Sp. gr. of alcoholic solution of $\text{NH}_4\text{NO}_3$ at 15°.

Pts. $\text{NH}_4\text{NO}_3$	Pts. alcohol	Sp. gr.
0	100	0.83904
2	98	0.84746
4	96	0.85604
6	94	0.86524

(Gerlach, Z. anal. 28. 521.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

#### Ammonium hydrogen nitrate, $\text{NH}_4\text{H}(\text{NO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 89. 576, 641.)

Decomp. by  $\text{H}_2\text{O}$ . (Groschuff, B. 1904, 37. 1487.)

#### Ammonium dihydrogen nitrate, $\text{NH}_4\text{H}_2(\text{NO}_3)_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte.)

#### Solubility in $\text{H}_2\text{O}$ .

Solution temp.	% by wt. $\text{NH}_4\text{NO}_3$	% by wt. $\text{HNO}_3$
-8.0	34.2	53.9
-2.5	34.8	54.8
+3.0	35.4	55.8
3.5	36.0	56.8
19.5	37.4	58.9
25.0	38.1	60.0
29.5 mpt.	38.8	61.2

(Groschuff, Z. anorg. 1904, 40. 7.)

**Ammonium cerous nitrate,  $3\text{NH}_4\text{NO}_3$ ,  $2\text{Ce}(\text{NO}_3)_3 + 12\text{H}_2\text{O}$ .**

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Holzmann, J. pr. 84. 78.)  
 $+10\text{H}_2\text{O}$ . Hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Drossbach, B. 1900, 33. 3507.)  
 $2\text{NH}_4\text{NO}_3$ ,  $\text{Ce}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ . As above. (Marignac, A. ch. (4) 30. 64.)

Solubility in  $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve at:  
 8.75° 25° 45°  
 235.5 296.8 410.2 g. anhydrous salt,

60° 65.06°  
 681.2 817.4 g. anhydrous salt.  
 (Wolff, Z. anorg. 1905, 45. 98.)

**Ammonium ceric nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Ce}(\text{NO}_3)_4$ .**

Very sol. in  $\text{H}_2\text{O}$  without decomp. Sol. in  $\text{HNO}_3$ . (Meyer, B. 1900, 33. 2137.)  
 Sol. in alcohol. (Meyer, Z. anorg. 1901, 27. 369.)

Solubility in  $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve at t°:  
 25° 35.2° 45.3°  
 140.9 161.7 174.9 g. anhydrous salt,

64.5° 85.60° 122°  
 201.6 226.8 735.4 g. anhydrous salt.  
 (Wolff, Z. anorg. 1905, 45. 94.)

$+1\frac{1}{2}\text{H}_2\text{O}$ . Very deliquescent. (Holzmann, J. pr. 84. 78.)

**Ammonium cobalt nitrate.**

Permanent. Sol. in  $\text{H}_2\text{O}$ . (Thenard.)

**Ammonium copper nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Cu}(\text{NO}_3)_2$ .**

Very sol. in  $\text{H}_2\text{O}$ .

**Ammonium didymium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Di}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$ .**

Somewhat deliquescent.

**Ammonium gadolinium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Gd}(\text{NO}_3)_3$ .**

Deliquesces in the air. (Benedicks, Z. anorg. 1900, 22. 407.)

**Ammonium gold (auric) nitrate (Ammonium auronitrate),  $\text{NH}_4\text{Au}(\text{NO}_3)_4$ .**

Extremely deliquescent.  
 $\text{H}(\text{NH}_4)_2\text{Au}(\text{NO}_3)_4$ . (Schottländer, A. 217. 312.)

**Ammonium lanthanum nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{La}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ .**

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

**Ammonium magnesium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Mg}(\text{NO}_3)_2$ .**

Slowly deliquescent. Sol. in 10 pts.  $\text{H}_2\text{O}$  at 12.5°, and much less hot  $\text{H}_2\text{O}$ . (Fourcroy.)

**Ammonium mercurous nitrate,  $4\text{NH}_4\text{NO}_3$ ,  $\text{Hg}_2(\text{NO}_3)_2 + 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Pagenstecher, Repert. 14. 188.)

**Ammonium nickel nitrate.**

Sol. in 3 pts. cold  $\text{H}_2\text{O}$ . (Thénard, Scher. J. 10. 428.)

**Ammonium praseodymium nitrate,  $2\text{NH}_4\text{NO}_3$ ,  $\text{Pr}(\text{NO}_3)_3 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg. 1898, 18. 356.)

**Ammonium silver nitrate,  $\text{NH}_4\text{NO}_3$ ,  $\text{AgNO}_3$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26. 357.)

Sol. in  $\text{H}_2\text{O}$  without decomp. (Schreinemakers and de Baat, Chem. Weekbl. 1910, 7. 6.)

See also solubility of  $\text{NH}_4\text{NO}_3 + \text{AgNO}_3$  under  $\text{NH}_4\text{NO}_3$ .

**Ammonium thorium nitrate,  $(\text{NH}_4)_2\text{Th}(\text{NO}_3)_4$ .**

Sol. in strong  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27. 383.)  
 $\text{NH}_4\text{Th}(\text{NO}_3)_5 + 5\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  of sp. gr. 1.25. (Meyer, Z. anorg. 1901, 27. 382.)

**Ammonium uranyl nitrate,  $\text{NH}_4\text{NO}_3$ ,  $\text{UO}_2(\text{NO}_3)_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ . (Meyer, B. 1903, 36. 4057.)

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	In 100 pts. by wt. of the solution			Solid phase
	Pts. by wt. $\text{UO}_2$	Pts. by wt. $\text{NH}_4$	Pts. by wt. total salt	
0.5	29.71	2.92	...	Double salt $+ \text{UO}_2(\text{NO}_3)_2$
13.5	32.35	3.42	...	"
24.9 a	36.40	3.54	68.72	"
b	36.53	3.54	68.97	"
35.0	42.07	3.44	...	"
59.0	44.37	2.90	...	"
80.7 a	44.90	2.98	78.76	Double salt
b	45.01	2.98	78.79	"

Ammonium uranyl nitrate is decomp. by  $\text{H}_2\text{O}$  at temp. below 60°: above 60° it is sol. in  $\text{H}_2\text{O}$  without decomp. (Rimbach, B. 1904, 37. 475.)

**Ammonium nitrate ammonia,  $2\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_3$ .**

Known only as a solution of  $\text{NH}_3$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Troost, C. R. 94. 789.)  
 $\text{NH}_4\text{NO}_3$ ,  $3\text{NH}_3$ . As above.

**Ammonium nitrate mercuric chloride,**  
 $\text{NH}_4\text{NO}_3, 2\text{HgCl}_2$ .

 Insol. in  $\text{H}_2\text{O}$ . Ether dissolves out  $\text{HgCl}_2$ .  
 (Kosmann, A. ch. (3) 27. 240.)

 $2\text{NH}_4\text{NO}_3, \text{HgCl}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305. 199.)

**Ammonium nitrate sulphate,  $2(\text{NH}_4)_2\text{O}, \text{N}_2\text{O}_5, 2\text{SO}_3, \text{H}_2\text{O}$ .**

 Very hygroscopic and sol. in  $\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 1894, 6. 297.)

 $2\text{NH}_4\text{NO}_3, (\text{NH}_4)_2\text{SO}_4$ . (de Waal, Dissert. 1910.)

 $3\text{NH}_4\text{NO}_3, (\text{NH}_4)_2\text{SO}_4$ . (de Waal.)

 See also solubility of  $\text{NH}_4\text{NO}_3 + (\text{NH}_4)_2\text{SO}_4$  under  $\text{NH}_4\text{NO}_3$ .

**Ammonium nitrate melatingstate,  $\text{NH}_4\text{NO}_3, 2(\text{NH}_4)_2\text{W}_6\text{O}_{19} + 4\text{H}_2\text{O}$ .**

 Decomposes by recrystallising out of  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 69. 61.)

**Antimony nitrate,  $\text{Sb}_2\text{O}_3, \text{N}_2\text{O}_5$ .**

 Decomp. by cold  $\text{H}_2\text{O}$ . (Bucholz.)

 Aqueous solution sat. at  $10^\circ$  contains 30.4% salt. (Eller.)

 Sol. in strong, less sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Peligot, A. ch. (3) 20. 288.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Barium nitrate,  $\text{Ba}(\text{NO}_3)_2$ .**

 Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.0 parts  $\text{Ba}(\text{NO}_3)_2$ . (Gay-Lussac, A. ch. 11. 313.)

 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.2 parts  $\text{Ba}(\text{NO}_3)_2$ . (Mulder.)

 $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $20^\circ$  contains 8.57 pts.

 $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and has 1.0679 sp. gr. (Karsten); sat. at  $20^\circ$  has 1.064 sp. gr., and contains 7.94 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ . (Michel and Krafft.)

 100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Ba}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$
0	5.00	52.11	17.97
14.95	8.18	73.75	25.01
17.62	8.54	86.21	29.57
37.87	13.67	101.65	35.18
49.22	17.07	...	...

(Gay-Lussac, A. ch. (2) 11. 313.)

**Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Ba}(\text{NO}_3)_2$
0	5.0	52	17.7
1	5.1	53	18.1
2	5.3	54	18.4
3	5.5	55	18.7
4	5.7	56	19.0
5	6.0	57	19.3
6	6.2	58	19.6
7	6.4	59	20.0
8	6.6	60	20.3
9	6.8	61	20.6
10	7.0	62	20.9
11	7.3	63	21.0
12	7.5	64	21.6
13	7.7	65	21.0
14	7.9	66	22.3
15	8.1	67	22.6
16	8.3	68	22.9
17	8.5	69	23.3
18	8.8	70	23.6
19	9.0	71	23.9
20	9.2	72	24.3
21	9.5	73	24.9
22	9.7	74	25.0
23	9.9	75	25.4
24	10.1	76	25.7
25	10.4	77	26.0
26	10.6	78	26.4
27	10.8	79	26.7
28	11.1	80	27.0
29	11.3	81	27.4
30	11.6	82	27.7
31	11.8	83	28.1
32	12.1	84	28.4
33	12.3	85	28.8
34	12.6	86	29.1
35	12.8	87	29.5
36	13.1	88	29.8
37	13.4	89	30.2
38	13.7	90	30.6
39	14.0	91	30.9
40	14.2	92	31.3
41	14.5	93	31.7
42	14.8	94	32.0
43	15.1	95	32.4
44	15.4	96	32.7
45	15.6	97	33.1
46	15.9	98	33.5
47	16.2	99	33.8
48	16.5	100	34.2
49	16.8	101	34.5
50	17.1	101.9	34.8
51	17.4	...	...

(Mulder, calculated from his own and other experiments, Scheik. Verhandel. 1864. 50.)

Sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  contains %  $\text{Ba}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	% $\text{Ba}(\text{NO}_3)_2$	$t^\circ$	% $\text{Ba}(\text{NO}_3)_2$
0.4	4.3	60.0	16.1
2.1	4.9	73.0	19.4
6.0	5.6	92.0	23.4
6.5	5.6	110.0	27.4
11.0	6.4	132.0	31.8
15.3	7.1	134.0	32.5
18.0	7.7	150.0	34.9
28.5	9.7	152.0	35.4
45.5	12.8	171.0	38.3
52.0	14.9	215.0	45.8

(Étard, A. ch. 1894, (7) 2. 528.)

100 g.  $\text{H}_2\text{O}$  dissolve 8.54 g.  $\text{Ba}(\text{NO}_3)_2$  at  $17^\circ$ . (Gmelin-Kraut, Handbuch der anorg. Chemie.)

100 g.  $\text{H}_2\text{O}$  dissolve 7.87 g.  $\text{Ba}(\text{NO}_3)_2$  at  $15^\circ$ ; 8.32 g. at  $17^\circ$ . (Euler, Z. phys. Ch. 1904, 49. 315.)

1000 g.  $\text{H}_2\text{O}$  dissolve 0.72 gram-equivalents  $\text{Ba}(\text{NO}_3)_2$  at  $21.5^\circ$ . (Euler, Z. phys. Ch. 1904, 49. 312.)

10.30 g. anhydrous  $\text{Ba}(\text{NO}_3)_2$  are sol. in 100 g.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Parsons and Colson, J. Am. Chem. Soc. 1910, 32. 1385.)

4.74 g.  $\text{Ba}(\text{NO}_3)_2$  are contained in 100 g.  $\text{Ba}(\text{NO}_3)_2$  sat. at  $0^\circ$ . (Coppadoro, Gazz. ch. it. 1911, 42, I. 233.)

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O} = 0.427$  mol. l. at  $30^\circ$ . (Masson, Chem. Soc. 1911, 99. 1136.)

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $30^\circ = 10.33\%$ . (Coppadoro, Gazz. ch. it. 1913, 43. I. 240.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

9.1°	21.1°	35°
6.25	8.46	11.39 g. $\text{Ba}(\text{NO}_3)_2$ .

(Findlay, Chem. Soc. 1914, 105. 780.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.	% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
1	1.009	6	1.050
2	1.017	7	1.060
3	1.025	8	1.069
4	1.034	9	1.078
5	1.042	10	1.087

(Calculated by Gerlach, Z. anal. 8. 286, from Kremers, Pogg. 95. 110.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
4.2	1.0340
8.4	1.0712

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.	% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
1	1.0085	6	1.0510
2	1.0170	7	1.0600
3	1.0255	8	1.0690
4	1.0340	Sat. sol.	1.0690
5	1.0425		.....

(Gerlach, Z. anal. 27. 283.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at room temp.

% $\text{Ba}(\text{NO}_3)_2$	Sp. gr.
5.25	1.0507
2.98	1.0274

(Wagner, W. Ann. 1883, 18. 264.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ .	Sp. gr.
$\frac{1}{2}$ normal	1.0518
$\frac{1}{4}$ "	1.0259
$\frac{1}{8}$ "	1.0130

(Wagner, Z. phys. Ch. 1890, 5. 35.)

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 6.08%  $\text{Ba}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0517$ .

$\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  containing 6.97%  $\text{Ba}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0597$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Sp. gr. of  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containing M g. mols. salt per liter.

M	0.01	0.025	0.05
Sp. gr.	1.002031	1.005224	1.010591

M	0.075	0.10	0.15
Sp. gr.	1.015671	1.021143	1.031770

(Jones and Pearce, Am. Ch. J. 1907, 38. 708.)

Sp. gr. of sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	g. $\text{Ba}(\text{NO}_3)_2$ sol. in 100 g. $\text{H}_2\text{O}$	Sp. gr.
0	5.2	1.043
10	7.0	1.056
20	9.2	1.073
30	11.6	1.087
40	14.2	1.104
50	17.1	1.121
60	20.3	1.137
70	23.6	1.146

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44. 1565.)

Saturated  $\text{BaNO}_3 + \text{Aq}$  contains:—  
36.13 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at  $101.1^\circ$ . (Griffiths.)



35.2 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at  $101.65^\circ$ . (Gay-Lussac.)

34.8 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at  $101.9^\circ$ . (Mulder.)

34.8 pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , and boils at  $102.5^\circ$ . (Kremers.)

Sat.  $\text{Ba}(\text{NO}_3)_2$  + Aq forms a crust at  $101.1^\circ$ ; highest temp. observed was  $101.5^\circ$ . (Gerlach, Z. anal. 26. 427.)

B. pt. of  $\text{Ba}(\text{NO}_3)_2$  + Aq containing pts.  $\text{Ba}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{Ba}(\text{NO}_3)_2$
100.5°	12.5
101.0	26.0
101.1	27.5

(Gerlach, Z. anal. 26. 440.)

Insol. in conc.  $\text{HNO}_3$  + Aq, and much less sol. in dil.  $\text{HNO}_3$  + Aq or  $\text{HCl}$  + Aq than in  $\text{H}_2\text{O}$ .

Solubility of  $\text{Ba}(\text{NO}_3)_2$  in  $\text{HNO}_3$  + Aq at  $30^\circ$ .

Solid phase $\text{Ba}(\text{NO}_3)_2$		
Sp. gr. of sat. solution	G. mol. per l.	
	$\text{HNO}_3$	$\text{Ba}(\text{NO}_3)_2$
1.0891	0.0000	0.4270
1.0811	0.1318	0.3282
.....	0.2496	0.3268
1.0663	0.4995	0.2410
1.0619	0.7494	0.1785
1.0609	1.000	0.1353
1.0633	1.247	0.1056
1.0668	1.493	0.0847
1.0783	1.998	0.0598
1.1050	2.993	0.0334
1.1341	3.986	0.0218
1.1341	3.994	0.0223
1.1645	5.012	0.0147

(Masson, Chem. Soc. 1911, 99. 1136.)

Less sol. in dil.  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq than in dil.  $\text{HCl}$  + Aq.

Solubility in  $\text{NH}_4\text{Cl}$  + Aq is the same as in  $\text{H}_2\text{O}$ .

Less sol. in  $\text{NH}_4\text{OH}$  + Aq,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  + Aq, or  $\text{NH}_4\text{NO}_3$  + Aq than in  $\text{H}_2\text{O}$ . (Pearson, Zeit. Ch. (2) 5. 662.)

$\text{Ba}(\text{NO}_3)_2$  is sol. in about:

13.33 pts.  $\text{H}_2\text{O}$  at ord. temp., and 4.67 pts. at  $100^\circ$ .

14.67 pts.  $\text{NH}_4\text{OH}$  + Aq (conc.) at ord. temp., and 5.67 pts. at  $100^\circ$ .

16.50 pts.  $\text{NH}_4\text{OH}$  + Aq (1 vol. conc. + 3 vols.  $\text{H}_2\text{O}$ ) at ord. temp.

28.00 pts.  $\text{HCl}$  + Aq (1 vol. conc.  $\text{HCl}$  + 4 vols.  $\text{H}_2\text{O}$ ) at ord. temp.

29.00 pts.  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq (1 vol. commercial  $\text{HC}_2\text{H}_3\text{O}_2$  + 1 vol.  $\text{H}_2\text{O}$ ) at ord. temp.

13.67 pts.  $\text{NH}_4\text{Cl}$  + Aq (1 pt.  $\text{NH}_4\text{Cl}$  + 10 pts.  $\text{H}_2\text{O}$ ) at ord. temp., and 4.67 pts. at  $100^\circ$ .

24.00 pts.  $\text{NH}_4\text{NO}_3$  + Aq (1 pt.  $\text{NH}_4\text{NO}_3$  + 10 pts.  $\text{H}_2\text{O}$ ) at ord. temp.

17.33 pts.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  + Aq (dil.  $\text{NH}_4\text{OH}$  neutralised by dil.  $\text{HC}_2\text{H}_3\text{O}_2$ ) at ord. temp., and 4.33 pts. at  $100^\circ$ .

14.67 pts.  $\text{NaC}_2\text{H}_3\text{O}_2$  + Aq (dil.  $\text{HC}_2\text{H}_3\text{O}_2$  neutralised by  $\text{Na}_2\text{CO}_3$ , and dil. with 4 vols.  $\text{H}_2\text{O}$ ) at ord. temp., and 5.33 pts. at  $100^\circ$ .

17.33 pts.  $\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$  + Aq (see Stolba, Z. anal. 2. 390) at ord. temp., and 6.00 pts. at  $100^\circ$ .

18.67 pts. grape sugar (1 pt. grape sugar + 10 pts.  $\text{H}_2\text{O}$ ) at ord. temp. (Pearson, Zeit. Ch. 1869. 662.)

Sol. in sat.  $\text{NH}_4\text{Cl}$  + Aq without pptn. at first, but finally  $\text{NH}_4\text{Cl}$  is pptd. until a certain state of equilibrium is reached. (Karsten.)

Solubility in  $\text{BaO}_2\text{H}_2$ ,  $8\text{H}_2\text{O}$  + Aq at  $25^\circ$ .

Sp. gr. $25^\circ/25^\circ$	G. $\text{BaO}$ as $\text{Ba}(\text{OH})_2$ in 100 g. $\text{H}_2\text{O}$	G. $\text{Ba}(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$
1.0797	0	10.30
1.1002	1.55	10.66
1.1210	3.22	11.04
*1.1448	5.02	11.48

\* This solution is sat. with respect to both  $\text{Ba}(\text{OH})_2$ ,  $8\text{H}_2\text{O}$  and  $\text{Ba}(\text{NO}_3)_2$ .

(Parsons. J. Am. Chem. Soc. 1910, 32. 1335.)

See also under  $\text{BaO}_2\text{H}_2$ .

Solubility in  $\text{BaCl}_2$  + Aq at  $t^\circ$ .

$t^\circ$	Sat. solution contains	
	% $\text{BaCl}_2$	% $\text{Ba}(\text{NO}_3)_2$
-7	21.4	4.0
-1	23.0	4.0
+1.5	22.6	4.4
2	....	5.0
10	24.7	6.1
21	24.5	5.6
32	26.6	7.7
35	26.4	7.7
38	26.7	7.8
48	28.1	8.0
53	28.5	9.0
53	28.3	9.2
66	28.0	10.0
73	30.0	10.5
79	30.3	11.2
90	32.1	12.5
155	32.5	23.1
162	33.1	23.4
210	32.5	31.9

(Étard, A. ch. 1894, (7) 3. 287.)

See also under  $\text{BaCl}_2$ .

$\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$ .  
Very al. sol. in sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ . (Karsten.)

100 pts. sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$  contain 33.95 pts. of the two salts at 19–20°.  
(v. Hauer, J. pr. 98. 137.)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$  at 25°.

G. per l.		Sp. gr.
$\text{Ba}(\text{NO}_3)_2$	$\text{Pb}(\text{NO}_3)_2$	
102.2	0	1.079
54.9	17.63	1.088
86.5	49.80	1.108
79.7	68.10	1.119
77.0	97.20	1.140
69.8	130.7	1.163
66.0	177.3	1.198
57.5	247.7	1.252
25.9	334.3	1.294
28.8	429.7	1.376
0	553.8	1.459

(Fock, Z. Kryst. Min. 1897, 23. 365, 397.)

100 ccm.  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at 17° contain 3.22 g.  $\text{Ba}(\text{NO}_3)_2$  and 38.59 g.  $\text{Pb}(\text{NO}_3)_2$  and solution has sp. gr. = 1.350.  
(Euler, Z. phys. Ch. 1904, 46. 313.)

100 pts. sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contain 45.90 pts. of the three salts at 19–20°. (v. Hauer, l. c.)

$\text{Ba}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2$ .

100 pts. sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Aq}$  contain 45.96 pts. of the two salts at 19–20°. (v. Hauer, l. c.)

$\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve:

	(Mulder)		
	(1)		
	29.7	28.8	...
$\text{KNO}_3$ . . .	29.7	28.8	...
$\text{Ba}(\text{NO}_3)_2$ . .	....	5.4	8.9
		34.2	

	(Karsten)		(Kopp)	
	(2)	(3)	(4)	(5)
	13.31	29.03	5.7	3.5
$\text{KNO}_3$ . . .	6.91	1.00	33.1	36.3
$\text{Ba}(\text{NO}_3)_2$ . .	20.22	30.03	38.8	39.8

1. Sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  sat. with  $\text{KNO}_3$  at 18.5°.

2. To sat.  $\text{KNO}_3 + \text{Aq}$ ,  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  was added.

3. To sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ ,  $\text{KNO}_3$  was added.

4. Both salts in excess +  $\text{Aq}$  at 21.5°.

5. Both salts in excess +  $\text{Aq}$  at 23°.

11. of the solution contains 59.1 g.  $\text{Ba}(\text{NO}_3)_2 + 124.2$  g.  $\text{KNO}_3 = 183.35$  g. mixed salts at 17°. Sp. gr.  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3 + \text{Aq} = 1.120$ .

11. of the solution contains 88.7 g.  $\text{Ba}(\text{NO}_3)_2 + 213.6$  g.  $\text{KNO}_3 = 302.3$  g. mixed salts at 30°. Sp. gr.  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3 + \text{Aq} = 1.191$ . (Euler, Z. phys. Ch. 1904, 46. 313.)

Solubility in  $\text{KNO}_3 + \text{Aq}$  at 25°.

100 pts. of solution contain		Solid phase
pts. $\text{KNO}_3$	pts. $\text{Ba}(\text{NO}_3)_2$	
15.24	6.64	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
14.69	6.60	"
14.79	6.62	"
16.30	5.49	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
21.99	3.04	"
27.66	2.01	$\text{KNO}_3 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
27.81	2.09	"
27.94	1.92	"
27.64	2.05	"

These results show that a double salt of potassium and barium nitrates is formed at 25°.

(Foote, Am. Ch. J. 1904, 32. 252.)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$  at t°.

t°	$\text{Ba}(\text{NO}_3)_2$	$\text{KNO}_3$	Solid phase
9.1	6.25	0	$\text{Ba}(\text{NO}_3)_2$
	4.20	8.15	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	1.98	12.02	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	0.98	16.80	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$
	0	16.76	$\text{KNO}_3$
21.1	8.46	0	$\text{Ba}(\text{NO}_3)_2$
	7.47	2.12	"
	6.35	5.98	"
	6.06	8.47	"
	5.98	13.24	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	3.35	18.24	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	2.30	21.47	"
	1.76	24.86	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$
	0	24.77	$\text{KNO}_3$
35	11.39	0	$\text{Ba}(\text{NO}_3)_2$
	8.18	12.99	"
	8.08	17.48	"
	8.42	19.75	$\text{Ba}(\text{NO}_3)_2 + 2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	5.85	24.	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2$
	5.02	26.05	"
	3.02	34.87	$2\text{KNO}_3$ , $\text{Ba}(\text{NO}_3)_2 + \text{KNO}_3$
	1.77	34.98	$\text{KNO}_3$
	0	35.01	"

(Findlay, Chem. Soc. 1914, 106. 779.)

$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$ .  
 $\text{Ba}(\text{NO}_3)_2$  is sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  without separation.

100 pts.  $\text{H}_2\text{O}$  dissolve:

		(Karsten) At 18.75°		
$\text{NaNO}_3$	...	86.6	88.14	...
$\text{Ba}(\text{NO}_3)_2$	...	....	3.77	8.9

		(Kopp) At 20.2°		
$\text{NaNO}_3$	...	87.7	88.6	...
$\text{Ba}(\text{NO}_3)_2$	...	....	3.6	9.2

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at 0°.

% $\text{NaNO}_3$	% $\text{Ba}(\text{NO}_3)_2$	Solid phase
0	4.74	$\text{Ba}(\text{NO}_3)_2$
0.41	4.33	"
0.61	4.03	"
1.68	3.34	"
3.54	2.50	"
8.05	1.60	"
12.71	1.56	"
20.24	1.53	"
20.92	1.43	"
27.74	1.56	"
30.81	1.55	"
33.79	1.53	"
35.83	1.49	"
41.30	1.55	$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$
41.68	0.51	$\text{NaNO}_3$
42.47	0	"

(Coppadoro, Gazz. ch. it, 1912, 42 (1) 233.)

Solubility of  $\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at 30°.

% $\text{NaNO}_3$	% $\text{Ba}(\text{NO}_3)_2$	Solid phase
0	10.33	$\text{Ba}(\text{NO}_3)_2$
2.33	8.58	"
7.09	5.28	"
12.07	3.89	"
14.41	3.54	"
17.87	3.20	"
19.06	3.07	"
23.55	2.81	"
41.22	2.27	"
48.22	2.11	$\text{Ba}(\text{NO}_3)_2 + \text{NaNO}_3$
48.50	1.00	$\text{NaNO}_3$
49.16	0	"

(Coppadoro, Gazz. ch. it. 1913, 43, I. 240.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 827.)

100 pts. hydrazine dissolves 81.1 pts.  $\text{Ba}(\text{NO}_3)_2$  at 12.5–13°. (de Bruyn, R. t. c. 1899, 18, 297.)

100 pts. anhydrous hydroxylamine dissolve 11.4 pts.  $\text{Ba}(\text{NO}_3)_2$ . (de Bruyn, R. t. c. 1892, 11, 18.)

Insol. in absolute alcohol.

Solubility in dilute alcohol increases with the temp. (Gerardin, A. ch. (4) 5, 145.)

Solubility in ethyl alcohol + Aq at 25°.

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ba}(\text{NO}_3)_2$ in the solution
0	0	9.55
10.25	9.5	7.63
18.60	17.5	6.02
25.05	23.7	5.25
40.20	38.8	3.53
58.00	57.0	1.85
78.70	78.2	0.62
90.10	89.9	0.18
99.40	99.39	0.005

(D'Ans and Siegler, Z. phys. Ch. 1913, 82, 37.)

Completely insol. in boiling amyl alcohol. (Browning, Sill. Am. J. 143, 314.)

Solubility in organic solvents.

Solvent	% $\text{Ba}(\text{NO}_3)_2$ in the solution at 25°
Methyl alcohol	0.50
Ethyl alcohol	0.005
Acetone	0.005
Ether	very small
Paracetaldehyde	" "

(D'Ans and Siegler, Z. phys. Ch. 1913, 82, 44.)

Solubility in phenol + Aq at 25°.

Concentration of the phenol Mol./Liter	Solubility of $\text{Ba}(\text{NO}_3)_2$ Mol./Liter
0.000	0.3835
0.045	0.3785
0.082	0.3746
0.146	0.3664
0.310	0.3492
0.401	0.3400
0.501	0.3299
0.728 (sat.)	0.3098

(Rothmund and Wilshire, Z. phys. Ch. 1902, 40, 620.)

Insol. in benzonitrile. (Naumann, B. 1914, 47, 1370.)

Insol. in methyl acetate (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37, 3602.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37, 4328.)

Sol. in acetone. (Eidmann, C. C. 1899, II, 1014.)

**Barium mercurous nitrate**,  $2\text{BaO}$ ,  $2\text{Hg}_2\text{O}$ ,  $3\text{N}_2\text{O}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in hot dil.  $\text{HNO}_3$  + Aq and hot  $\text{Hg}_2(\text{NO}_3)_2$  + Aq, from which it crystallises on cooling. (Städeler, A. 87. 129.)

**Barium potassium nitrate**,  $\text{Ba}(\text{NO}_3)_2$ ,  $2\text{KNO}_3$ .  
Ppt. (Wallbridge, Am. Ch. J. 1903, 30. 154.)

Solubility determinations show that the only double salt formed by barium and potassium nitrates at  $25^\circ$  is  $\text{Ba}(\text{NO}_3)_2$ ,  $2\text{KNO}_3$ .

See  $\text{Ba}(\text{NO}_3)_2$  +  $\text{KNO}_3$  under  $\text{Ba}(\text{NO}_3)_2$ . (Foote, Am. Ch. J. 1904, 32. 252.)

**Barium nitrate melatungstate**,  $2\text{Ba}(\text{NO}_3)_2$ ,  $\text{BaW}_6\text{O}_{19}$  +  $6\text{H}_2\text{O}$ .

Efflorescent. Sol. in warm  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 198.)

**Bismuth nitrate, basic**,  $\text{Bi}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5$  +  $2\text{H}_2\text{O}$ .

Sol. in a large amount of  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  + Aq. (Heintz.)

Sol. in 135 pts.  $\text{H}_2\text{O}$  at  $90$ – $93^\circ$ . (Ruge, J. B. 1862. 163.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Sol. in much  $\text{H}_2\text{O}$ . (Yvon, C. R. 84. 1161.)

+  $\text{H}_2\text{O}$ . (Ruge.)

$2\text{Bi}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5$ . Not acted upon by  $\text{H}_2\text{O}$ . (Ditte, C. R. 84. 1317.)

+  $\text{H}_2\text{O}$ . (Yvon.)

$\text{Bi}_2\text{O}_3$ ,  $2\text{N}_2\text{O}_5$  +  $\text{H}_2\text{O}$ . (Ruge.)

$11\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5$  +  $16\text{H}_2\text{O}$ . Not decomp. by  $\text{H}_2\text{O}$ . (Yvon.)

$5\text{Bi}_2\text{O}_3$ ,  $4\text{N}_2\text{O}_5$  +  $8\text{H}_2\text{O}$ . Ppt. Not attacked by  $\text{H}_2\text{O}$ . (Schulten, Bull. Soc. 1903, (3) 29. 722.)

$5\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5$  +  $9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Schulten.)

$6\text{Bi}_2\text{O}_3$ ,  $5\text{N}_2\text{O}_5$  +  $8\text{H}_2\text{O}$ , and +  $9\text{H}_2\text{O}$ . (Rutten, Z. anorg. 1902, 30. 368.)

At  $25^\circ$  the salt  $\text{Bi}_{12}\text{O}_{19}(\text{NO}_3)_{10}$ ,  $9\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0.03–0.32-N; the salt  $\text{BiO}(\text{NO}_3)$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0.425–0.72-N.

At  $50^\circ$  the salt  $\text{Bi}_2\text{O}_3(\text{NO}_3)_3$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0.057–0.285-N; the salt  $\text{Bi}_{12}\text{O}_{19}(\text{NO}_3)_{10}$ ,  $9\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0.285–0.446-N.

At  $75^\circ$  the salt  $\text{Bi}_2\text{O}_3(\text{NO}_3)_2$ ,  $\text{H}_2\text{O}$  is in equilibrium with  $\text{HNO}_3$  + Aq from 0.109–0.314-N. (Allan, Am. Ch. J. 1901, 25. 314.)

**Bismuth nitrate**,  $\text{Bi}(\text{NO}_3)_3$ .

Permanent. Decomp. by little  $\text{H}_2\text{O}$  with separation of a basic salt. This decomposition is prevented by slight excess of  $\text{HNO}_3$ , and then the salt is completely sol. in a large amount of  $\text{H}_2\text{O}$ . (Rose.)

Sol. in dil.  $\text{HNO}_3$  + Aq. Not decomp. by  $\text{H}_2\text{O}$  in presence of  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\frac{3}{10}$  pt.  $\text{NH}_4\text{NO}_3$ . (Löwe, J. pr. 74. 341.)

Completely sol. in  $\text{HNO}_3$  + Aq containing 83 g.  $\text{HNO}_3$  per liter. (Ditte.)

Solubility of  $\text{Bi}(\text{NO}_3)_3$  in  $2.3\text{N}$ – $\text{HNO}_3$  + Aq. = 2.04 g. at Bi per l.; in  $0.922\text{N}$ – $\text{HNO}_3$  + Aq. = 2.23 g. at Bi per l. (Dubrisay, C. R. 1911, 153. 1077.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Krug and M'Elroy.)

Solubility of  $\text{Bi}(\text{NO}_3)_3$  in 6.67% acetone +  $2.3\text{N}$ – $\text{HNO}_3$  + Aq = 1.89 g. at Bi per l.; in 6.67% acetone +  $0.922\text{N}$ – $\text{HNO}_3$  + Aq = 2.17 g. at Bi per l.; in 13.33% acetone +  $0.922\text{N}$ – $\text{HNO}_3$  + Aq = 2.08 g. at Bi per l. (Dubrisay, C. R. 1911, 153. 1077.)

When  $\text{Bi}(\text{NO}_3)_3$  is mixed with mannite (dulcite, sorbite) in proportion to the mol. wts. and  $\text{H}_2\text{O}$  is added, a clear solution is obtained which is not pptd. by addition of much  $\text{H}_2\text{O}$ . These solutions are more stable the greater the proportion of mannitol. (Vanino and Hunser, Z. anorg. 1901, 23. 211.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . (Ditte.)

+  $5\text{H}_2\text{O}$ . If treated with increasing amts. of  $\text{H}_2\text{O}$ , the amt. of Bi which dissolves decreases, and when 1 pt. is treated with 50,000 pts.  $\text{H}_2\text{O}$ , no Bi goes into solution. (Antony and Gigli, Gazz. ch. it. 1898, 23. 245.)

48.66 pts. are sol. in 100 pts. acetone at  $0^\circ$ .

41.70 " " " " 100 " " "  $19^\circ$ .

(Laszczyński, B. 1894, 27. 2287.)

+  $5\frac{1}{2}\text{H}_2\text{O}$ . (Yvon, C. R. 84. 1161.)

+  $10\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  with decomp. at  $74^\circ$ . (Ordway.)

**Bismuth cesium nitrate**,  $\text{Bi}(\text{NO}_3)_3$ ,  $2\text{CsNO}_3$ .

Ppt. (Wells, Am. Ch. J. 1901, 26. 277.)

**Bismuth cobalt nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Co}(\text{NO}_3)_2$ , +  $24\text{H}_2\text{O}$ .

100 cc. sat. solution in  $\text{HNO}_3$  + Aq (sp. gr. 1.325) contain 54.67 g. hydrated salt. (Jantsch Z. anorg. 1912, 76. 321.)

**Bismuth magnesium nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Mg}(\text{NO}_3)_2$  +  $24\text{H}_2\text{O}$ .

Deliquescent. Effloresces in dry air. Decomp. by  $\text{H}_2\text{O}$ . (Urbain and Lacombe, C. R. 1903, 137. 569.)

100 cc. sat. solution in  $\text{HNO}_3$  + Aq (sp. gr. 1.325) contain 41.69 g. hydrated salt. (Jantsch Z. anorg. 1912, 76. 321.)

**Bismuth manganous nitrate**,  $2\text{Bi}(\text{NO}_3)_3$ ,  $3\text{Mn}(\text{NO}_3)_2$  +  $24\text{H}_2\text{O}$ .

Deliquescent. Effloresces in dry air. Decomp. by  $\text{H}_2\text{O}$ . (Urbain and Lacombe, C. R. 1903, 137. 569.)

100 cc. sat. solution in  $\text{HNO}_3$  + Aq (sp. gr. 1.325) contain 65.77 g. hydrated salt. (Jantsch Z. anorg. 1912, 76. 321.)

**Bismuth nickel nitrate,  $2\text{Bi}(\text{NO}_3)_3 \cdot 3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .**

Deliquescent. Effloresces in dry air. Decomp. by  $\text{H}_2\text{O}$ . (Urbain and Lacombe, C. R. 1903, 37. 569.)

100 cc. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contain 46.20 g. hydrated salt at  $16^\circ$ . (Jantsch.)

**Bismuth zinc nitrate,  $2\text{Bi}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Urbain and Lacombe, C. R. 1903, 137. 569.)

100 cc. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contain 57.51 g. hydrated salt at  $16^\circ$ . (Jantsch.)

**Cadmium nitrate, basic,  $\text{Cd}(\text{OH})\text{NO}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ , or ordinary alcohol. (Klinger, B. 16. 997.)

$12\text{CdO} \cdot \text{N}_2\text{O}_5 + 11\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{H}_2\text{O}$  than basic sulphate. (Habermann, 5. 432.)

$5\text{CdO} \cdot 2\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Rousseau and Tite, C. R. 114. 1184.)

**Cadmium nitrate,  $\text{Cd}(\text{NO}_3)_2$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .

See +4, and  $9\text{H}_2\text{O}$ .

Sp. gr. of aqueous solution containing:

	5	10	15	20	25%
% $\text{Cd}(\text{NO}_3)_2$	1.0528	1.0978	1.1516	1.2134	1.2842

	30	35	40	45	50%
% $\text{Cd}(\text{NO}_3)_2$	1.3566	1.4372	1.5372	1.6474	1.7608

(Frans, J. pr. (2) 5. 274.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{Cd}(\text{NO}_3)_2$	1	5	10	15
Sp. gr.	1.0069	1.0415	1.0869	1.136

% $\text{Cd}(\text{NO}_3)_2$	20	25	30	35
Sp. gr.	1.1903	1.25	1.3125	1.3802

% $\text{Cd}(\text{NO}_3)_2$	40	45	48
Sp. gr.	1.459	1.543	1.5978

(Grottrian, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

	7.81	15.71	22.36%
% $\text{Cd}(\text{NO}_3)_2$	1.0744	1.1593	1.2411

(Wagner, W. Ann. 1883, 18. 265.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$ .

$\text{Cd}(\text{NO}_3)_2$	$t^\circ$	Sp. gr. at $t^\circ$	Sp. gr. at $18^\circ$
0.0492	17.57	0.99912	0.99904
...	21.14	0.99839	...
0.100	18.00	...	0.99945
0.249	17.34	1.0008	1.0007
...	20.22	1.0002	...
0.464	18.00	...	1.0025
0.952	18.00	...	1.0065

(Wershofen, Z. phys. Ch. 1890, 5. 493.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$ .	Sp. gr.
1-normal	1.0954
$\frac{1}{2}$ - " "	1.0479
$\frac{1}{3}$ - " "	1.0249
$\frac{1}{15}$ - " "	1.0119

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ/4^\circ$ .

% $\text{Cd}(\text{NO}_3)_2$	54.027	43.716	30.879
Sp. gr.	1.711	1.515	1.321

% $\text{Cd}(\text{NO}_3)_2$	21.353	14.899	8.683
Sp. gr.	1.204	1.134	1.074

(de Muijnck, W. Ann. 1894, 53. 561.)

$\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  containing 7.89%  $\text{Cd}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.0673$ .

$\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  containing 12.14%  $\text{Cd}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.1070$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sat.  $\text{Cd}(\text{NO}_3)_2 + \text{Aq}$  boils at  $132^\circ$ .

Almost entirely insol. in conc.  $\text{HNO}_3 + \text{Aq}$ . (Wurts.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in alcohol.

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

$+4\text{H}_2\text{O}$ . M.-pt. of  $\text{Cd}(\text{NO}_3)_2 + 4\text{H}_2\text{O} = 59.5^\circ$ . (Ordway; Tilden, Chem. Soc. 45. 409.)

Solubility in  $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Cd}(\text{NO}_3)_2$ in the solution	Mols. $\text{H}_2\text{O}$ to 1 mol. $\text{Cd}(\text{NO}_3)_2$
0	52.31	11.96
18	55.90	10.34
30	58.40	9.34
40	61.42	8.24
59.5 mpt.	76.54	4.00

(Funk, B. 1899, 32. 105.)

Sat. solution of  $\text{Cd}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $0^\circ$  contains 52.3%  $\text{Cd}(\text{NO}_3)_2$ ; at  $18^\circ$ , 55.9%  $\text{Cd}(\text{NO}_3)_2$ . (Mylius, Z. anorg. 1912, 74. 411.)

Sol. in liquid  $\text{NH}_3$ . (Johnson and Wilmore, Elektroch. Z. 1908, 14. 227.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

$+9\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$-13^\circ$	$-1^\circ$	$+1^\circ$
37.37	47.33	52.73%

Cryohydrate is formed at  $-16^{\circ}$ . (Funk, Z. anorg. 1899, 20. 416.)

The composition of the hydrates formed by  $\text{Cd}(\text{NO}_3)_2$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $\text{Cd}(\text{NO}_3)_2$  and of the conductivity and sp. gr. of  $\text{Cd}(\text{NO}_3)_2 + \text{Aq.}$  (Jones, Am. Ch. J. 1905, 34. 308.)

**Cadmium uranyl nitrate**,  $\text{Cd}(\text{NO}_3)_2 \cdot (\text{UO}_2)(\text{NO}_3)_2 + 30\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and acids. Insol. in alcohol and alkalis + Aq. (Lancien, C. C. 1912, I. 208.)

**Cadmium nitrate ammonia**,  $\text{Cd}(\text{NO}_3)_2 \cdot 6\text{NH}_3 + \text{H}_2\text{O}$ .  
(André, C. R. 104. 987.)

**Cadmium nitrate cupric oxide**,  $\text{Cd}(\text{NO}_3)_2 \cdot \text{CuO} + 5\text{H}_2\text{O}$ .  
Ppt. (Mailhe, C. R. 1902, 134. 235.)

**Cadmium nitrate cupric oxide**,  $\text{Cd}(\text{NO}_3)_2 \cdot 3\text{CuO} + 5\text{H}_2\text{O}$ .  
(Mailhe, A. ch. 1902, (7) 27. 383.)

**Cadmium nitrate hydrazine**,  $\text{Cd}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$ .

Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in warm  $\text{NH}_4\text{OH}$ . (Fransen, Z. anorg. 1908, 60. 282.)

**Cæsium nitrate**,  $\text{CaNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 10.58 pts.  $\text{CaNO}_3$  at  $3.2^{\circ}$ . Sl. sol. in absolute alcohol. (Bunsen.)

$\text{L}_{25}$  Solubility of  $\text{CaNO}_3$  in  $\text{H}_2\text{O}$  at  $t^{\circ}$ .

$t^{\circ}$	G. $\text{CaNO}_3$ per 100 g.		$t^{\circ}$	G. $\text{CaNO}_3$ per 100 g.	
	Solu- tion	Water		Solu- tion	Water
0	8.54	9.33	60	45.6	83.8
10	12.97	14.9	70	51.7	107.0
20	18.7	23.0	80	57.3	134.0
30	25.3	33.9	90	62.0	163.0
40	32.1	47.2	100	66.3	197.0
50	39.2	64.4	106.2	68.8	220.3

(Berkeley, Trans. Roy. Soc. 1904, 203. A, 213.)

100 g.  $\text{H}_2\text{O}$  dissolve 26.945 g.  $\text{CaNO}_3$  at  $25^{\circ}$ . (Haigh, J. Am. Chem. Soc. 1912, 34. 1148.)

Sp. gr.  $20^{\circ}/4^{\circ}$  of a normal solution of  $\text{CaNO}_3 = 1.140905$ ; of a 0.5 normal solution = 1.07001. (Haigh.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Solubility in glycol = 8% at ord. temp. (de Coninck, Belg. Acad. Bull. 1906, 359.)

**Cæsium hydrogen nitrate.**

$\text{CaNO}_3 \cdot \text{HNO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1901, 26. 273.)

$\text{CaNO}_3 \cdot 2\text{HNO}_3$ . (W.)

**Cæsium cerium nitrate**,  $\text{Cs}_2\text{Ce}(\text{NO}_3)_6$ .

Sol. in  $\text{H}_2\text{O}$ ; very sl. sol. in  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27. 371.)

Sol. in  $\text{HNO}_3$ . (Meyer, B. 1900, 33. 2137.)

**Cæsium ferric nitrate**,  $\text{CaNO}_3 \cdot \text{Fe}(\text{NO}_3)_3 + 7\text{H}_2\text{O}$ .

Deliquescent. (Wells, Am. Ch. J. 1901, 26. 276.)

**Cæsium silver nitrate**,  $\text{CsNO}_3 \cdot \text{AgNO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26. 357.)

**Cæsium thorium nitrate**,  $\text{Cs}_2\text{Th}(\text{NO}_3)_6$ .

Decomp. by  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27. 384.)

**Cæsium uranyl nitrate**,  $\text{Cs}(\text{UO}_2)(\text{NO}_3)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ . (Meyer, B. 1903, 36. 4057.)

Decomp. by  $\text{H}_2\text{O}$  at low temp., so that the solid phase in contact with the solution consists of the double salt and  $\text{CsNO}_3$ . At  $16.1^{\circ}$  100 pts. by wt. of the solution in  $\text{H}_2\text{O}$  contain 31.39 pts.  $\text{UO}_2$  and 6.59 pts. Cs. (Rim-bach, B. 1904, 37. 477.)

**Calcium nitrate, basic**,  $\text{Ca}(\text{NO}_3)_2 \cdot \text{CaO}_2\text{H}_2 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Werner, A. ch. (6) 27. 570.)

+  $\text{H}_2\text{O}$ . As above. (Rousseau and Tite, C. R. 114. 1184.)

**Calcium nitrate**,  $\text{Ca}(\text{NO}_3)_2$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  with evolution of much heat.

100 pts.  $\text{H}_2\text{O}$  at  $0^{\circ}$  dissolve 84.2 pts.  $\text{Ca}(\text{NO}_3)_2$ . (Poggiale.)

100 pts.  $\text{H}_2\text{O}$  at  $0^{\circ}$  dissolve 93.1 pts.  $\text{Ca}(\text{NO}_3)_2$ . (Mulder.)

Sol. in 0.25 pt. cold  $\text{H}_2\text{O}$  with reduction of temp. Sol. in all proportions in boiling  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in 2 pts. cold, and 0.6687 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)

Sat.  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $12.5^{\circ}$  contains 33.8%. (Hassensfrats, A. ch. 28. 29.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the solution contain at:

55° 80° 90° 100°  
78.16 78.20 78.37 78.43 g.  $\text{Ca}(\text{NO}_3)_2$ ,

125° 147.5° 151° (bpt. of sat. solution at 760 mm.)

78.57 78.80 79.00 g.  $\text{Ca}(\text{NO}_3)_2$ .

The anhydrous salt is the stable solid phase above  $51.3^{\circ}$ . (Bassett and Taylor, Chem. Soc. 1912, 101. 580.)

100 g. sat.  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  contain 77.3 g.  $\text{Ca}(\text{NO}_3)_2$  at 25°. (Taylor and Henderson, J. Am. Chem. Soc. 1915, **37**, 1692.)

See also +2, 3, and  $4\text{H}_2\text{O}$ .

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

17.55    30.10    40.13%  $\text{Ca}(\text{NO}_3)_2$ .  
1.1714   1.2739   1.3857

(Wagner, W. Ann. 1883; **18**, 270.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°.

$\text{Ca}(\text{NO}_3)_2$	Sp. gr.	$\text{Ca}(\text{NO}_3)_2$	Sp. gr.
1	1.009	35	1.328
5	1.045	40	1.385
10	1.086	45	1.447
15	1.129	50	1.515
20	1.174	55	1.588
25	1.222	60	1.666
30	1.272	..	...

(Franz, J. pr. (2) **5**, 274.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°.

$\text{Ca}(\text{NO}_3)_2$	Sp. gr.	$\text{Ca}(\text{NO}_3)_2$	Sp. gr.
10	1.076	40	1.368
20	1.163	50	1.483
30	1.261	60	1.605

(Gerlach, Z. anal. **27**, 283.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 18°.

$\text{Ca}(\text{NO}_3)_2$	Sp. gr.	$\text{Ca}(\text{NO}_3)_2$	Sp. gr.
6.25	1.0487	37.5	1.3546
12.5	1.1016	50.0	1.5102
25.0	1.2198	...	...

(Kohlrausch, W. Ann. 1879, **1**.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 24.65°.  $a = \text{no. of g.} \times \frac{1}{2} \text{ mol. wt. dissolved in 1000 g. H}_2\text{O}$ ;  $b = \text{sp. gr. if } a \text{ is } \text{Ca}(\text{NO}_3)_2, 4\text{H}_2\text{O}$ ,  $\frac{1}{2} \text{ mol. wt.} = 118$ ;  $c = \text{sp. gr. if } a \text{ is } \text{Ca}(\text{NO}_3)_2, \frac{1}{2} \text{ mol. wt.} = 82$ .

a	b	c	a	b	c
1	1.056	1.059	6	1.243	1.286
2	1.104	1.112	7	1.270	1.323
3	1.145	1.160	8	1.294	...
4	1.181	1.205	9	1.316	...
5	1.213	1.246	10	1.336	...

(Favre and Valson, C. R. **79**, 968.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 25°.

Concentration of $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$ .	Sp. gr.
1-normal	1.0596
$\frac{1}{2}$ "	1.0300
$\frac{1}{4}$ "	1.0151
$\frac{1}{8}$ "	1.0076

(Wagner, Z. phys. Ch. 1890, **5**, 36.)

$\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 7.15%  $\text{Ca}(\text{NO}_3)_2$ , has sp. gr.  $20^\circ/20^\circ = 1.0554$ .

$\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 7.91%  $\text{Ca}(\text{NO}_3)_2$ , has sp. gr.  $20^\circ/20^\circ = 1.0613$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, **19**, 284.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at 20° containing

M g. mols. of salt per liter.  
M    0.0125    0.025    0.05    0.125  
Sp. gr.   1.001846   1.003166   1.00604   1.01523

M    0.25    0.5    0.75  
Sp. gr.   1.03074   1.06011   1.06874

M    1.00    1.50  
Sp. gr.   1.11751   1.17375

(Jones and Pearce, Am. Ch. J. 1907, **38**, 704.)

Saturated  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing 351.2 pts.  $\text{Ca}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$  boils at 151° (Legrand); 152° (Kremers).

Forms a crust at 141°, and contains 333.5 pts.  $\text{Ca}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed, 151°. (Gerlach, Z. anal. **26**, 427.)

B.-pt. of  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  containing pts.  $\text{Ca}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (Z. anal. **26**, 447); L = according to Legrand (A. ch. (2) **59**, 436).

B.-pt.	G	L	B.-pt.	G	L
101°	10	15	127	215.5	...
102	20	25.3	128	222.5	197.0
103	30	34.4	129	230	...
104	40	42.6	130	237.5	209.5
105	50	50.4	131	245	...
106	60	57.8	132	253	222.2
107	70	64.9	133	261.5	...
108	80	71.8	134	270	235.1
109	89	78.6	135	278.5	...
110	98	85.3	136	287	248.1
111	106.5	91.9	137	296	...
112	114.5	98.4	138	305	261.3
113	122.5	104.8	139	314.5	...
114	130	111.2	140	324	274.7
115	137.5	117.5	141	333.5	...
116	144	123.8	142	343.5	288.4
117	150.5	130	143	354	...
118	157	136.1	144	364.5	302.6
119	163.5	142.1	145	375	...
120	170	148.1	146	386	317.4
121	176	...	147	397.5	...
122	182.5	160.1	148	409	333.2
123	189	...	149	420.5	...
124	195.5	172.2	150	432.5	351.2
125	202	...	151	444.5	362.2
126	208.5	184.5	151.97	455.68	...

Sat.  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  boils at 132°. (Ordway, Sill. Am. J. (2) **27**, 14.)

Conc.  $\text{HNO}_3$  precipitates  $\text{Ca}(\text{NO}_3)_2$  from its aqueous solution. (Mitscherlich, Pogg. **18**, 159.)

Very sol. in conc.  $\text{HNO}_3$ . (Rawson, J. Soc. Chem. Ind. 1897, **16**, 113.)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

100 g. of the solution contain		Solid phase
G. $\text{Ca}(\text{NO}_3)_2$	G. $\text{HNO}_3$	
57.98	0.00	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
54.82	3.33	
52.96	5.87	
51.58	7.21	
47.82	11.27	
45.59	13.71	
40.70	19.65	
38.17	22.80	
34.46	28.81	
32.84	32.63	
32.50	33.52	$\text{Ca}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$
33.44	35.63	
29.05	41.66	
27.79	45.70	
31.09	40.56	
26.07	45.70	
17.41	55.48	
12.25	62.05	
9.34	65.69	
8.52	67.20	
5.06	71.12	$\text{Ca}(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$
2.53	74.77	
1.05	78.56	
0.54	80.83	
0.36	85.83	
0.01 (about)	90.90	
0.00	96.86	

These results show that the hydrates of  $\text{Ca}(\text{NO}_3)_2$ , which are stable at  $25^\circ$  in contact with  $\text{HNO}_3 + \text{Aq}$  are  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ ,  $+3\text{H}_2\text{O}$  and  $+2\text{H}_2\text{O}$ .

(Bassett and Taylor, Chem. Soc. 1912, 101. 582.)

Sol. in glacial  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persoz.)

Sol. in sat.  $\text{KNO}_3 + \text{Aq}$  with elevation of temp. and pptn. of a portion of  $\text{KNO}_3$ . (Fourcroy and Vauquelin, A. ch. 11. 135.)

Solubility of  $\text{Ca}(\text{NO}_3)_2 + \text{NaNO}_3$  at  $t^\circ$ .

$t^\circ$	% $\text{Ca}(\text{NO}_3)_2$	% $\text{NaNO}_3$	Solid phase
9	47.51	9.51	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ " $+ \text{NaNO}_3$ $\text{NaNO}_3$ "
	46.08	12.56	
	26.67	23.32	
	11.76	34.26	
25	54.58	7.25	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ " $+ \text{NaNO}_3$ $\text{NaNO}_3$ " " " "
	53.22	10.70	
	52.73	12.08	
	52.40	11.58	
	37.31	19.48	
	26.91	24.98	
	14.61	36.12	

(Kremann and Rothmund, Z. anorg. 1914, 86. 373.)

Solubility of  $\text{Ca}(\text{NO}_3)_2 + \text{CaS}_2\text{O}_8$  at  $t^\circ$ .

$t^\circ$	% $\text{Ca}(\text{NO}_3)_2$	% $\text{CaS}_2\text{O}_8$	Solid phase
9	46.02	5.46	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ " $\text{CaS}_2\text{O}_8 \cdot 6\text{H}_2\text{O}$ $\text{CaS}_2\text{O}_8 \cdot 6\text{H}_2\text{O}$ " "
	45.68	6.81	
	27.92	10.46	
	10.49	22.81	
	...	29.33	
25	54.03	4.27	$\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ " " $+ \text{CaS}_2\text{O}_8 \cdot 6\text{H}_2\text{O}$ $\text{CaS}_2\text{O}_8 \cdot 6\text{H}_2\text{O}$ " " "
	50.25	9.10	
	45.92	13.	
	42.93	13.83	
	32.01	17.09	
	19.51	23.78	
	8.15	29.85	

(Kremann and Rothmund, Z. anorg. 1914, 86. 373.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Sol. in 0.8 pt. alcohol (Macquer); 1 pt. boiling alcohol. (Bergmann.)

Dry  $\text{Ca}(\text{NO}_3)_2$  is sol. in 7 pts. alcohol at  $15^\circ$  and 1 pt. boiling alcohol. (Bergmann.)

Sp. gr. of  $\text{Ca}(\text{NO}_3)_2 + \text{alcohol}$ .

% $\text{Ca}(\text{NO}_3)_2$	Sp. gr. $20^\circ/20^\circ$
0	0.7949
4.96	0.8278
6.47	0.8383

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 284.)

Solubility in ethyl alcohol + Aq at  $25^\circ$ .

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ca}(\text{NO}_3)_2$ in the solution
*0	0	82.5
*25.1	5.8	77.0
*50.1	15.2	69.52
*60.1	20.4	66.08
*63.9	22.4	64.94
70.4	26.5	62.3
72.0	27.39	61.96
73.4	28.5	61.15
75.3	29.9	60.3
*84.9	35.9	57.7
*99.1	48.1	51.4

\* Metastable solutions.

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 43.)



Solubility of  $\text{Ca}(\text{NO}_3)_2 \cdot 2\text{C}_2\text{H}_5\text{OH}$  in  $\text{C}_2\text{H}_5\text{OH}$   
+ Aq at  $25^\circ$ .

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Ca}(\text{NO}_3)_2$ in the solution
98.1	60.2	38.6
94.1	54.6	41.9
85.8	42.5	50.97
80.5	35.8	55.3
75.3	29.9	60.28

(D'Ans and Siegler, *l. c.*)

See also under  $+4\text{H}_2\text{O}$ .

Solubility in organic solvents.

Solvent	% $\text{Ca}(\text{NO}_3)_2$ in the solution at $25^\circ$
Methyl alcohol	65.5
Ethyl alcohol	52.0
Propyl alcohol	36.5
Isobutyl alcohol	25.0
Amyl alcohol	13.3
Acetone	58.5

(D'Ans and Siegler, *l. c.*)

Sol. in 1.87 pts. ether-alcohol (1:1). (Fresenius, *Z. anal.* **32**, 191.)

Ether ppts.  $\text{Ca}(\text{NO}_3)_2$  from its alcoholic solution. Easily sol. in boiling amyl alcohol. (Browning, *Sill. Am. J.* **143**, 53.)

Sol. in acetone. (Naumann, B. 1904, **37**, 4328.)

Insol. in benzonitrile. (Naumann, B. 1914, **47**, 1370.)

Insol. in methylal. (Eidmann, C. C. 1899, II, 1014.)

1 g.  $\text{Ca}(\text{NO}_3)_2$  is sol. in 1.44 g. methyl acetate at  $18^\circ$ . Sp. gr.  $18^\circ/4^\circ$  of sat. solution = 1.313. (Naumann, B. 1909, **42**, 3795.)

Sol. in ethyl acetate. (Naumann, B. 1910, **43**, 314.)

+  $2\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the solution contain at:

$49^\circ$        $51^\circ$

77.49      78.05 g.  $\text{Ca}(\text{NO}_3)_2$ .

Solutions in stable equilibrium with the dihydrate can only exist between the limits of temp.  $48.4^\circ$  and  $51.3^\circ$ . (Bassett and Taylor, *Chem. Soc.* 1912, **101**, 580.)

+  $3\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the solution contain at:

$40^\circ$        $45^\circ$        $50^\circ$        $51^\circ$   
70.37      71.45      73.79      74.73 g.  $\text{Ca}(\text{NO}_3)_2$ .

Mpt. of  $\text{Ca}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} = 51.1^\circ$ .

(Bassett and Taylor, *l. c.*)

+  $4\text{H}_2\text{O}$ .  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$  melts in its crystal  $\text{H}_2\text{O}$  at  $44^\circ$ . (Tilden, *Chem. Soc.* **45**, 409.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

100 g. of the solution contain g.  $\text{Ca}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	G. $\text{Ca}(\text{NO}_3)_2$
$-26.7$	43.37
$-10.0$	47.31
0.0	50.50
$+5.0$	51.97
10.0	53.55
15.0	54.94
20.0	56.39
25.0	57.98
30.0	60.41
35.0	62.88
40.0	66.21
42.4	68.68
42.5	68.74
42.7	mpt. of $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
42.45	71.70

(Bassett and Taylor, *l. c.*)

Solubility of  $\alpha$  and  $\beta$  modifications in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$\alpha$  modification is the stable form.

$t^\circ$	G. $\text{Ca}(\text{NO}_3)_2$ in 100 g. of solution	Solid phase
0	50.17	$\alpha$ $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$
22.2	56.88	$\alpha$ "
25.0	57.90	$\alpha$ "
30.0	60.16	$\alpha$ "
30.0	61.57	$\beta$ "
34.0	63.66	$\beta$ "
35.0	62.88	$\alpha$ "
38.0	64.34	$\alpha$ "
38.0	66.65	$\beta$ "
39.0	67.93	$\beta$ "
<sup>1</sup> 39.6	69.50	$\beta$ "
<sup>2</sup> 39.0	75.34	$\beta$ "
40.0	66.21	$\alpha$ "
<sup>1</sup> 42.7	69.50	$\alpha$ "
<sup>2</sup> 42.4	71.70	$\alpha$ "

<sup>1</sup> mpt. of hydrate.

<sup>2</sup> reflex pt.

(Taylor and Henderson, *J. Am. Chem. Soc.* 1915, **37**, 1692.)

Sp. gr. of solution sat. at  $18^\circ = 1.548$ , containing 54.8%  $\text{Ca}(\text{NO}_3)_2$ . (Mylius, B. 1897, **30**, 1718.)

## Solubility in ethyl alcohol + Aq at 25°.

% C <sub>2</sub> H <sub>5</sub> OH in the solvent	% C <sub>2</sub> H <sub>5</sub> OH in the solution	% Ca(NO <sub>3</sub> ) <sub>2</sub> in the solution
0	0	57.5
18.3	3.5	56.1
39.2	8.1	55.2
59.2	14.1	52.9
80.4	22.3	50.2
90.4	29.4	49.0
99.4	31.1	49.7
99.4	31.2	52.0
99.4	29.5	56.2
60.1	28.3	58.9
60.1	27.8	60.0
60.1	27.3	60.7
60.1	26.5	62.3

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 42.)

**Calcium nitrate hydrazine**, Ca(NO<sub>3</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>, +H<sub>2</sub>O.

Ppt. (Franzen, Z. anorg. 1908, 60. 288.)

**Calcium nitrate tungstosilicate**, Ca<sub>2</sub>W<sub>12</sub>SiO<sub>40</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>.+13H<sub>2</sub>O and +15H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Wyruboff, Chem. Soc. 1897, 72. (2) 176.)**Cerous nitrate**, Ce(NO<sub>3</sub>)<sub>3</sub>, +6H<sub>2</sub>O.

Not very deliquescent. (Jolin.)

Very sol. in H<sub>2</sub>O; sol. in 2 pts. alcohol. (Vauquelin.)

Sol. in acetone. (Eidmann, C. C. 1899. II. 1014; Naumann, B. 1904, 37. 4328.)

**Ceric nitrate**, Ce(NO<sub>3</sub>)<sub>4</sub>.Deliquescent. Decomp. by hot H<sub>2</sub>O. (Berzelius.)

Sol. in alcohol. (Dumas.)

Basic compounds containing 12 mols. or less CeO<sub>2</sub> to 1 mol. N<sub>2</sub>O<sub>5</sub> may be obtained, which are sol. in H<sub>2</sub>O. (Ordway.)**Cerous cobaltous nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Co(NO<sub>3</sub>)<sub>2</sub>, +24H<sub>2</sub>O.

Deliquescent. Easily forms supersaturated solutions. (Lange, J. pr. 82. 129.)

1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 103.3 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76. 321.)**Ceric cobaltous nitrate**, CeCo(NO<sub>3</sub>)<sub>6</sub>, +8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O when heated; sol. in cold H<sub>2</sub>O; sl. sol. in HNO<sub>3</sub>. (Meyer, Z. anorg. 1901, 27. 376.)**Cerous magnesium nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Mg(NO<sub>3</sub>)<sub>2</sub>, +24H<sub>2</sub>O.Slightly deliquescent. Easily sol. in H<sub>2</sub>O or alcohol, and easily forms supersaturated solutions. (Holzmann, J. pr. 76. 330.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 63.8 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76. 321.)**Ceric magnesium nitrate**, CeMg(NO<sub>3</sub>)<sub>6</sub>, +8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O; sol. in HNO<sub>3</sub> + Aq without decomp. (Meyer, Z. anorg. 1901, 27. 373.)**Cerous manganous nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Mn(NO<sub>3</sub>)<sub>2</sub>, +24H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Lange, J. pr. 82. 129.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 193.1 g. hydrous salt at 16°. (Jantsch.)**Ceric manganous nitrate**, CeMn(NO<sub>3</sub>)<sub>6</sub>, +8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O and dil. HNO<sub>3</sub>; sol. in conc. HNO<sub>3</sub> without decomp. (Meyer, Z. anorg. 1901, 27. 377.)**Cerous nickel nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Ni(NO<sub>3</sub>)<sub>2</sub>, +24H<sub>2</sub>O.Easily sol. in H<sub>2</sub>O. (Holzmann, J. pr. 75. 321.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 80.3 g. hydrous salt at 16°. (Jantsch.)**Ceric nickel nitrate**, CeNi(NO<sub>3</sub>)<sub>6</sub>, +8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O when heated; sol. in H<sub>2</sub>O in the cold; sl. sol. in HNO<sub>3</sub>. (Meyer, Z. anorg. 1901, 27. 375.)**Cerous potassium nitrate**, Ce(NO<sub>3</sub>)<sub>3</sub>, 2KNO<sub>3</sub>, +2H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Lange, J. pr. 82. 136.)**Ceric potassium nitrate**, CeK<sub>2</sub>(NO<sub>3</sub>)<sub>6</sub>.Sol. in H<sub>2</sub>O with decomp. (Meyer, Z. anorg. 1901, 27. 370.)+1½H<sub>2</sub>O. Efflorescent. (Holzmann, J. pr. 75. 324.)**Ceric rubidium nitrate**, CeRu<sub>2</sub>(NO<sub>3</sub>)<sub>6</sub>.Very sol. in H<sub>2</sub>O; sl. sol. in HNO<sub>3</sub>. (Meyer.)**Ceric sodium nitrate**.

Deliquescent. Decomp. by recrystallization. (Holzmann.)

**Cerous thalious nitrate**, [Ce(NO<sub>3</sub>)<sub>3</sub>]Tl<sub>2</sub>, +4H<sub>2</sub>O.Very hygroscopic. Decomp. by H<sub>2</sub>O. (Jantsch, Z. anorg. 1911, 69. 229.)**Cerous zinc nitrate**, 2Ce(NO<sub>3</sub>)<sub>3</sub>, 3Zn(NO<sub>3</sub>)<sub>2</sub>, +24H<sub>2</sub>O.Sol. in H<sub>2</sub>O. Easily forms supersat. solutions. (Lange, J. pr. 82. 129.)1 l. sat. solution in HNO<sub>3</sub> + Aq (sp. gr. 1.325) contains 124.1 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76. 321.)**Ceric zinc nitrate**, ZnCe(NO<sub>3</sub>)<sub>6</sub>, +8H<sub>2</sub>O.Decomp. by H<sub>2</sub>O; sol. in HNO<sub>3</sub> + Aq. (Meyer, Z. anorg. 1901, 27. 374.)

**Ceroceric zinc nitrate** (?),  $\text{Ce}_2\text{O}_3 \cdot 2\text{ZnO} \cdot 6\text{N}_2\text{O}_5 + 18\text{H}_2\text{O}$  (?).

Easily sol. in  $\text{H}_2\text{O}$ . (Holzmann, J. pr. 75. 321.)

**Chromic nitrate, basic**,  $\text{Cr}_2\text{O}(\text{NO}_3)_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Löwel.)

+12 $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ordway.)

**Chromic nitrate**,  $\text{Cr}(\text{NO}_3)_3 + 9\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Löwel.)

Melts in its crystal  $\text{H}_2\text{O}$  at 36.5°. Sat.  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$  boils at 125.6°. (Ordway.)

Sp. gr. of  $\text{Cr}(\text{NO}_3)_3 + \text{Aq}$ .

M = concentration of solution in gram. mols.

W = wt. of 25 cc. of solution.

M	0.0934	0.1868	0.3736	0.5604	0.9340
W	25.4300	25.8828	26.7302	27.5524	29.3072

M	1.1208	1.3076	1.4944	1.8680
W	30.0668	30.8464	31.6327	33.3379

(Jones and Getman, Z. phys. Ch. 1904, 49. 426.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328; Eidmann, C. C. 1899, II. 1014.)

**Chromic nitrate chloride**,  $\text{CrCl}_2(\text{NO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Schiff, A. 124. 177.)

$\text{Cr}(\text{NO}_3)_2\text{Cl}$ . (Schiff.)

**Chromic nitrate sulphate**,  $\text{Cr}_2(\text{SO}_4)(\text{NO}_3)_4$ .

Hygroscopic. Completely sol. in  $\text{H}_2\text{O}$ .

$\text{Cr}_2(\text{SO}_4)_2(\text{NO}_3)_2$ . Sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 124. 174.)

**Cobaltous nitrate, basic**,  $6\text{CoO} \cdot \text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ .

Ppt. Gradually sol. in  $\text{H}_2\text{O}$  with deposition of  $\text{CoO}$ . (Winkelblech, A. 13. 155.)

Sol. in cold  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ . Decomp. by hot  $\text{KOH} + \text{Aq}$ .

$4\text{CoO} \cdot \text{N}_2\text{O}_5 + 6\text{H}_2\text{O}$ . Ppt. (Habermann, M. 5. 432.)

**Cobaltous nitrate**,  $\text{Co}(\text{NO}_3)_2$ .

Deliquescent in moist air. Very sol. in  $\text{H}_2\text{O}$ .

See +3, 6, and 9 $\text{H}_2\text{O}$ .

Sp. gr. of aqueous solution at 17.5° containing:

5	10	15	20% $\text{Co}(\text{NO}_3)_2$
1.0462	1.0906	1.1378	1.1936

25	30	35	40% $\text{Co}(\text{NO}_3)_2$
1.2538	1.3190	1.3896	1.4662

Sp. gr. of sat. solution = 1.5382.

(Franz, J. pr. (2) 5. 274.)

Sp. gr. of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

8.28	15.96	24.528% $\text{Co}(\text{NO}_3)_2$
1.0732	1.1436	1.2288

(Wagner, W. Ann. 1883, 18. 268.)

Sp. gr. of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  at 25°.

Concentration of $\text{Co}(\text{NO}_3)_2 + \text{Aq}$ .	Sp. gr.
1-normal	1.0728
$\frac{1}{r}$ "	1.0369
$\frac{1}{r}$ "	1.0184
$\frac{1}{r}$ "	1.0094

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Sp. gr. at 20° of  $\text{Co}(\text{NO}_3)_2 + \text{Aq}$  containing M g. mols.  $\text{Co}(\text{NO}_3)_2$  per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001496	1.003863	1.007579	1.011239

M	0.10	0.25	0.5	0.75
Sp. gr.	1.015084	1.03737	1.07415	1.11204

M	1.0	1.5	2.0
Sp. gr.	1.14612	1.21720	1.28576

(Jones and Pearce, Am. Ch. J. 1907, 38. 715.)

Sol. in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc. 1909 (4) 5. 1009.)

100 g. sat. solution in glycol contains 80 g.  $\text{Co}(\text{NO}_3)_2$ . (de Coninck, C. C. 1905, II. 883.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

+3 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

55°	62°	70°	84°	91° mpt.
61.74	62.88	64.89	68.84	77.21% $\text{Co}(\text{NO}_3)_2$

(Funk, Z. anorg. 1899, 20. 408.)

+6 $\text{H}_2\text{O}$ . Melts in its crystal  $\text{H}_2\text{O}$  at 56° (Ordway); 38° (Tilden).

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-21°	-10°	-4°	0°
41.55	43.69	44.85	45.66% $\text{Co}(\text{NO}_3)_2$

+18° 41° 56° mpt.

49.73 55.96 62.88%  $\text{Co}(\text{NO}_3)_2$ .

(Funk, Z. anorg. 1899, 20. 408.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Easily sol. in alcohol. Sol. in 1 pt. strong alcohol at 12.5°. (Wenzel.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

+9 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-26°	-23.5°	-20.5°
39.45	40.40	42.77% $\text{Co}(\text{NO}_3)_2$

Cryohydrate is formed at -29° (Funk, Z. anorg. 1899, 20. 409.)

**Cobaltous didymium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Di}(\text{NO}_3)_2 + 48\text{H}_2\text{O}$ .

Very deliquescent. (Frerichs and Smith, A. 191. 331.)

**Cobaltous gadolinium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Gd}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3$  (sp. gr. 1.325) contains 451.4 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

**Cobaltous lanthanum nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{La}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 109.2 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

**Cobaltous neodymium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Nd}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 151.6 hydrous salt at  $16^\circ$ . (Jantsch.)

**Cobaltous praseodymium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Pr}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 12.99 g. hydrous salt at  $16^\circ$ . (Jantsch.)

**Cobaltous samarium nitrate**,  $3\text{Co}(\text{NO}_3)_2$ ,  $2\text{Sm}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 34.27 g. hydrous salt at  $16^\circ$ . (Jantsch.)

**Cobaltous thorium nitrate**,  $\text{CoTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$ .

Hydroscopic; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1901, 27. 387.)

**Cobaltous nitrate ammonia**,  $\text{Co}(\text{NO}_3)_2$ ,  $6\text{NH}_3 + 2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  with separation of basic nitrate. (Fremy.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Hess.)

**Cobaltous nitrate cupric oxide**,  $\text{Co}(\text{NO}_3)_2$ ,  $3\text{CuO} + 3\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1902, 134. 234.)

**Cobaltous nitrate hydrazine**,  $\text{Co}(\text{NO}_3)_2$ ,  $3\text{N}_2\text{H}_4$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1908, 60. 274.)

**Cupric nitrate, basic**,  $2\text{CuO}$ ,  $\text{N}_2\text{O}_5$ .

(Ditte, A. ch. 1879, (5) 18. 339.)

$4\text{CuO}$ ,  $\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Graham, A. 29. 13.)

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Athanasesco, Bull. Soc. 1895, (3) 11. 1113.)

$+3\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , and decomp. by heat. (Casselmann, Z. anal. 4. 24.)

**Cupric nitrate**,  $\text{Cu}(\text{NO}_3)_2$ .

Deliquescent. Very easily sol. in  $\text{H}_2\text{O}$  or alcohol; also in moderately conc.  $\text{HNO}_3 + \text{Aq}$ , but is precipitated from conc. aqueous solution by  $\text{HNO}_3 + \text{Aq}$  of 1.522 sp. gr. (Mitscherlich, Pogg. 18. 159.)

Sat.  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  contains at:

$-10^\circ$   $-3^\circ$   $+3^\circ$   
38.8 41.6 44.5%  $\text{Cu}(\text{NO}_3)_2$ ,

$8^\circ$   $20^\circ$   $32^\circ$   
48.5 54.1 61.2%  $\text{Cu}(\text{NO}_3)_2$ .

(Étard, A. ch. 1894, (7) 2. 528.)

See +3, 6, and  $9\text{H}_2\text{O}$ .

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$  containing:

5 10 15% anhydrous salt,  
1.0452 1.0942 1.1442

20 25 30% anhydrous salt,  
1.2036 1.2644 1.3298

35 40 45% anhydrous salt.  
1.3974 1.4724 1.5576

(B. Franz, J. pr. (2) 5. 274.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $15^\circ$ .

% $\text{Cu}(\text{NO}_3)_2$	Sp. gr.
5.22	1.046
10.44	1.094
15.67	1.146
20.85	1.202
26.12	1.262
35.00	1.377

(Long, W. Ann. 1880, 11. 39.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

18.99 26.68 46.71%  $\text{Cu}(\text{NO}_3)_2$ .  
1.1774 1.2637 1.5363

(Wagner, W. Ann. 1883, 18. 272.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0755
$\frac{1}{2}$ - " "	1.0372
$\frac{1}{3}$ - " "	1.0185
$\frac{1}{4}$ - " "	1.0092

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  at  $12.5^\circ$ .

%  $\text{Cu}(\text{NO}_3)_2$  1 5 10 14  
Sp. gr. 1.0059 1.0320 1.0655 1.0916

%  $\text{Cu}(\text{NO}_3)_2$  20 24 30 34  
Sp. gr. 1.1350 1.1716 1.2320 1.2712

%  $\text{Cu}(\text{NO}_3)_2$  40 44 50 56  
Sp. gr. 1.3320 1.3749 1.4440 1.5205

(Hassenfratz, Muspratt, 1893, 4. 2243.)

Sp. gr. at 20° of  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  containing  
M g. mols. salt per liter.  
M 0.01 0.025 0.05 0.075  
Sp. gr. 1.001504 1.004076 1.007859 1.011715

M 0.25 0.50 0.75 0.935  
Sp. gr. 1.040290 1.07723 1.11469 1.14262

Sp. gr. 1.5 2.0  
M 1.22618 1.29262

(Jones and Pearce, Am. Ch. J. 1917, **38**, 719.)

Sat.  $\text{Cu}(\text{NO}_3)_2 + \text{Aq}$  boils at about 173°. (Griffiths.)

Insol. in fuming  $\text{HNO}_3$ . (Ditte, A. ch. 1879 (5) **18**, 339.)

Solubility of  $\text{Cu}(\text{NO}_3)_2 + \text{Pb}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at 20°.

Sp. gr.	In 1 l. of solution				Solid phase
	Cu(NO <sub>3</sub> ) <sub>2</sub>		Pb(NO <sub>3</sub> ) <sub>2</sub>		
	g.	g. mol.	g.	g. mol.	
1.354	70.5	0.375	359.5	1.086	Pb(NO <sub>3</sub> ) <sub>2</sub>
1.322	139.2	0.742	257.2	0.777	"
1.321	226.5	1.207	175.1	0.529	"
1.343	301.8	1.608	133.4	0.403	"
1.360	341.8	1.821	117.8	0.356	"
1.451	519.4	2.767	70.5	0.213	"
1.546	681.7	3.632	44.0	0.133	"
1.622	798.1	4.252	28.1	0.085	"
1.700	943.2	5.028	17.2	0.052	Pb(NO <sub>3</sub> ) <sub>2</sub> + Cu(NO <sub>3</sub> ) <sub>2</sub> ·6H <sub>2</sub> O

(Fedotieff, Z. anorg. 1911, **73**, 178.)

Very sol. in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc. 1909, (4) **5**, 1007.)

Easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 827.)

Insol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, **46**, 2.)

Insol. in ethyl acetate. (Naumann, B. 1910, **43**, 314.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, **47**, 1369.)

+3 $\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  at 114.5°. (Ordway; Tilden, Chem. Soc. **45**, 409.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

25°	30°	40°	50°
60.01	60.44	61.51	62.62% $\text{Cu}(\text{NO}_3)_2$
60°	70°	80°	114.5° Mpt.
64.17	65.79	67.51	77.59% $\text{Cu}(\text{NO}_3)_2$

(Funk, Z. anorg. 1899, **20**, 413.)

100 pts.  $\text{HNO}_3$  dissolve 2 pts. at 13°, considerably more on heating. (Ditte, A. ch. 1879, (5) **18**, 339.)

Sol. in 1 pt. strong alcohol at 12.5°. (Wenzel.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

+6 $\text{H}_2\text{O}$ . Efflorescent. Melts in crystal  $\text{H}_2\text{O}$  at 38°. (Ordway.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-21°	-10°	0°	+10°
39.52	42.08	45.00	48.79% $\text{Cu}(\text{NO}_3)_2$

18°	20°	26.4° mpt.
53.86	55.58	63.39% $\text{Cu}(\text{NO}_3)_2$

(Funk, Z. anorg. 1899, **20**, 413.)

Sat. solution of  $\text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 20° contains 5.04 g. mol. per l. Sp. gr. of sat. solution = 1.688. (Fedotieff, Z. anorg. 1911, **73**, 78.)

Sat. solution of  $\text{Cu}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains 45.0 g.  $\text{Cu}(\text{NO}_3)_2$  in 100 g. solution at 0°; 53.9 g. at 18°. (Mylius, Z. anorg. 1912, **74**, 411.)

+9 $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-23°	-21°	-20°
36.08	37.38	40.92% $\text{Cu}(\text{NO}_3)_2$

Cryohydrate is formed at -24°. (Funk, Z. anorg. 1899, **20**, 414.)

Cupric nitrate ammonia (Cuprammonium nitrate),  $\text{Cu}(\text{NO}_3)_2 \cdot 4\text{NH}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ , from which it can be recrystallized. Sol. in alcohol. (Berzelius.)

Sol. in 1 pt. liquid  $\text{NH}_3$ . (Horn, Am. Ch. J. 1908, **39**, 216.)

$\text{Cu}(\text{NO}_3)_2 \cdot 5\text{NH}_3$ . (Horn, Am. Ch. J. 1907, **37**, 620.)

4 $\text{Cu}(\text{NO}_3)_2 \cdot 23\text{NH}_3$ . (Horn.)

Cupric nitrate hydrazine,  $\text{Cu}(\text{NO}_3)_2 \cdot \text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, **305**, 221.)

Cupric nitrate mercuric oxide,  $\text{Cu}(\text{NO}_3)_2 \cdot \text{HgO} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Finzi, Gazz. ch. it. 1913, **43**, (2) 709.)

Didymium nitrate, basic, 4 $\text{Di}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5 + 15\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Marignac.)  
2 $\text{Di}_2\text{O}_3 \cdot 3\text{N}_2\text{O}_5$ . (Becquerel, A. ch. (6) **14**, 257.)

Didymium nitrate,  $\text{Di}(\text{NO}_3)_3$ .

Anhydrous. Very sol. in  $\text{H}_2\text{O}$ . As sol. in 96% alcohol as in  $\text{H}_2\text{O}$ , and the solution is not precipitated by much ether. Insol. in pure ether. (Marignac, A. ch. (3) **36**, 161.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 827.)

Sol. in acetone. (Naumann, B. 1904, **37**, 4328; Eidmann, C. C. 1899, II, 1014.)

+6 $\text{H}_2\text{O}$ . Very deliquescent. (Cleve, Bull. Soc. (2) **43**, 361.)

**Didymium nickel nitrate**,  $2\text{Di}(\text{NO}_3)_2$ ,  $3\text{Ni}(\text{NO}_3)_2 + 36\text{H}_2\text{O}$ .

Very deliquescent. (Frerichs and Smith, A. 191. 355.)

See Neodymium and praseodymium.

**Didymium zinc nitrate**,  $2\text{Di}(\text{NO}_3)_2$ ,  $3\text{Zn}(\text{NO}_3)_2 + 69\text{H}_2\text{O}$ .

Very deliquescent. (F. and S.)

See Neodymium and praseodymium.

**Dysprosium nitrate**,  $\text{Dy}(\text{NO}_3)_3 + 5\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; less sol. in  $\text{H}_2\text{O} + \text{HNO}_3$ . Sol. in alcohol. (Urbain, C. R. 1908, 146. 129.)

**Erbium nitrate, basic**,  $2\text{Er}_2\text{O}_3$ ,  $3\text{N}_2\text{O}_5 + 9\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3$ . (Bahr and Bunsen.)

$3\text{Er}_2\text{O}_3$ ,  $4\text{N}_2\text{O}_5 + 20\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 21. 344.)

**Erbium nitrate**,  $\text{Er}(\text{NO}_3)_3 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Höglund.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Gadolinium nitrate**,  $\text{Gd}(\text{NO}_3)_3 + 6\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Benedicks, Z. anorg. 1900, 22. 406.)

+  $5\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . (B.)

**Gadolinium magnesium nitrate**,  $2\text{Gd}(\text{NO}_3)_2$ ,  $3\text{Mg}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 352.3 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

**Gadolinium nickel nitrate**,  $2\text{Gd}(\text{NO}_3)_2$ ,  $3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 400.8 g. hydrous salt at  $16^\circ$ . (Jantsch.)

**Gadolinium zinc nitrate**,  $2\text{Gd}(\text{NO}_3)_2$ ,  $3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 472.7 g. hydrous salt at  $16^\circ$ . (Jantsch.)

**Gallium nitrate**,  $\text{Ga}(\text{NO}_3)_3$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Dupré.)

**Glucinum nitrate, basic**,  $2\text{GhO}$ ,  $\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ .

$3\text{GhO}$ ,  $\text{N}_2\text{O}_5$ . Sol. in  $\text{H}_2\text{O}$ . (Ordway, Sill. Am. J. (2) 26. 205.)

Compounds more basic than this are insol. in  $\text{H}_2\text{O}$ . (Ordway.)

**Glucinum nitrate**,  $\text{Gl}(\text{NO}_3)_2 + 3\text{H}_2\text{O}$ .

Very deliquescent. (Joy, Sill. Am. J. (2) 36. 90.)

Easily sol. in  $\text{H}_2\text{O}$  and alcohol. (Vauquelin.)

Melts in its crystal  $\text{H}_2\text{O}$  at  $29.4^\circ$ . (Ordway.)

Sat.  $\text{Gl}(\text{NO}_3)_2 + \text{Aq}$  boils at  $140.5^\circ$ . (Ordway.)

**Gold (auric) nitrate, basic**,  $\text{Au}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5 + \frac{1}{2}\text{H}_2\text{O}$ , or **Auryl nitrate**,  $(\text{AuO})\text{NO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

(Schottländer, A. 217. 364.)

$2\text{Au}_2\text{O}_3$ ,  $\text{N}_2\text{O}_5 + 2\text{H}_2\text{O} = \text{Au}_4\text{O}_6(\text{NO}_3)_2 + 2\text{H}_2\text{O}$ . Slowly sol. in  $\text{HNO}_3 + \text{Aq}$  at  $100^\circ$ . (Schottländer, A. 217. 356.)

**Gold (auric) nitrate**,  $\text{Au}(\text{NO}_3)_3 + x\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in acetone. (Hanriot and Raoult, C. R. 1912, 155. 1086.)

**Gold (auric) hydrogen nitrate**,  $\text{Au}(\text{NO}_3)_3$ ,  $\text{HNO}_3 + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Schottländer, A. 217. 356.)

**Gold (auric) potassium nitrate**,  $\text{KAu}(\text{NO}_3)_4$ .

Easily sol. in  $\text{H}_2\text{O}$ .

$\text{HK}_2\text{Au}(\text{NO}_3)_6$ . Decomp. immediately by  $\text{H}_2\text{O}$ .

$2\text{KAu}(\text{NO}_3)_4$ ,  $\text{K}_2\text{HAu}(\text{NO}_3)_6$ . (Schottländer, J. B. 1884. 453.)

**Gold (auric) rubidium nitrate**,  $\text{RbAu}(\text{NO}_3)_4$ .

Easily sol. in  $\text{H}_2\text{O}$ .

$\text{HRb}_2\text{Au}(\text{NO}_3)_6$ . As above. (Schottländer.)

**Gold (auric) thallium nitrate**,  $\text{TlAu}(\text{NO}_3)_4$ .

Easily sol. in  $\text{H}_2\text{O}$ .

$6\text{Au}_2\text{O}_3$ ,  $2\text{Tl}_2\text{O}_3$ ,  $3\text{N}_2\text{O}_5 + 15\text{H}_2\text{O}$ . Ppt. (Schottländer.)

**Indium nitrate**,  $\text{In}(\text{NO}_3)_3 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Winkler.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ .

**Iron (ferrous) nitrate**,  $\text{Fe}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$ .

100 pts. of crystals dissolve in 50 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , sp. gr. of solution = 1.44; 40.8 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , sp. gr. of solution = 1.48; 33.3 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ , sp. gr. of solution = 1.50. (Ordway, Sill. Am. J. (2) 40. 325.)

Sat. solution contains at:

$-9^\circ$   $0^\circ$   $+18^\circ$   $24^\circ$   $60.5^\circ$  Mpt.  
39.68 41.53 45.14 46.51 62.50%  $\text{Fe}(\text{NO}_3)_2$ .  
(Funk, Z. anorg. 1899, 20. 406.)

Sat. solution of  $\text{Fe}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains 41.5%  $\text{Fe}(\text{NO}_3)_2$  at  $0^\circ$ ; 45.1% at  $18^\circ$ . (Mylius, Z. anorg. 1912, 74. 411.)

+9H<sub>2</sub>O. Solubility in H<sub>2</sub>O.

Sat. solution contains at:

—27° —21.5° —19° —15.5°  
35.66 36.10 36.56 37.17% Fe(NO<sub>3</sub>)<sub>3</sub>.

Cryohydrate is formed at —28°. (Funk, Z. anorg. 1899, 20, 407.)

Fe(NO<sub>3</sub>)<sub>3</sub>+Aq decomposes on heating; less rapidly when dil., more readily in presence of excess of acid. (Ordway.)

**Iron (ferric) nitrate, basic, 36Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+48H<sub>2</sub>O (?).**

Easily sol. in H<sub>2</sub>O. Sl. sol. in dil. HNO<sub>3</sub>+Aq; very sl. sol. in alcohol. (Hausmann, A. 89, 111.)

8Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+12H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O; very sl. sol. in cold or warm dil. HNO<sub>3</sub>+Aq; more easily sol. in hot HCl+Aq. (Hausmann.)

+xH<sub>2</sub>O. Sol. in H<sub>2</sub>O; completely pptd. from aqueous solution by NaCl, NH<sub>4</sub>Cl, KI, KClO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>, CaSO<sub>4</sub>, ZnSO<sub>4</sub>, CuSO<sub>4</sub>, KNO<sub>3</sub>, NaNO<sub>3</sub>, Ba(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, or Zn(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq. More slowly pptd. by NH<sub>4</sub>NO<sub>3</sub>, Mg(NO<sub>3</sub>)<sub>2</sub>, Ba(NO<sub>3</sub>)<sub>2</sub>, or Pb(NO<sub>3</sub>)<sub>2</sub>+Aq. Not pptd. by alcohol, Pb(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>, Hg(CN)<sub>2</sub>, AgNO<sub>3</sub>, or As<sub>2</sub>O<sub>3</sub>+Aq. (Ordway, Sil. Am. J. (2) 9, 30.)

4Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+1½H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O; sl. sol. in dil. HNO<sub>3</sub>+Aq, and in alcohol. (Hausmann.)

+3H<sub>2</sub>O. Insol. in H<sub>2</sub>O or HNO<sub>3</sub>+Aq; sol. in HCl+Aq. (Scheurer-Kestner, C. R. 87, 927.)

+9H<sub>2</sub>O. Not deliquescent; easily sol. in H<sub>2</sub>O. (Ordway.)

3Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+2H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Scheurer-Kestner.)

2Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>+H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Scheurer-Kestner.)

+8H<sub>2</sub>O. (S.-K.)

Fe<sub>2</sub>O<sub>3</sub>, N<sub>2</sub>O<sub>5</sub>. Decomp. by H<sub>2</sub>O. (S.-K.)

Fe<sub>2</sub>O<sub>3</sub>, 2N<sub>2</sub>O<sub>5</sub>. Sol. in H<sub>2</sub>O or alcohol in all proportions. Insol. in HNO<sub>3</sub>+Aq.

N<sub>2</sub>O<sub>5</sub> with 1, 2, 3, 4, 5, 6, and 8Fe<sub>2</sub>O<sub>3</sub>, forms compounds, sol. in H<sub>2</sub>O. (Ordway.)

Solubility determinations show that there are no definite basic nitrates of iron formed from solutions at 25°, and that the solid phase under these conditions is a solid solution of Fe<sub>2</sub>O<sub>3</sub>, HNO<sub>3</sub>, and H<sub>2</sub>O. The normal salt, Fe<sub>2</sub>O<sub>3</sub>, 3N<sub>2</sub>O<sub>5</sub>, 18H<sub>2</sub>O is stable in solutions containing about 30–45% N<sub>2</sub>O<sub>5</sub>. In higher concentrations of nitric acid it appears to be metastable and a new salt, Fe<sub>2</sub>O<sub>3</sub>, 4N<sub>2</sub>O<sub>5</sub>, 18(?)H<sub>2</sub>O is the stable form. (Cameron, J. phys. Chem. 1909, 13, 252.)

**Iron (ferric) nitrate, Fe(NO<sub>3</sub>)<sub>3</sub>.**

+H<sub>2</sub>O. (Scheurer-Kestner, A. ch. (3) 65, 113.)

+6H<sub>2</sub>O. Deliquescent, and sol. in any amount of H<sub>2</sub>O. (Schönbein, Pogg. 39, 141.)

Sol. in acetone. (Naumann, B. 1904, 37, 4328.)

+9H<sub>2</sub>O. Deliquescent. Sol. in H<sub>2</sub>O and alcohol. Sl. sol. in HNO<sub>3</sub>+Aq. 2 pts. salt with 1 pt. H<sub>2</sub>O lower the temperature 18.5°. (Scheurer-Kestner.)

Sp. gr. of solution at 17.5° containing:  
5 10 15 20 25% Fe(NO<sub>3</sub>)<sub>3</sub>,  
1.0398 1.0770 1.1182 1.1612 1.2110

30 35 40 45 50% Fe(NO<sub>3</sub>)<sub>3</sub>,  
1.2622 1.3164 1.3746 1.4338 1.4972  
55 60 65% Fe(NO<sub>3</sub>)<sub>3</sub>,  
1.5722 1.6572 1.7532

(Franz, J. pr. (2) 5, 274.)

Nearly insol. in conc. HNO<sub>3</sub>+Aq at temp. below 15.5°.

Easily sol. in alcohol.

Melts in crystal H<sub>2</sub>O at 47.2°. (Ordway.)

Sat. Fe(NO<sub>3</sub>)<sub>3</sub>+Aq boils at 125°. (Ordway.)

**Lanthanum nitrate, La(NO<sub>3</sub>)<sub>3</sub>+6H<sub>2</sub>O.**

Very deliquescent; easily sol. in H<sub>2</sub>O and alcohol. (Mosander.) Melts in its crystal H<sub>2</sub>O at 40°; boils at 124.5°. (Ordway.)

La(NO<sub>3</sub>)<sub>3</sub>+Aq sat. at 25° contains 60.17% La(NO<sub>3</sub>)<sub>3</sub>, or 100 g. H<sub>2</sub>O dissolve 151.1 g. La(NO<sub>3</sub>)<sub>3</sub> at 25°. (James and Whitemore, J. Am. Chem. Soc. 1912, 34, 1169.)

Sol. in acetone. (Naumann, B. 1904, 37, 4328; Eidmann, C. C. 1899, II, 1014.)

**Lanthanum magnesium nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Mg(NO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O.**

Deliquescent in moist air. (Holzmann, J. pr. 75, 350.)

1 l. sat. solution in HNO<sub>3</sub>+Aq (sp. gr. 1.325) contains 63.8 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76, 321.)

**Lanthanum manganous nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Mn(NO<sub>3</sub>)<sub>2</sub>+24H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Damour and Deville.)

1 l. sat. solution in HNO<sub>3</sub>+Aq (sp. gr. 1.325) contains 193.1 g. hydrous salt at 16°. (Jantsch.)

**Lanthanum nickel nitrate, 2La(NO<sub>3</sub>)<sub>3</sub>, 3Ni(NO<sub>3</sub>)<sub>2</sub>+36H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Frerichs and Smith, A. 191, 355.)

+24H<sub>2</sub>O. 1 l. sat. solution in HNO<sub>3</sub>+Aq (sp. gr. 1.325) contains 80.3 g. hydrous salt at 16°. (Jantsch.)

**Lanthanum rubidium hydrogen nitrate, [La(NO<sub>3</sub>)<sub>3</sub>]<sub>2</sub>Rb, HNO<sub>3</sub>+6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O and HNO<sub>3</sub>. (Jantsch, Z. anorg. 1911, 69, 225.)

**Lanthanum thallous nitrate, [La(NO<sub>3</sub>)<sub>3</sub>]<sub>2</sub>Tl+4H<sub>2</sub>O.**

Hydroscopic. (Jantsch, Z. anorg. 1911, 69, 228.)

**Lanthanum zinc nitrate**,  $2\text{La}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Damour and Deville, J. B. 1858. 135.)

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 124.1 g. hydrous salt at  $16^\circ$ . (Jantech, Z. anorg. 1912, 76. 321.)

+69 $\text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 355.)

**Lead nitrate, basic**,  $2\text{PbO} \cdot \text{N}_2\text{O}_5 + \text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ .

Sol. in 5.15 pts.  $\text{H}_2\text{O}$  at  $19.2^\circ$ . (Pohl, W. A. B. 6. 597.) Very sl. sol. in cold, much more in hot  $\text{H}_2\text{O}$ . (Berzelius.) Sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Guignet, C. R. 56. 358.)

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Athanasesco, Bull. Soc. 1895, (3) 18. 178.)

+2 $\text{H}_2\text{O}$ . (André, C. R. 100. 639.)

3 $\text{PbO} \cdot \text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in pure  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Berzelius.)

+3 $\text{H}_2\text{O}$ . Sol. in 119.2 pts. cold, and 10.5 pts. boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ , but sl. sol. in  $\text{KNO}_3 + \text{Aq}$ . (Vogel, jr. A. 94. 97.)

=10 $\text{PbO} \cdot 3\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ . (Wakemann and Wells, Am. Ch. J. 9. 299.)

+4 $\text{H}_2\text{O}$ . (André, C. R. 100. 639.)

6 $\text{PbO} \cdot \text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Löwe, J. pr. 98. 385.)

10 $\text{PbO} \cdot 3\text{N}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than  $\text{Pb}(\text{NO}_3)_2\text{OH}$ , and not decomp. by boiling  $\text{H}_2\text{O}$ . (Wakemann and Wells, Am. Ch. J. 9. 299.)

**Lead nitrate**,  $\text{Pb}(\text{NO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$  with absorption of much heat. (Roos.)

1 pt.  $\text{Pb}(\text{NO}_3)_2$  dissolves in  $7\frac{1}{2}$  pts. cold  $\text{H}_2\text{O}$ . (Mitscherlich.)

1 pt.  $\text{Pb}(\text{NO}_3)_2$  dissolves in 1.989 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  and forms a liquid of 1.3978 sp. gr. (Karsten.)

1 pt.  $\text{Pb}(\text{NO}_3)_2$  dissolves in 1.707 pts.  $\text{H}_2\text{O}$  at  $22.3^\circ$ ; in 1.585 pts.  $\text{H}_2\text{O}$  at  $24.7^\circ$ . (Kopp.)

Sol. in 1.87 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$ . (Schiff, A. 109. 326.)

100 pts.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $102.2^\circ$  contain 52.5 pts.  $\text{Pb}(\text{NO}_3)_2$ , or 100 pt.  $\text{H}_2\text{O}$  dissolve 110.526 pts.  $\text{Pb}(\text{NO}_3)_2$  at  $102.2^\circ$ . (Griffiths.)

Sol. in 7.5 pts. cold  $\text{H}_2\text{O}$  and much less hot  $\text{H}_2\text{O}$ . (Wittestein.)

100 pts. boiling  $\text{H}_2\text{O}$  dissolve 13 pts.  $\text{Pb}(\text{NO}_3)_2$ . (Ure's Dict.)

100 pts.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $19-20^\circ$  contain 35.80 pts. salt. (v. Hauer, W. A. B. 53, 2. 221.)

1 pt. dissolves:

at  $0^\circ$   $10^\circ$   $25^\circ$   $45^\circ$   $65^\circ$   $85^\circ$   $100^\circ$   
in 2.58 2.07 1.65 1.25 0.99 0.83 0.72 pts.  $\text{H}_2\text{O}$ .

(Kremers, Pogg. 92. 497.)

1 l.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $15^\circ$  contains 461.49 g.  $\text{Pb}(\text{NO}_3)_2$ , and 928.58 g.  $\text{H}_2\text{O}$ , and has sp. gr. 1.39. (Michel and Krafft, A. ch. (3) 41. 471.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Pb}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Pb}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Pb}(\text{NO}_3)_2$
0	36.5	36	65.9	72	99.7
1	37.4	37	66.7	73	100.7
2	38.3	38	67.6	74	101.7
3	39.1	39	68.5	75	102.6
4	39.8	40	69.4	76	103.6
5	40.5	41	70.3	77	104.6
6	41.2	42	71.2	78	105.6
7	42.0	43	72.1	79	106.6
8	42.8	44	73.0	80	107.6
9	43.6	45	74.0	81	108.6
10	44.4	46	74.9	82	109.6
11	45.2	47	75.9	83	110.6
12	46.0	48	76.8	84	111.5
13	46.8	49	77.7	85	112.5
14	47.5	50	78.7	86	113.5
15	48.3	51	79.6	87	114.5
16	49.1	52	80.5	88	115.4
17	49.9	53	81.5	89	116.4
18	50.7	54	82.4	90	117.4
19	51.5	55	83.3	91	118.4
20	52.3	56	84.3	92	119.4
21	53.1	57	85.2	93	120.3
22	53.9	58	86.1	94	121.3
23	54.7	59	87.1	95	122.3
24	55.6	60	88.0	96	123.2
25	56.4	61	89.0	97	124.2
26	57.3	62	90.0	98	125.2
27	58.1	63	90.9	99	126.1
28	59.0	64	91.9	100	127.0
29	59.8	65	92.8	101	128.0
30	60.7	66	93.8	102	128.9
31	61.6	67	94.8	103	129.9
32	62.4	68	95.7	104	130.9
33	63.3	69	96.7	104.7	131.5
34	64.1	70	97.7	...	...
35	65.0	71	98.7	...	...

(Mulder, Scheik. Verhandel. 1864. 66.)

100 g.  $\text{H}_2\text{O}$  dissolve 52.76 g.  $\text{Pb}(\text{NO}_3)_2$  at  $17^\circ$ . (Euler, Z. phys. Ch. 1904, 49. 315.)

Solubility of  $\text{Pb}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $20^\circ = 1.52$  g. mol. per l. Sp. gr. of sat. solution = 1.419. (Fedotieff, Z. anorg. 1911, 73. 178.)

Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at  $0^\circ$  contains 26.7%  $\text{Pb}(\text{NO}_3)_2$ ; at  $18^\circ$ , 29.1%  $\text{Pb}(\text{NO}_3)_2$ . (Mylius, Z. anorg. 1912, 74. 411.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$ .

$\text{Pb}(\text{NO}_3)_2$	Sp. gr.	$\text{Pb}(\text{NO}_3)_2$	Sp. gr.
5	1.045	25	1.266
10	1.093	30	1.334
15	1.144	35	1.414
20	1.203	..	...

(Kremers, calculated by Gerlach, Z. anal. 8. 286.)



Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°.

$\text{Pb}(\text{NO}_3)_2$	Sp. gr.	$\text{Pb}(\text{NO}_3)_2$	Sp. gr.
5	1.044	25	1.263
10	1.092	30	1.333
15	1.144	35	1.409
20	1.200	sat. sol.	1.433

(Gerlach, Z. anal. 27. 283.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  sat. at 8° = 1.372. (Anthon.)Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at 17.5°.

$\text{Pb}(\text{NO}_3)_2$	Sp. gr.	$\text{Pb}(\text{NO}_3)_2$	Sp. gr.
1	1.0080	20	1.1902
2	1.0163	21	1.2016
3	1.0247	22	1.2132
4	1.0331	23	1.2251
5	1.0416	24	1.2372
6	1.0502	25	1.2495
7	1.0591	26	1.2620
8	1.0682	27	1.2747
9	1.0775	28	1.2876
10	1.0869	29	1.3007
11	1.0963	30	1.3140
12	1.1059	31	1.3276
13	1.1157	32	1.3416
14	1.1257	33	1.3558
15	1.1359	34	1.3702
16	1.1463	35	1.3848
17	1.1569	36	1.3996
18	1.1677	37	1.4146
19	1.1788	..	...

(Schiff, calculated by Gerlach, Z. anal. 8. 286.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at t°.

t°	% $\text{Pb}(\text{NO}_3)_2$	Sp. gr.
14	5	1.0451
14	10	1.0939
14.5	15	1.1468
14.3	20	1.2045
15	25	1.2678
15	32.28	1.3716

(Long, W. Ann. 1880, 11. 40.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

17.93      32.22%  $\text{Pb}(\text{NO}_3)_2$ .  
1.1786      1.3619

(Wagner, W. Ann. 1883, 18. 267.)

Sp. gr. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  at 25°.

Concentration of $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.1380
$\frac{1}{2}$ " "	1.0699
$\frac{1}{4}$ " "	1.0351
$\frac{1}{8}$ " "	1.0175

(Wagner, Z. phys. Ch. 1890, 5. 36.)

 $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 15.93%  $\text{Pb}(\text{NO}_3)_2$ , has sp. gr.  $20^\circ/20^\circ = 1.1558$ . $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 30.57%  $\text{Pb}(\text{NO}_3)_2$ , has sp. gr.  $20^\circ/20^\circ = 1.3436$ . $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing 30.69%  $\text{Pb}(\text{NO}_3)_2$ , has sp. gr.  $20^\circ/20^\circ = 1.3465$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at 103.5°. (Kremers.)Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at 102.2°, and contains 140 pts.  $\text{Pb}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ . (Griffiths.)Sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  boils at 103.5°. (Gerlach, Z. anal. 26. 427.)B.-pt. of  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  containing pts.  $\text{Pb}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ , according to Gerlach (Z. anal. 26. 449).

B.-pt.	Pts. $\text{Pb}(\text{NO}_3)_2$	B.-pt.	Pts. $\text{Pb}(\text{NO}_3)_2$
100.5°	11	102.5°	87
101	26	103	111
101.5	44	103.5	137
102	65	...	...

Insol. in conc.  $\text{HNO}_3 + \text{Aq}$ .Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Ba}(\text{NO}_3)_2$ .See under  $\text{Ba}(\text{NO}_3)_2$ .Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Cu}(\text{NO}_3)_2$ .See under  $\text{Cu}(\text{NO}_3)_2$ .Sol. in sat.  $\text{KNO}_3 + \text{Aq}$  without pptn., 100 pts.  $\text{H}_2\text{O}$  at 18.75° dissolving 114 pts. mixed salt, viz. 84.1 pts.  $\text{Pb}(\text{NO}_3)_2$ , and 29.9 pts.  $\text{KNO}_3$ . (Karsten.)100 pts.  $\text{H}_2\text{O}$  dissolve 119.6 pts.  $\text{Pb}(\text{NO}_3)_2$  and 67.1 pts.  $\text{KNO}_3$  at 21.2°. (Rüdorff, B. 6. 484.)100 g.  $\text{H}_2\text{O}$  dissolve 95.39 g.  $\text{Pb}(\text{NO}_3)_2$  and 61.05 g.  $\text{KNO}_3$  at 20°. (Le Blanc and Noyes, Z. phys. Ch. 1890, 6. 386.)Sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  without pptn., 100 pts.  $\text{H}_2\text{O}$  at 18.75° dissolving 121.9 pts. mixed salt, viz. 87.8 pts.  $\text{Pb}(\text{NO}_3)_2$  and 34.1 pts.  $\text{NaNO}_3$ . (Karsten.)Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3$ .Solid phase =  $\text{Pb}(\text{NO}_3)_2$ .

t° of saturation	% $\text{NaNO}_3$	% $\text{Pb}(\text{NO}_3)_2$
32	34.42	19.69
35.5	34.15	20.33
39.5	33.71	21.35
44.	33.35	22.19
49.1	32.94	23.15
55	32.60	23.93
58	32.47	24.24
62	32.33	24.57
65	32.14	24.89

Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{NaNO}_3$ —Continued.

Solid phase = $\text{NaNO}_3$		
t° of saturation	% $\text{NaNO}_3$	% $\text{Pb}(\text{NO}_3)_2$
21	40.97	13.62
26.5	42.04	13.38
31	43.18	12.88
38.8	44.63	12.78
41	45.11	12.94
44.25	46.03	12.45
51	47.28	12.50
58	49.03	11.76
64	49.92	11.56

(Isaac, Chem. Soc. 1908, 93. 398.)

Also sol. in  $\text{KNO}_3 + \text{NaNO}_3 + \text{Ag}$ .  
 100 pts. sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2 + \text{Ag}$   
 contain 45.98 pts. of the two salts at 19.20°.  
 (v. Hauer, J. pr. 98. 137.)

Solubility of  $\text{Pb}(\text{NO}_3)_2 + \text{Sr}(\text{NO}_3)_2$  at 25°.

G. per 100 cc.		Mol. per cent in solid phase	
$\text{Pb}(\text{NO}_3)_2$	$\text{Sr}(\text{NO}_3)_2$	$\text{Pb}(\text{NO}_3)_2$	$\text{Sr}(\text{NO}_3)_2$
46.31	0	100.	0
50.47	4.56	99.05	0.95
53.92	8.14	98.11	1.89
45.34	17.81	97.02	2.98
44.48	18.74	96.06	3.94
25.23	35.03	83.84	16.16
19.13	37.54	32.88	67.12
0	71.04	0	100.

(Fock, Z. Kryst. Min. 1897, 23. 365.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

100 pts. alcohol of 0.9282 sp. gr. dissolve:  
 at 4° 8° 22° 40° 50°  
 4.96 5.82 8.77 12.8 14.9 pts.  $\text{Pb}(\text{NO}_3)_2$ .  
 (Gerardin, A. ch. (4), 5. 129.)

100 pts. absolute methyl alcohol dissolve 1.37 pts. at 20.5°.

100 pts. absolute ethyl alcohol dissolve 0.04 pt. at 20.5°. (de Bruyn. Z. phys. Ch. 10. 783.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Insol. in cold, sl. sol. in hot  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 21.)

Solubility of  $\text{Pb}(\text{NO}_3)_2$  in pyridine at t°.

t°	G. $\text{Pb}(\text{NO}_3)_2$ per 100 g. $\text{C}_5\text{H}_5\text{N}$	Solid phase
-19.4	2.93	$\text{Pb}(\text{NO}_3)_2, 4\text{C}_5\text{H}_5\text{N}$
-14.5	2.14	"
-10	1.90	"
0	3.54	"
5.4	3.93	"
8.7	5.39	"
14.72	6.13	"
19.97	6.78	"
24.75	8.56	"
30.03	10.98	"
34.97	13.20	"
40.03	16.94	"
45.	22.03	"
49.97	29.37	"
51 tr. pt.	...	" + $\text{Pb}(\text{NO}_3)_2, 3\text{C}_5\text{H}_5\text{N}$
59.52	36.70	$\text{Pb}(\text{NO}_3)_2, 3\text{C}_5\text{H}_5\text{N}$
70	47.29	"
80	61.60	"
89.93	90.21	"
94.94	128.06	"
96 tr. pt.	...	" + $\text{Pb}(\text{NO}_3)_2, 2\text{C}_5\text{H}_5\text{N}$
99.89	143.36	$\text{Pb}(\text{NO}_3)_2, 2\text{C}_5\text{H}_5\text{N}$
104.90	152	"
109.90	163.80	"

(Walton and Judd, J. Am. Chem. Soc. 1911, 33. 1036.)

Lead mercurous nitrate,  $2\text{PbO}, 2\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm dil.  $\text{HNO}_3$ , or  $\text{Hg}_2(\text{NO}_3)_2 + \text{Ag}$  without decomp. (Städeler, A. 87. 129.)

Lead silver nitrate,  $\text{Pb}(\text{NO}_3)_2, 2\text{AgNO}_3$ .Sol. in  $\text{H}_2\text{O}$ . (Stürenberg, Pogg. 74. 115.)Lead silver nitrate iodide,  $\text{Pb}(\text{NO}_3)_2, 8\text{AgNO}_3, 4\text{AgI}$ .Decomp. by  $\text{H}_2\text{O}$ . (Stürenberg.)

$\text{Pb}(\text{NO}_3)_2, 2\text{AgNO}_3, 2\text{AgI}$ . Decomp. by  $\text{H}_2\text{O}$ . (Stürenberg.)

Lead nitrate nitrite, basic,  $4\text{PbO}, \text{N}_2\text{O}_5, \text{N}_2\text{O}_3 + 2\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3, \text{Pb}(\text{OH})\text{NO}_2$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Sol. in 80 pts.  $\text{H}_2\text{O}$  at 23° (Chevreuil); 85 pts. at ord. temp. (Bromeis, A. 72. 38); 10.6 pts. at 100° (Chevreuil).

+  $2\text{H}_2\text{O}$ .

Solubility in acetic acid.

Normality of acid	g. $\text{PbO}$ per 100 cc. sat. solution	Normality of acid	g. $\text{PbO}$ per 100 cc. sat. solution
0	0.601	0.25	5.450
0.05	1.323	0.50	9.690
0.10	2.185	0.75	15.874

(Chilesotti, Att. Acad. Linc. 1908, (5) 17, II. 475.)

Formula is  $3\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_3 + \text{H}_2\text{O}$ . (v. Lorenz, W. A. B. **84**, **2**, 1133.)

$+3\text{H}_2\text{O}$ . (v. Lorenz.)

$4\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Bromeis.)

$6\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_5 + 3\frac{1}{2}\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $2\text{Pb}(\text{OH})\text{NO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$6\text{PbO}$ ,  $2\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_5 + 3\frac{1}{2}\text{H}_2\text{O} = 2\text{Pb}(\text{OH})\text{NO}_3$ ,  $\text{Pb}(\text{OH})\text{NO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$7\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than  $4\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ ; sol. in cold conc.  $\text{HNO}_3 + \text{Aq}$ . (Peligot, A. **39**, 338.)

$8\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_5 + 4\frac{1}{2}\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $3\text{Pb}(\text{OH})\text{NO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$10\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $4\text{N}_2\text{O}_5 + 5\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $4\text{Pb}(\text{OH})\text{NO}_3$ . (v. Lorenz.)

$12\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $5\text{N}_2\text{O}_5 + 6\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_3$ . (v. Lorenz.)

$10\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_5 + 4\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $2\text{Pb}(\text{OH})\text{NO}_3$ ,  $2\text{PbO} + \frac{1}{2}\text{H}_2\text{O}$ . (v. Lorenz.)

$14\text{PbO}$ ,  $\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_5 + 6\text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_3$ ,  $3\text{Pb}(\text{OH})\text{NO}_3$ ,  $3\text{PbO} + \text{H}_2\text{O}$ . (Bromeis.)

$14\text{PbO}$ ,  $3\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_5 + 6\text{H}_2\text{O} = 3\text{Pb}(\text{OH})\text{NO}_3$ ,  $\text{Pb}(\text{OH})\text{NO}_3$ ,  $3\text{PbO} + \text{H}_2\text{O}$ . (Bromeis.)

$16\text{PbO}$ ,  $2\text{N}_2\text{O}_5$ ,  $3\text{N}_2\text{O}_5 + 6\text{H}_2\text{O} = 4\text{Pb}(\text{OH})\text{NO}_3$ ,  $6\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{PbO}$ ,  $\text{Pb}(\text{OH})$ . (v. Lorenz.)

$16\text{PbO}$ ,  $3\text{N}_2\text{O}_5$ ,  $5\text{N}_2\text{O}_5 + 10\text{H}_2\text{O} = 3\text{Pb}(\text{OH})\text{NO}_3$ ,  $5\text{Pb}(\text{OH})\text{NO}_3 + \text{H}_2\text{O}$ . (v. Lorenz.)

$26\text{PbO}$ ,  $6\text{N}_2\text{O}_5$ ,  $7\text{N}_2\text{O}_5 + 21\text{H}_2\text{O} = 6\text{Pb}(\text{OH})\text{NO}_3$ ,  $7\text{Pb}(\text{OH})\text{NO}_3 + 4\text{H}_2\text{O}$ . (v. Lorenz.)

**Lead nitrate phosphate**,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{Pb}_3(\text{PO}_4)_2 + 2\text{H}_2\text{O}$ .

Completely insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$  into its constituents. Sol. in a little conc.  $\text{HNO}_3 + \text{Aq}$  without decomp. (Gerhardt, A. **72**, 83.)

**Lead nitrate phosphite**,  $\text{Pb}(\text{NO}_3)_2$ ,  $\text{PbHPO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ .  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  (33.3 g. per litre) dissolves 1 g. salt at  $15^\circ$ . If less than 31 g. per litre of  $\text{Pb}(\text{NO}_3)_2$  are present the salt is decomp. (Amat, A. ch. (6) **24**, 317.)

**Lead nitrate potassium nitrite**,  $\text{Pb}(\text{NO}_3)_2$ ,  $2\text{KNO}_2 + \text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (Lang, J. B. **1862**, 102.)

$3\text{PbO}$ ,  $3\text{K}_2\text{O}$ ,  $4\text{N}_2\text{O}_5$ ,  $2\text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Hayes, Sill. Am. J. (2) **31**, 226.)

**Lithium nitrate**,  $\text{LiNO}_3$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve:

at  $0^\circ$   $20^\circ$   $40^\circ$   $70^\circ$   $100^\circ$   $110^\circ$

48.3 75.7 169.4 196.1 227.3 256.4 pts.  $\text{LiNO}_3$ .

(Kremers, Pogg. **99**, 47.)

Forms supersaturated solutions with ease, which crystallise when temp. is lowered to  $+1^\circ$ . (Kremers, Pogg. **92**, 520.)

Sat. solution boils at over  $200^\circ$ . (Kremers, Pogg. **99**, 43.)

1 pt.  $\text{LiNO}_3$  dissolves in 200 pts.  $\text{HNO}_3$ . (Schultz, Zeit. Ch. (2) **5**, 531.)

100 pts. of the sat. solution contain at:

$64.2^\circ$   $70.9^\circ$

64.9 66.1 pts. anhydrous salt.

(Donnan and Burt, Chem. Soc. **1903**, **83**, 339.)

See  $+\frac{1}{2}\text{H}_2\text{O}$ , and  $3\text{H}_2\text{O}$ .

Sp. gr. of  $\text{LiNO}_3 + \text{Aq}$  at  $19.5^\circ$  containing pts.  $\text{LiNO}_3$  in 100 pts.  $\text{H}_2\text{O}$ :

12.7	14.2	26.4	41.8 pts. $\text{LiNO}_3$
1.069	1.077	1.134	1.197

54.8	57.5	77.4	79.4 pts. $\text{LiNO}_3$
1.245	1.255	1.315	1.319

(Kremers, Pogg. **114**, 45.)

Sp. gr. of  $\text{LiNO}_3 + \text{Aq}$ .

g. $\text{LiNO}_3$ in 1000 g. of solution	Sp. gr. $16/16^\circ$
0	1.000000
4.8526	1.002469
10.9128	1.0055495
17.9016	1.009113

(Dijken, Z. phys. Ch. **1897**, **24**, 109.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{LiNO}_3$  = 1.03803; of a 0.5-normal solution = 1.01830. (Haigh, J. Am. Chem. Soc. **1912**, **34**, 1151.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. **1898**, **20**, 828.)

Sol. in strong alcohol.

Sol. in acetone. (Eidmann, C. C. **1899**, II, 1014; Naumann, B. **1904**, **37**, 4328.)

Solubility in acetone = 0.343 g. mol. per l. at  $18^\circ$ . (Roshdestwensky and McBride, Chem. Soc. **1911**, **99**, 2140.)

Insol. in benzonitrile. (Naumann, B. **1914**, **47**, 1370.)

Difficultly sol. in ethyl acetate. (Naumann, B. **1910**, **43**, 314.)

$+\frac{1}{2}\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 pts. of the sat. solution contain at:

$43.6^\circ$   $50.5^\circ$   $55.0^\circ$   $60.0^\circ$

60.8 61.3 63.0 63.6 pts. anhydrous salt.

$61.1^\circ$  is the temp. at which  $\text{LiNO}_3 + \frac{1}{2}\text{H}_2\text{O}$  goes over into  $\text{LiNO}_2$ . (Donnan and Burt, Chem. Soc. **1903**, **83**, 339.)

$+3\text{H}_2\text{O}$ .Solubility in  $\text{H}_2\text{O}$ .100 pts. of the sat. solution contain pts. anhydrous salt at  $t^\circ$ .

$t^\circ$	Pts. anhydrous salt
0.10	34.8
10.50	37.9
12.10	38.2
13.75	39.3
19.05	40.4
22.10	42.9
27.55	47.3
29.47	53.67
29.78	55.09
29.87	56.42
29.86	56.68
29.64	57.48
29.55	58.03

Mpt. of  $\text{LiNO}_3 + 3\text{H}_2\text{O}$  is  $29.88^\circ$ .

(Donnan and Burt, Chem. Soc. 1903, 83. 337.)

**Magnesium nitrate, basic,  $\text{Mg}_3\text{N}_2\text{O}_8$ .**Insol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in acids. (Chodnew, A. 71. 241.) $+5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Didier, C. R. 1896, 122. 936.)**Magnesium nitrate,  $\text{Mg}(\text{NO}_3)_2$ .***Anhydrous*. Deliquescent.

Sol in 1 pt.  $\text{H}_2\text{O}$  at  $15.6^\circ$ . Sol. in 4 pts. abs. alcohol at  $15.6^\circ$ , and 2 pts. at boiling temp. More sol. in alcohol of 0.817 sp. gr. than in that of 0.900. (Kirwan.)  
 Sol. in 0.3458 pt. strong alcohol at  $82.5^\circ$ . (Wensel.)  
 Sol. in 10 pts. strong alcohol at  $15^\circ$ . (Bergmann.)  
 Sol. in 9 pts. strong alcohol on heating. (Bergmann.)

Solubility in  $\text{H}_2\text{O}$  in presence of the anhydrous salt.

Sat. solution contains at:

$89^\circ$      $77.5^\circ$      $67^\circ$   
 63.14    65.67.    67.55%  $\text{Mg}(\text{NO}_3)_2$ .

(Funk, Z. anorg. 1899, 20. 396.)

See +6, and  $9\text{H}_2\text{O}$ .Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $14^\circ$ .

% $\text{Mg}(\text{NO}_3)_2$ $+6\text{H}_2\text{O}$	Sp. gr.	% $\text{Mg}(\text{NO}_3)_2$ $+6\text{H}_2\text{O}$	Sp. gr.
1	1.0034	30	1.1347
5	1.0202	35	1.1649
10	1.0418	40	1.1909
15	1.0639	45	1.2176
20	1.0869	49	1.2397
25	1.1103	..	...

(Oudemans, Z. anal. 7. 419.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $21^\circ$ .

% $\text{Mg}(\text{NO}_3)_2$ $+6\text{H}_2\text{O}$	Sp. gr.	% $\text{Mg}(\text{NO}_3)_2$ $+6\text{H}_2\text{O}$	Sp. gr.
2	1.0078	28	1.1216
4	1.0158	30	1.1312
6	1.0239	32	1.1410
8	1.0321	34	1.1508
10	1.0405	36	1.1608
12	1.0490	38	1.1709
14	1.0577	40	1.1811
16	1.0663	42	1.1914
18	1.0752	44	1.2019
20	1.0843	46	1.2124
22	1.0934	48	1.2231
24	1.1026	50	1.2340
26	1.1120	..	...

(Schiff, calculated by Gerlach, Z. anal. 8. 286.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $18^\circ$ .

% $\text{Mg}(\text{NO}_3)_2$	Sp. gr.	% $\text{Mg}(\text{NO}_3)_2$	Sp. gr.
5	1.0378	15	1.1181
10	1.0763	17	1.1372

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

18.62    34.19    39.77%  $\text{Mg}(\text{NO}_3)_2$ .  
 1.1025    1.2000    1.4298

(Wagner, W. Ann. 1883, 18. 273.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0512
$1/2$ -"	1.0259
$1/4$ -"	1.0130
$1/8$ -"	1.0066

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of solution sat. at  $18^\circ = 1.384$ , containing 43.1%  $\text{Mg}(\text{NO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$ .

$1/2$ $\text{Mg}(\text{NO}_3)_2$ g. in 1000 g. of solution	Sp. gr. $16^\circ/16^\circ$
0	1.000000
0.8099	1.000660
1.5621	1.001253
3.3398	1.002539
7.4410	1.005523
15.161	1.011151
29.356	1.021580
58.353	1.043329
81.025	1.060773

(Dijken, Z. phys. Ch. 1897, 24. 107.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 20.1°.  
 p = per cent strength of solution; d = observed density; w = volume concentration in grams per cc.  $\left(\frac{pd}{100} = w\right)$

p	d	w
35.02	1.3110	0.46695
31.15	1.2655	0.39420
25.03	1.2057	0.30172
19.55	1.1551	0.22585
13.43	1.1028	0.14815
10.09	1.0753	0.10850
6.650	1.0480	0.06968
4.672	1.0330	0.04826
4.001	1.0276	0.04112
1.372	1.0085	0.01383

(Barnes, J. phys. Chem. 1898, 2. 545.)

Sp. gr. of  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at 20° containing M g. mols. of salt per liter.

M	0.02	0.05	0.10	0.15
Sp. gr.	1.00224	1.005626	1.011118	1.016557

M	0.20	0.50	1.00	1.274
Sp. gr.	1.022026	1.054804	1.107865	1.136615

(Jones and Pearce, Am. Ch. J. 1907, 38. 707.)

Less sol. in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Dijonval.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 328.)

+  $2\text{H}_2\text{O}$ . Mpt. 127°. (Wasiljew, C. C. 1909, II. 1966.)

+  $4\text{H}_2\text{O}$ . Mpt. 45.5°. (W.)

+  $6\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in 0.5 pt. cold  $\text{H}_2\text{O}$ , and 9 pts. cold alcohol of 0.84 sp. gr.; very sl. sol. in abs. alcohol. (Graham.)

Melts in its crystal  $\text{H}_2\text{O}$  at 90°, and the resulting liquid boils at 143.4°. (Ordway, Sill. Am. J. (2) 27. 14.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-18°	-4.5°	0°	18°
38.03	39.50	39.96	42.33% $\text{Mg}(\text{NO}_3)_2$
40°	80°	90° (mpt.).	
45.87	53.69	57.81% $\text{Mg}(\text{NO}_3)_2$ .	

(Funk, Z. anorg. 1899, 20. 395.)

+  $9\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-23°	-20.5°	-18°
35.44	36.19	38.03% $\text{Mg}(\text{NO}_3)_2$ .

Cryohydrate is formed at -29°. (Funk, Z. anorg. 1899, 20. 398.)

**Magnesium neodymium nitrate**,  $3\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 97.7 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76. 303.)

**Magnesium praseodymium nitrate**,  $3\text{Mg}(\text{NO}_3)_2 \cdot 2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 7.70 g. hydrous salt at 16°. (Jantsch.)

**Magnesium samarium nitrate**,  $3\text{Mg}(\text{NO}_3)_2 \cdot \text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .

(Demaray, C. R. 1900, 130. 1187.)

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 24.55 g. hydrous salt at 16°. (Jantsch.)

**Magnesium thorium nitrate**,  $\text{MgTh}(\text{NO}_3)_6 + \text{H}_2\text{O}$ .

Hydroscopic; sol. in  $\text{HNO}_3$ . (Meyer, Z. anorg. 1901, 27. 385.)

**Magnesium nitrate ammonia**,  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{NH}_3$ .

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1913, 35. 1459.)

**Manganous nitrate, basic**,  $2\text{MnO} \cdot \text{N}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Gorgeu.)

**Manganous nitrate**,  $\text{Mn}(\text{NO}_3)_2$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

See +3, and  $6\text{H}_2\text{O}$ .

Sp. gr. of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at 8°.

% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$	Sp. gr.	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$	Sp. gr.
5	1.0253	45	1.2705
10	1.0517	50	1.3074
15	1.0792	55	1.3459
20	1.1078	60	1.3861
25	1.1137	65	1.4281
30	1.1688	70	1.4721
35	1.2012	71	1.4811
40	1.2352	..	...

(Oudemans, Z. anal. 7. 421.)

Sp. gr. of aqueous solutions containing:

10	20	30	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$
6.237	12.474	18.711	% $\text{Mn}(\text{NO}_3)_2$
1.052	1.107	1.165	

40	50	60	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$
24.948	31.185	37.422	% $\text{Mn}(\text{NO}_3)_2$
1.230	1.302	1.381	

70	80	% $\text{Mn}(\text{NO}_3)_2 + 6\text{H}_2\text{O}$
43.659	49.896	% $\text{Mn}(\text{NO}_3)_2$
1.466	1.558	

(Gerlach, Z. anal. 28. 477.)

Sp. gr. of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

18.309	29.602	49.309%	$\text{Mn}(\text{NO}_3)_2$
1.1482	1.3227	1.5056	

(Wagner, W. Ann. 1883, 18. 271.)

Sp. gr. of  $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$  at 25°.

Concentration of $\text{Mn}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0690
$\frac{1}{5}$ " "	1.0349
$\frac{1}{10}$ " "	1.0174
$\frac{1}{25}$ " "	1.0093

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Sol. in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc. 1909, (4) 5. 1006.)Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)+  $\text{H}_2\text{O}$ . Deliquescent. (Guntz, Bull. Soc. 1909 (4) 5. 1005.)+  $3\text{H}_2\text{O}$ . From solution in  $\text{HNO}_3$ . (Schultz-Sellack, Zeit. Ch. 1870. 646.)Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

27°	29°	30°	34°	35.5° mpt.
65.66	66.99	67.38	71.31	76.82% $\text{Mn}(\text{NO}_3)_2$ .

(Funk, Z. anorg. 1899, 20. 403.)

+  $6\text{H}_2\text{O}$ . Melts in its crystal  $\text{H}_2\text{O}$  at 25.8° and boils at 129.4°. (Ordway.)Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

-29°	-26°	-21°	-16°	-5°
42.29	43.15	44.30	45.52	48.88% $\text{Mn}(\text{NO}_3)_2$ .

0°	+11°	18°	25.8° mpt.
50.49	54.50	57.33	62.37% $\text{Mn}(\text{NO}_3)_2$ .

Cryohydrate is formed at -36°. (Funk, Z. anorg. 1899, 20. 403.)

**Manganous neodymium nitrate**,  $3\text{Mn}(\text{NO}_3)_2, 2\text{Nd}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 296 g. hydrous salt at 16°. (Jantsch, Z. anorg. 1912, 76. 303.)**Manganous praseodymium nitrate**,  $3\text{Mn}(\text{NO}_3)_2, 2\text{Pr}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 23.4 g. hydrous salt at 16°. (Jantsch.)**Manganous samarium nitrate**,  $3\text{Mn}(\text{NO}_3)_2, 2\text{Sm}(\text{NO}_3)_3 + 24\text{H}_2\text{O}$ .1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 50.04 g. hydrous salt at 16°. (Jantsch.)**Manganous thorium nitrate**,  $\text{MnTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$ .

Ppt. (Meyer, Z. anorg. 1901, 27. 388.)

**Manganous nitrate cupric oxide**,  $\text{Mn}(\text{NO}_3)_2, 3\text{CuO} + 3\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1902, 134. 234.)

**Manganous nitrate hydrazine**,  $\text{Mn}(\text{NO}_3)_2, 2\text{N}_2\text{H}_4$ .Not decomp. by  $\text{H}_2\text{O}$ . (Fransen, Z. anorg. 1908, 60. 236.)**Mercurous nitrate, basic**,  $2\text{Hg}_2\text{O}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$ .Ppt. Decomp. by boiling with  $\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 27. 332.)Slowly sol. in cold, rapidly in hot  $\text{HCl} + \text{Aq}$ ; insol. in  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ .+  $10\text{H}_2\text{O}$ . Slowly sol. in normal  $\text{HNO}_3$ . (Reuss, Dissert. 1886.) $4\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Sol. in a small quantity of  $\text{H}_2\text{O}$ ; decomp. by a large amt. of  $\text{H}_2\text{O}$  or by warm  $\text{H}_2\text{O}$ . (Rose, Pogg. 83. 154.)Is  $3\text{HgO}, 2\text{N}_2\text{O}_5 + \text{H}_2\text{O}$  according to Gerhardt.+  $5\text{H}_2\text{O}$ . (Reuss, Dissert. 1886.) $5\text{Hg}_2\text{O}, 3\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ . (Marignac.) Is  $2\text{Hg}_2\text{O}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . (Lefort, A. 56. 247.)Sol. in boiling, less sol. in cold  $\text{H}_2\text{O}$ . (Marignac, l. c.)+  $4\text{H}_2\text{O}$ , and +  $6\text{H}_2\text{O}$ . (Reuss, Dissert. 1886.) $8\text{Hg}_2\text{O}, 5\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}$ , and +  $11\text{H}_2\text{O}$ .

(Reuss.)

 $11\text{Hg}_2\text{O}, 6\text{N}_2\text{O}_5 + 25\text{H}_2\text{O}$ . (Reuss.) $16\text{Hg}_2\text{O}, 9\text{N}_2\text{O}_5 + 19\text{H}_2\text{O}$ , +  $23\text{H}_2\text{O}$ , and +  $31\text{H}_2\text{O}$ . (Reuss.) $3\text{Hg}_2\text{O}, \text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ . (Cox, Z. anorg. 1904, 40. 177.)**Mercurous nitrate**,  $\text{HgNO}_3$ .Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)Fairly sol. in boiling  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in methylamine. (Franklin, J. Am. Chem. Soc. 1906, 28. 1419.)

+  $\text{H}_2\text{O}$ . Completely sol. in a little warm  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . Completely sol. as acid salt in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Marignac, A. ch. (3) 27. 332.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $\frac{1}{2}\text{H}_2\text{O}$ , +  $\frac{1}{3}\text{H}_2\text{O}$ , +  $\frac{1}{4}\text{H}_2\text{O}$ , etc. (Reuss, Dissert. 1886.)**Mercuric nitrate, basic**,  $6\text{HgO}, \text{N}_2\text{O}_5$  (?).Insol. in hot  $\text{H}_2\text{O}$ . (Kane.) $3\text{HgO}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Decomp. to oxide by washing with cold  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Millon, A. ch. (3) 18. 361.) $2\text{HgO}, \text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Sl. deliquescent. Decomp. by  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Millon.)+  $2\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . (Marignac.)+  $3\text{H}_2\text{O}$ . (Ditte, J. B. 1854. 366.)**Mercuric nitrate**,  $\text{Hg}(\text{NO}_3)_2$ .Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Neither dissolved nor attacked by liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sol. in methylal. (Eidmann, C. C. 1899. II, 1014.)

+ $\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. Very sol. in a little  $\text{H}_2\text{O}$ .  $\text{H}_2\text{O}$  precipitates basic salt from conc.  $\text{Hg}(\text{NO}_3)_2$ +Aq. Insol. in alcohol. Decomp. by ether. (Millon.)

+ $\text{H}_2\text{O}$ . Extraordinarily sol. in  $\text{H}_2\text{O}$ . (Cox, Z. anorg. 1904, 40. 159.)

+ $8\text{H}_2\text{O}$ . Melts at  $6^\circ$  in crystal  $\text{H}_2\text{O}$ . (Ditte.)

**Mercuriomercuric nitrate**,  $\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5$ .

Boiling  $\text{H}_2\text{O}$  gradually dissolves out  $\text{Hg}_2(\text{NO}_3)_2$ , and leaves residue of  $\text{HgO}$  and  $\text{Hg}$ . (Brooks, Pogg. 66. 63.)

$2\text{Hg}_2\text{O}$ ,  $\text{HgO}$ ,  $\text{N}_2\text{O}_5$ + $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1905, 87. 175.)

$\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5$ + $\text{H}_2\text{O}$ . (Ray.)

**Mercurous hydrogen nitrate**,  $4\text{HgNO}_3$ ,  $\text{HNO}_3$ , + $8\text{H}_2\text{O}$ .

(Reuss, Dissert. 1886.)

$5\text{HgNO}_3$ ,  $3\text{HNO}_3$ + $26\text{H}_2\text{O}$ . (Reuss.)

**Mercuric silver nitrate**,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{AgNO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$  without decomp. (Berzelius.)

**Mercurous strontium nitrate**,  $2\text{SrO}$ ,  $2\text{Hg}_2\text{O}$ ,  $3\text{N}_2\text{O}_5$ .

Decomp. by  $\text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$  than the corresponding Ba compound.

Readily sol. in warm dil.  $\text{HNO}_3$ +Aq or  $\text{Hg}_2(\text{NO}_3)_2$ +Aq without decomposition. (Städeler, A. 87. 131.)

**Mercurous thallous nitrate**,  $\text{HgNO}_3$ ,  $\text{TlNO}_3$ .

Miscible with  $\text{H}_2\text{O}$ . (Retgers, N. Jahrb. Miner, 1896. II, 183.)

**Mercuric nitrate bromide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgBr}_2$ . (Morse, Z. phys. Ch. 1902, 41. 733.)

**Mercuric nitrate cadmium oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CdO}$ + $2\text{H}_2\text{O}$ .

Ppt. (Mailhe, Bull. Soc. 1901, (3) 25. 788.) + $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe.)

**Mercuric nitrate cobaltous oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CoO}$ + $3\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1901, 132. 1275.) + $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 369.)

**Mercuric nitrate cupric oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{CuO}$ + $2\text{H}_2\text{O}$ , and + $4\text{H}_2\text{O}$ .

(Mailhe, Bull. Soc. 1901, (3) 25. 791.)

+ $5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 365.)

**Mercuric nitrate cyanide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{Hg}(\text{CN})_2$ .

Very sol. in  $\text{H}_2\text{O}$ . Very sol. in methyl alcohol and solution is not decomp. at bpt. Ethyl alcohol apparently decomp. it. (Prussia, Gazz. ch. it. 1898, 23. (2) 115.)

**Mercurous nitrate hydrazine**,  $2\text{HgNO}_3$ ,  $\text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Stable in dil.  $\text{HNO}_3$ +Aq solution. (Hofmann and Marburg, A. 1899, 305. 215.)

Ppt.; very unstable. (Hofmann, B. 1897, 30. 2021.)

$\text{Hg}(\text{NO}_3)_2$ ,  $\text{N}_2\text{H}_4$ . Sol. in dil.  $\text{HCl}$  and  $\text{HNO}_3$ . (Hofmann and Marburg, A. 1899, 305. 215.)

Ppt.; sol. in acids; decomp. by alkali. (Hofmann, B. 1897, 30. 2021.)

**Mercuric nitrate iodide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $2\text{HgI}_2$ .

Decomp. by long boiling with  $\text{H}_2\text{O}$ . (Riegel, Jahrb. Pharm. 11. 396.)

$2\text{Hg}(\text{NO}_3)_2$ ,  $3\text{HgI}_2$ . Easily decomp. by  $\text{H}_2\text{O}$ ; less easily by alcohol or ether. (Riegel.)

$\text{Hg}(\text{NO}_3)_2$ ,  $\text{HgI}_2$ . Decomp. very quickly by  $\text{HNO}_3$ +Aq or alcohol of 0.814 sp. gr. (Souville, J. Pharm. 26. 474.)

**Mercuric nitrate manganous oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{MnO}$ + $2\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, Bull. Soc. 1901, (3) 25. 790.)

+ $3\text{H}_2\text{O}$ . (Mailhe.)

+ $4\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 370.)

**Mercuric nitrate nickel oxide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{NiO}$ + $2\text{H}_2\text{O}$ .

(Mailhe, Bull. Soc. 1901, (3) 25. 788.)

+ $4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 369.)

**Mercurous nitrate phosphate**,  $\text{HgNO}_3$ ,  $\text{Hg}_3\text{PO}_4$ + $\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling there-with. Insol. in  $\text{H}_3\text{PO}_4$ +Aq or alcohol. Completely sol. in hot  $\text{NH}_4\text{Cl}$ +Aq. Decomp. by cold  $\text{KOH}$ +Aq, and warm  $\text{K}_2\text{CO}_3$ +Aq. (Wittstein.)

$2\text{HgNO}_3$ ,  $\text{Hg}_2\text{O}$ ,  $5\text{Hg}_3\text{PO}_4$ + $\text{H}_2\text{O}$ . (Haack, A. 262. 192.)

**Mercuric nitrate silver bromide**,  $\text{Hg}(\text{NO}_3)_2$ ,  $\text{AgBr}$ .

(Morse, Z. phys. Ch. 1902, 41. 733.)

**Mercuric nitrate silver cyanide, basic,**  
 $\text{Hg}(\text{OH})\text{NO}_3, \text{AgCN} + 2\text{H}_2\text{O}.$

(Schmidt, Z. anorg. 1895, 9. 431.)

$\text{Hg}(\text{OH})\text{NO}_3, 5\text{Ag}_2\text{O}, 20\text{AgCN} + 7\text{H}_2\text{O}.$   
 (Schmidt.)

**Mercuric nitrate silver iodide,  $\text{Hg}(\text{NO}_3)_2,$**   
 $2\text{AgI} + \frac{1}{2}\text{H}_2\text{O}.$

Decomp. by  $\text{H}_2\text{O}$ . (Preuss, A. 29. 328.)

**Mercuric nitrate sulphide,  $\text{Hg}(\text{NO}_3)_2, 2\text{HgS}.$**

Very sl. sol. in hot  $\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3 + \text{Aq}$ . Decomp. by hot  $\text{H}_2\text{SO}_4$  or aqua regia, also by hot  $\text{HCl} + \text{Aq}$ . (Barfoed, J. pr. 93. 230.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) 17. 355.)

$2\text{Hg}(\text{NO}_3)_2, \text{Ag}_2\text{O}, 6\text{HgS} + 12\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}$ , and  $\text{HNO}_3 + \text{Aq}$  of 1.2 sp. gr. (Gramp, J. pr. (2) 14. 299.)

**Mercuric nitrate zinc oxide,  $\text{Hg}(\text{NO}_3)_2, \text{ZnO} + \text{H}_2\text{O}.$**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Mailhe, C. R. 1901, 132. 1274.)

**Molybdenum nitrate,  $\text{Mo}_4\text{O}_{11}, \text{N}_2\text{O}_5$  (?)**

Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Berselius.)

$\text{MoO}_3, 2\text{N}_2\text{O}_5$  (?). Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Berselius.)

**Neodymium nickel nitrate,  $2\text{Nd}(\text{NO}_3)_3,$**   
 $3\text{Ni}(\text{NO}_3)_2 + 24\text{H}_2\text{O}.$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 116.6 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

**Neodymium rubidium nitrate,  $[\text{Nd}(\text{NO}_3)_3]\text{Rb}_2,$**   
 $+ 4\text{H}_2\text{O}.$

Hydroscopic. (Jantsch, Z. anorg. 1911, 69. 230.)

**Neodymium zinc nitrate,  $2\text{Nd}(\text{NO}_3)_3,$**   
 $3\text{Zn}(\text{NO}_3)_2 + 24\text{H}_2\text{O}.$

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 177 g. hydrous salt at  $16^\circ$ . (Jantsch.)

**Nickel nitrate, basic.**

Insol. in  $\text{H}_2\text{O}$ . (Proust.)

$8\text{NiO}, 2\text{N}_2\text{O}_5 + 5\text{H}_2\text{O}.$  Insol. in cold or hot  $\text{H}_2\text{O}$ . (Habermann, M. 5. 432.)

$5\text{NiO}, \text{N}_2\text{O}_5 + 4\text{H}_2\text{O}.$  Not decomp. by boiling  $\text{H}_2\text{O}$ . (Rousseau and Tite, C. R. 114. 1184.)

**Nickel nitrate,  $\text{Ni}(\text{NO}_3)_2.$**

Solubility in  $\text{H}_2\text{O}$ . See +3, 6, and  $9\text{H}_2\text{O}$ .

Sp. gr. of aqueous solution at  $17.5^\circ$  containing:

5	10	15	20	% $\text{Ni}(\text{NO}_3)_2,$
1.0463	1.0903	1.1375	1.1935	

25	30	35	40	% $\text{Ni}(\text{NO}_3)_2,$
1.2534	1.3193	1.3896	1.4667	

(Frans, J. pr. (2) 5. 295.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2 + \text{Aq}$  containing g.  $\text{Ni}(\text{NO}_3)_2$  (anhydrous) in 1000 g.  $\text{H}_2\text{O}$  at  $24.4^\circ$ :

91.5 g. (= $\frac{1}{2}$ mol.)	183	274.5	369	460.5	549
1.073	1.141	1.205	1.266	1.324	1.378

(Gerlach, Z. anal. 28. 468.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

16.493	30.006	40.953	% $\text{Ni}(\text{NO}_3)_2,$
1.1363	1.2776	1.3879	

(Wagner, W. Ann. 1883, 18. 269.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Ni}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0755
$\frac{1}{2}$ -normal	1.0381
$\frac{1}{3}$ -normal	1.0192
$\frac{1}{4}$ -normal	1.0096

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Sp. gr. at  $20^\circ$  of  $\text{Ni}(\text{NO}_3)_2 + \text{Aq}$  containing M g. mols. of salt per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.001521	1.003882	1.007792	1.011541

M	0.1	0.25	0.5	0.75
Sp. gr.	1.015307	1.03837	1.07611	1.11310

M	1.0	1.5	2.0
Sp. gr.	1.14562	1.22134	1.29459

(Jones and Pearce, Am. Ch. J. 1907, 38. 720.)

Sol. in liquid  $\text{NH}_3$ . (Guntz, Bull. Soc. 1909, (4) 5. 1008.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Solubility in glycol = 7.5%. (de Coninck, C. C. 1906, II. 1234.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

+  $3\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$58^\circ$	$60^\circ$	$64^\circ$	$70^\circ$
61.61	61.99	62.76	63.95% $\text{Ni}(\text{NO}_3)_2,$

$90^\circ$   $95^\circ$  mpt.

70.16 77.12%  $\text{Ni}(\text{NO}_3)_2.$

(Funk, Z. anorg. 1899, 20. 411.)

+  $6\text{H}_2\text{O}$ . Not deliquescent in dry air. Sol. in 2 pts. cold  $\text{H}_2\text{O}$  and in alcohol. (Tupputi.)

Mpt. of  $\text{Ni}(\text{NO}_3)_2 + 6\text{H}_2\text{O} = 56.7^\circ$ . (Ordway; Tilden, Chem. Soc. 45. 409.)

Sat. solution boils at  $136.7^\circ$ . (Ordway.)

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$-21^\circ$	$-12.5^\circ$	$-10^\circ$	$-6^\circ$
39.94	41.59	42.11	43.00% $\text{Ni}(\text{NO}_3)_2,$

$0^\circ$	$+20^\circ$	$41^\circ$	$56.7^\circ$ mpt.
44.32	49.06	55.22	62.76% $\text{Ni}(\text{NO}_3)_2.$

(Funk, Z. anorg. 1899, 20. 410.)



Sat. solution of  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  contains 44.3%  $\text{Ni}(\text{NO}_3)_2$  at  $0^\circ$ , and 48.7%  $\text{Ni}(\text{NO}_3)_2$  at  $18^\circ$ . (Mylius, Z. anorg. 1912, 74. 411.)

Sp. gr. of  $\text{Ni}(\text{NO}_3)_2 \cdot \text{Aq}$  containing in 1000 g.  $\text{H}_2\text{O}$  at  $24.4^\circ$ , g.  $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

145.5 g. ( $= \frac{1}{2}$  mol.) 291 436.5 582  
1.069 1.128 1.179 1.224

727.5 873 1018.5 1164  
1.264 1.299 1.329 1.357

(Gerlach, Z. anal. 28. 468.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in absolute alcohol.

Sl. sol. in acetone. (Krug and M'Elroy.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

+9 $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

$-23^\circ$   $-21^\circ$   $-10.5^\circ$   
39.02 39.48 44.13%  $\text{Ni}(\text{NO}_3)_2$ .

Cryohydrate is formed at  $-27^\circ$ . (Funk, Z. anorg. 1899, 20. 411.)

**Nickel praseodymium nitrate**,  $3\text{Ni}(\text{NO}_3)_2$ ,  $2\text{Pr}(\text{NO}_3)_3 \cdot 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 9.28 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 303.)

**Nickel samarium nitrate**,  $3\text{Ni}(\text{NO}_3)_2$ ,  $2\text{Sm}(\text{NO}_3)_3 \cdot 24\text{H}_2\text{O}$ .

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 29.11 g. hydrous salt at  $16^\circ$ . (Jantsch.)

**Nickel thorium nitrate**,  $\text{NiTh}(\text{NO}_3)_6 \cdot 8\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1901, 27. 387.)

**Nickel uranyl nitrate**,  $10\text{Ni}(\text{NO}_3)_2$ ,  $3(\text{UO}_2)_3(\text{NO}_3)_2$ .

Sol. in  $\text{H}_2\text{O}$  and acids; insol. in aq. alkali. (Lancien, C. C. 1912, I. 208.)

**Nickel nitrate ammonia**,  $\text{Ni}(\text{NO}_3)_2 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$ .

Efflorescent. Easily sol. in cold  $\text{H}_2\text{O}$ ; decomp. by boiling. Insol. in alcohol. (Erdmann, J. pr. 97. 395; Ephraim, B. 1913, 46. 3106.)

+1 $\frac{1}{2}$  $\text{H}_2\text{O}$ . (André, C. R. 106. 936.)

**Nickel nitrate chloride ammonia**,  $6\text{Ni}(\text{NO}_3)_2$ ,  $\text{NiCl}_3 \cdot 30\text{NH}_3 + 16\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Schwarz, W. A. B. 1850. 272.)

**Nickel nitrate cupric oxide**,  $\text{Ni}(\text{NO}_3)_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$ .

Ppt. (Mailhe, C. R. 1902, 134. 234.)

**Nickel nitrate hydrazine**,  $\text{Ni}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Fransen, Z. anorg. 1908, 60. 267.)

**Palladium nitrate, basic**,  $\text{Pd}(\text{NO}_3)_2 \cdot 3\text{PdO} + 4\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Kane.)

**Palladium nitrate**,  $\text{Pd}(\text{NO}_3)_2 \cdot x\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$  or alcohol. (Kane.)

Decomp. by cold or hot  $\text{H}_2\text{O}$ . (Rose, A. 83. 143.)

**Platinic nitrate**,  $\text{Pt}(\text{NO}_3)_4$  (?).

Known only in solution, which is decomp. on evaporating. (Berzelius.)

$\text{Pt}(\text{NO}_3)_2 \cdot 3\text{PtO}_2 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Prost, Bull. Soc. (2) 46. 156.)

**Platinum nitrate sulphocarbamide**,  $\text{Pt}(\text{NO}_3)_2 \cdot 4\text{CS}(\text{NH}_2)_2$ .

Very sol. in  $\text{H}_2\text{O}$ . Unstable. (Kurnokow, J. pr. 1894, (2) 60. 490.)

**Potassium nitrate**,  $\text{KNO}_3$ .

Not deliquescent, but, according to Mulder, 100 pts.  $\text{KNO}_3$  under a bell jar with  $\text{H}_2\text{O}$  take up 339 pts.  $\text{H}_2\text{O}$  in 22 days, and small amounts finally deliquesce completely.

Sol. in  $\text{H}_2\text{O}$  with absorption of heat. 16 pts.  $\text{KNO}_3 + 100$  pts.  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temperature  $10.2^\circ$ . If the initial temp. is  $23^\circ$  it falls to  $12.8^\circ$ , if  $0^\circ$  it does not fall below  $-2.7^\circ$ , which is the freezing-point of the mixture. (Rüdorff, Pogg. 136. 276.)

$\text{KNO}_3 + \text{Aq}$  sat. at  $18.1^\circ$  has 1.1601 sp. gr. and contains 22.72%  $\text{KNO}_3$ , or 100 pts.  $\text{H}_2\text{O}$  at  $18.1^\circ$  dissolve 29.45 pts.  $\text{KNO}_3$ . (Karsten, 1840.)

Sol. in 3.745 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Gerlach.)

Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $21^\circ$  (Schiff, A. 100. 326), and solution has 1.1683 sp. gr.

Sol. in 3 pts. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}$ . (Fourcroy.)

$\text{KNO}_3 + \text{Aq}$  sat. at  $18^\circ$  has sp. gr. 1.151, and contains 21.63%  $\text{KNO}_3$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 27.60 pts.  $\text{KNO}_3$  at  $18^\circ$ . (Longchamp.)

Sol. in 4 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 0.25 pt. at b.-pt. (Riffault.)

100 pts.  $\text{H}_2\text{O}$  at  $114.5^\circ$  dissolve 284.61 pts. (Griffiths.)

Sol. in 7 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . (Bergmann.)

Sol. in 6.15 pts. cold  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abl.)

100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 26.6 pts.  $\text{KNO}_3$  at  $100^\circ$ . 100 pts. (Tre's Dictionary.)

$\text{KNO}_3 + \text{Aq}$  sat. at  $10^\circ$  contains 33.3%. (Eller.)

$\text{KNO}_3 + \text{Aq}$  sat. in the cold contains 25%. (Fourcroy.)

$\text{KNO}_3 + \text{Aq}$  sat. at  $12.5^\circ$  contains 24.8%. (Hansen-fratz.)

Solubility of  $\text{KNO}_3$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{KNO}_3$	$t^\circ$	Pts. $\text{KNO}_3$
0	13.2	45.10	74.7
5	16.7	54.72	97.1
11.67	22.2	65.45	125.5
17.91	29.3	79.72	169.2
24.94	38.4	97.66	236.4

(Gay-Lussac, A. ch. 11. 314.)

Solubility of  $\text{KNO}_3$  in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{KNO}_3$
16.0	26.7
29	43.5
44.2	71.4

(Nordenskjöld, Pogg. 136. 312.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

10°	18°	27°	41°	53°
21.2	27.9	40.1	66.3	93.3

(Gerardin, A. ch. (4) 5. 150.)

100 pts.  $\text{KNO}_3 + \text{Aq}$  sat. at  $14^\circ$  contain  
16.34 pts.  $\text{KNO}_3$ ; at  $15^\circ$ , 18.81 pts.  $\text{KNO}_3$ .  
(v. Hauer, J. pr. 98. 177.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

4°	16.3°	68.3°
16	27.2	132.1

(Andreae, J. pr. (2) 29. 456.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{KNO}_3$	$t^\circ$	Pts. $\text{KNO}_3$	$t^\circ$	Pts. $\text{KNO}_3$
0	13.3	39	62	78	165
1	13.8	40	64	79	168
2	14.6	41	66	80	172
3	15.5	42	68	81	175
4	16.4	43	70	82	179
5	17.1	44	72	83	182
6	17.8	45	74	84	185
7	18.5	46	76	85	189
8	19.3	47	78	86	192
9	20.2	48	81	87	196
10	21.1	49	83	88	199
11	22.0	50	86	89	203
12	23.0	51	88	90	206
13	24.0	52	91	91	210
14	25.0	53	93	92	214
15	26.0	54	96	93	218
16	27.0	55	98	94	222
17	28.1	56	101	95	226
18	29.1	57	103	96	230
19	30.2	58	106	97	234
20	31.2	59	108	98	238
21	32.3	60	111	99	243
22	33.5	61	113	100	247
23	34.7	62	116	101	252
24	36.0	63	119	102	256
25	37.3	64	121	103	261
26	38.6	65	124	104	266
27	40.0	66	127	105	272
28	41.4	67	130	106	278
29	42.9	68	133	107	284
30	44.5	69	136	108	289
31	46.0	70	139	109	295
32	48	71	142	110	301
33	50	72	146	111	307
34	52	73	149	112	313
35	54	74	152	113	319
36	56	75	155	114	326
37	58	76	159	114.1	327.4
38	60	77	162	...	...

(Mulder, Scheik. Verhand. 1864. 89.)

100 pts.  $\text{H}_2\text{O}$  dissolve 493 pts.  $\text{KNO}_3$  at  $125^\circ$ . (Tilden and Shenstone, Phil. Trans. 1884. 23.)

Rhombohedral  $\text{KNO}_3$  is more easily soluble than the prismatic, and easily forms super-saturated solutions. (Frankenheim.)

Sat.  $\text{KNO}_3 + \text{Aq}$  contains at:

139°	158°	160°	175°	180°
79.8	83.7	83.9	84.0	84.2%

190°	215°	225°	258°	283°
86.0	89.0	90.4	91.6	96.5%

(Étard, A. ch. 1894, (7) 2. 526.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{KNO}_3$	Sp. gr. $t^\circ/4^\circ$
0.40	13.43	1.0817
14.90	25.78	1.1389
30.80	47.52	1.2218
44.75	74.50	1.3043
60.05	111.18	1.3903
76	156.61	1.4700
91.65	210.20	1.5394
114*	311.64	1.6269

\* B.-pt. of sat. solution.

(Berkeley, Phil. Trans. 1904, 203, A. 189.)

100 g.  $\text{H}_2\text{O}$  dissolve 37.79 g.  $\text{KNO}_3$  at  $25^\circ$ .

100 g.  $\text{H}_2\text{O}$  dissolve 3.08 g. equiv.  $\text{KNO}_3$  at  $20^\circ$ ; 3.27 at  $21.5^\circ$ . (Euler, Z. phys. Ch. 1904, 49. 312.)

1 l.  $\text{H}_2\text{O}$  dissolves 384.48 g.  $\text{KNO}_3$  at  $25^\circ$ . (Armstrong and Eyre, Proc. Roy. Soc. 1910, A, 84. 123.)

1 l. sat.  $\text{KNO}_3 + \text{Aq}$  contains 2.8 g. mols.  $\text{KNO}_3$ . (Rosenheim and Weinheber, Z. anorg. 1911, 69. 263.)

100 g.  $\text{H}_2\text{O}$  dissolve 38.485 g.  $\text{KNO}_3$  at  $25^\circ$ . (Haigh, J. Am. Chem. Soc. 1912, 34. 1148.)

Sat.  $\text{KNO}_3 + \text{Aq}$  contains at:

50°	58°	62°	68°
46.39	51.55	53.64	57.04%

(Tschugaeff, Z. anorg. 1914, 86. 160.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

9.1°	21.1°	35°
16.76	24.77	35.01 g. $\text{KNO}_3$ .

(Findlay, Chem. Soc. 1914, 105. 780.)

Sp. gr. of solution sat. at  $15^\circ = 1.134$ . (Michel and Krafft.)

Sp. gr. of solution sat. at  $16^\circ = 1.138$ . (Stolba, J. pr. 97. 503.)

Sp. gr. of solution sat. at  $18^\circ = 1.1601$ , and contains 29.45%  $\text{KNO}_3$ . (Karsten.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{KNO}_3$	Sp. gr.	% $\text{KNO}_3$	Sp. gr.
4.871	1.0307	17.965	1.1198
9.618	1.0618	21.488	1.1457
14.044	1.0920	...	...

(Kremers, Pogg. 95. 120.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $21^\circ$ .

% $\text{KNO}_3$	Sp. gr.	% $\text{KNO}_3$	Sp. gr.
1	1.0058	13	1.0819
2	1.0118	14	1.0887
3	1.0178	15	1.0956
4	1.0239	16	1.1026
5	1.0300	17	1.1097
6	1.0363	18	1.1169
7	1.0425	19	1.1242
8	1.0490	20	1.1316
9	1.0555	21	1.1390
10	1.0621	22	1.1464
11	1.0686	23	1.1538
12	1.0752	24	1.1613

(Schiff, A. 110. 75.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $15^\circ$ .

% $\text{KNO}_3$	Sp. gr.	% $\text{KNO}_3$	Sp. gr.
1	1.00641	12	1.07905
2	1.01283	13	1.08596
3	1.01924	14	1.09286
4	1.02566	15	1.09977
5	1.03207	16	1.10701
6	1.03870	17	1.11426
7	1.04534	18	1.12150
8	1.05197	19	1.12875
9	1.05861	20	1.13599
10	1.06524	21	1.14361
11	1.07215	..	...

(Gerlach, Z. anal. 8. 286.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{KNO}_3$	Sp. gr.	% $\text{KNO}_3$	Sp. gr.	% $\text{KNO}_3$	Sp. gr.
1	1.006	8	1.051	15	1.099
2	1.012	9	1.058	16	1.106
3	1.019	10	1.065	17	1.113
4	1.025	11	1.072	18	1.120
5	1.032	12	1.078	19	1.127
6	1.038	13	1.085	20	1.134
7	1.045	14	1.092	..	...

(Hager, Comm. 1883.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $18^\circ$ .

% $\text{KNO}_3$	Sp. gr.	% $\text{KNO}_3$	Sp. gr.
5	1.0305	20	1.133
10	1.0632	22	1.148
15	1.097	..	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $20^\circ$ , containing mols.  $\text{KNO}_3$  in 100 mols.  $\text{H}_2\text{O}$ .

Mols. $\text{KNO}_3$	Sp. gr.	Mols. $\text{KNO}_3$	Sp. gr.
0.5	1.01730	4	1.12264
1	1.03373	5	1.14888
2	1.06524	..	...

(Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{KNO}_3 + \text{Aq}$ .	Sp. gr.
1-normal	1.0605
$\frac{1}{2}$ " "	1.0305
$\frac{1}{3}$ " "	1.0161
$\frac{1}{4}$ " "	1.0075

(Wagner, Z. phys. Ch. 1890, 5. 37.)

Sp. gr. of  $\text{KNO}_3 + \text{Aq}$  at  $20.1^\circ$ .

p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc.  $\left(\frac{pd}{100} = w.\right)$

p	d	w
25.54	1.1783	0.30095
21.95	1.1510	0.25270
17.88	1.1200	0.20033
13.93	1.0913	0.15203
8.706	1.0553	0.09186
5.393	1.0331	0.05571
4.389	1.0264	0.04506
2.848	1.0165	0.02895
2.030	1.0113	0.02053
0.741	1.0030	0.00743

(Barnes, J. Phys. Chem. 1898, 2. 544.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{KNO}_3$  = 1.05954; of a 0.5 normal solution = 1.029325. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of sat.  $\text{KNO}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	G. $\text{KNO}_3$ sol. in 100 g. $\text{H}_2\text{O}$	Sp. gr.
0	13.27	1.084
10	20.89	1.120
20	31.59	1.161
30	45.85	1.212
40	63.90	1.282
50	85.51	1.339
60	109.00	1.403
70	138.00	1.446

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44. 1565.)

The saturated solution boils at  $114.1^\circ$  (Mulder);  $114.5^\circ$  (Griffiths);  $115.9^\circ$  (Legrand, Gerardin);  $117^\circ$  (Magnus);  $118^\circ$  (Kremers);  $126^\circ$  (Le Page).

The saturated solution forms a crust at  $111^\circ$ , and boils at  $115^\circ$ ; highest temp. observed,  $115.3^\circ$ . (Gerlach, Z. anal. 26. 426.)

B.-pt of  $\text{KNO}_3 + \text{Aq}$  containing pts.  $\text{KNO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26. 444); L=according to Legrand (A. ch. (2) 52. 426).

B.-pt.	G	L	B.-pt.	G	L
100.5°	7.5	...	107°	120.5	119.0
101	15.2	12.2	108	141.5	140.6
101.5	23	...	109	164	163.0
102	31	26.4	110	188.5	185.9
102.5	39	...	111	215	209.2
103	47.5	42.2	112	243	233.0
103.5	56	...	113	274	257.6
104	64.5	59.6	114	306	283.3
104.5	73	...	115	338.5	310.2
105	82	78.3	115.9	...	335.1
106	101	98.2	...	...	...

1 pt.  $\text{KNO}_3$  dissolves in 1.4 pts.  $\text{HNO}_3$ ; at 20° in 3.8 pts., and at 123° in 1 pt.  $\text{HNO}_3 + \text{Aq}$  of 1.423 sp. gr. (Composition  $2\text{HNO}_3, 3\text{H}_2\text{O}$ .) (Schultz, Zeit. Ch. (2) 5. 531.)

Solubility of  $\text{KNO}_3$  in  $\text{HNO}_3$  at 0°.

G. per 100 cc. solution		Sp. gr.
$\text{KNO}_3$	$\text{HNO}_3$	
12.65	0.00	1.079
10.02	3.71	
8.38	8.38	1.093
7.49	13.58	1.117
7.49	19.47	1.144
7.68	30.04	1.202
10.42	42.86	1.289
28.64	75.95	1.498

(Engel, C. R., 1887, 104. 913.)

Solubility in  $\text{HNO}_3 + \text{Aq}$ .

Solution temp.	% by wt. $\text{KNO}_3$	Solid phase
-6°	24.4	$\text{KNO}_3, 2\text{HNO}_3$ (solution in $\text{HNO}_3$ ) (stable)
+14.0	32.6	"
17.0	34.8	"
19.5	37.2	"
22.0	44.5	(mpt.)
21.5	47.8	(Solution in $\text{KNO}_3$ ) (labile)
21.5	48.6	"
20.0	50.9	"
-4.0	37.2	$\text{KNO}_3, \text{HNO}_3$ (labile)
+16.5	44.5	"
22.5	47.2	(stable)
23.5	47.8	"
25.5	48.6	"
27.0	49.4	"
29.0	50.1	(labile)
30.5	50.9	"
21.0	49.4	$\text{KNO}_3$ (labile)
39.0	50.9	(stable)
50.0	51.7	"

(Groschuff, Z. anorg. 1904, 40. 10.)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . Solution thus obtained contains 43.07 pts. mixed salts, or 100 pts.  $\text{H}_2\text{O}$  dissolve 75.66 pts. mixed salts, viz. 38.62 pts.  $\text{KNO}_3$  and 39.84 pts.  $\text{NH}_4\text{Cl}$ . (Karsten.) See also under  $\text{NH}_4\text{Cl}$ .

Solubility of  $\text{KNO}_3 + \text{K}_2\text{CO}_3$  and  $\text{KHCO}_3$  in  $\text{H}_2\text{O}$ , see under  $\text{K}_2\text{CO}_3$  and  $\text{KHCO}_3$ .

Sol. in sat.  $\text{BaCl}_2 + \text{Aq}$  with pptn. of  $\text{Ba}(\text{NO}_3)_2$ .

Sol. in sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$ , at first without pptn., but afterwards  $\text{NH}_4\text{NO}_3$  is pptd. (Karsten.)

Sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  with pptn. of  $\text{NH}_4\text{NO}_3$ . (Rüdorff, B. 6. 485.)

See also under  $\text{NH}_4\text{NO}_3$ .

Sol. in sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ , but soon a double salt separates. (Karsten.)

See also under  $\text{Ba}(\text{NO}_3)_2$ .

Sol. in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$ . (Longchamp.)

See also under  $\text{Ca}(\text{NO}_3)_2$ .

Sol. in sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$  without pptn.

100 pts.  $\text{H}_2\text{O}$  dissolve 119.6 pts.  $\text{Pb}(\text{NO}_3)_2$  and 67.1 pts.  $\text{KNO}_3$  at 21.2°. (Rüdorff, B. 6. 484.) See also under  $\text{Pb}(\text{NO}_3)_2$ .

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at t°.

t°	Sat. solution contains		
	% $\text{KNO}_3$	% $\text{AgNO}_3$	% total salt
-7	10.5	39.4	49.9
-7.5	10.5	40.5	51.0
-4	11.3	42.5	53.8
+20	23.6	46.4	70.0
33	26.3	50.9	77.2
34	27.3	51.1	78.4
36	29.4	52.0	81.4
38	...	...	81.7
46	...	...	82.3
54	33.1	55.0	88.1
54	...	55.8	...
61	...	...	89.5
68	34.3	54.6	88.9
96	37.8	55.4	93.2
105	38.5	55.6	94.1
142	41.5	55.8	97.3

(Étard, A. ch. 1894, (7) 3. 236.)

Solubility of mixed crystals of  $\text{KNO}_3$  and  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at 25°.

G. per l.		Mg. mols. per l.		Mol. % $\text{AgNO}_3$ in solution	Mol. % $\text{AgNO}_3$ in solid phase
$\text{AgNO}_3$	$\text{KNO}_3$	$\text{AgNO}_3$	$\text{KNO}_3$		
45.9	321.8	270	3180	7.83	0.2896
110.7	322.6	6513	3184	16.96	0.6006
176.8	333.7	1040	3298	23.97	0.9040
259.6	364.0	1258	3597	29.81	1.054
365.6	456.4	2151	4511	32.28	1.604
507.9	387.2	2988	3816	43.85	2.439
745.9	398.6	4388	3960	57.70	8.294

(Herz, Z. Kryst. Min. 1897, 28. 405.)

Solubility of  $\text{KNO}_3 + \text{AgNO}_3$  at  $30^\circ$ .

Composition of the solution		Solid phase
% $\text{KNO}_3$	% $\text{AgNO}_3$	
0	73.0	$\text{AgNO}_3$
5.53	71.65	"
11.22	69.01	$\text{AgNO}_3 + \text{AgNO}_3, \text{KNO}_3$
13.44	65.08	$\text{AgNO}_3, \text{KNO}_3$
17.38	57.85	"
25.05	46.32	$\text{KNO}_3 + \text{AgNO}_3, \text{KNO}_3$
25.00	46.45	"
26.58	39.09	$\text{KNO}_3$
29.22	23.59	"
30.45	11.51	"
31.30	0	"

(Schreinemakers, Z. phys. Ch. 1909, 65. 576.)

 $\text{KNO}_3 + \text{NaNO}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 34.53 pts.  $\text{KNO}_3$  and 91.16 pts.  $\text{NaNO}_3$  at  $15.6^\circ$ , and solution has sp. gr. = 1.478. (Page and Keightley.)

100 pts.  $\text{KNO}_3 + \text{NaNO}_3 + \text{Aq}$  sat. at  $14^\circ$  contain 52.17 pts. of the two salts; sat. at  $13^\circ$  contain 53.15 pts. of the two salts. (v. Hauer.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $18.75^\circ$  29.45 pts.  $\text{KNO}_3$  and 89.53 pts.  $\text{NaNO}_3$ , if sat.  $\text{KNO}_3 + \text{Aq}$  is treated with  $\text{NaNO}_3$ , and 35.79 pts.  $\text{KNO}_3$  and 88.00 pts.  $\text{NaNO}_3$  by the opposite process. 134.38 pts. of the two salts are dissolved if a mixture of the salts is treated with  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Karsten.)

100 pts.  $\text{H}_2\text{O}$  dissolve 39.34 pts.  $\text{KNO}_3$  and 94.60 pts.  $\text{NaNO}_3$ , or 133.94 pts. of the two salts at  $20^\circ$ . (Nicol, Phil. Mag. (5) 13. 385.)

Solubility of mixtures of  $\text{KNO}_3$  and  $\text{NaNO}_3$ .

% $\text{NaNO}_3$ in mixture before solution	Total amt. mixed salts dissolved in 100 pts. $\text{H}_2\text{O}$ at $20^\circ$	Pts. $\text{NaNO}_3$ dissolved	Pts. $\text{KNO}_3$ dissolved	% $\text{NaNO}_3$ in mixture after solution and evap. to dryness
100	86.8	86.8	0	100
90	109.6	96.4	13.2	88
80	136.5	98.0	38.5	71.8
70	136.3	...	...	...
60	137.6	90.0	47.6	65.4
50	106.1	66.0	40.1	62.2
45.7*	88.0	53.3	34.7	60.6
40	81.1	45.6	35.6	56.2
30	73.5	...	...	...
20	54.1	20.8	33.3	38.5
10	40.9	9.4	31.5	22.9
0	33.6	0	33.6	0

\*  $\text{NaNO}_3 + \text{KNO}_3$ .

(Carnelley and Thomson, Chem. Soc. 53. 782.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $10^\circ$ .

In 1000 ccm. $\text{H}_2\text{O}$		Solid phase
$\text{NaNO}_3$	$\text{KNO}_3$	
805.0	...	$\text{NaNO}_3$
848.3	301.9	$\text{NaNO}_3, \text{KNO}_3$
...	208.9	$\text{KNO}_3$

(Kremann and Zitek, M. 1909, 30. 325.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $24.2^\circ$ .

In 1000 ccm. $\text{H}_2\text{O}$		Solid phase
$\text{NaNO}_3$	$\text{KNO}_3$	
913.58	...	$\text{NaNO}_3$
910.60	123.60	"
1019.65	435.85	$\text{NaNO}_3, \text{KNO}_3$
1018.40	437.70	"
931.30	422.00	$\text{KNO}_3$
346.70	390.00	"
...	377.35	"

(Kremann and Zitek.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% $\text{KNO}_3$	% $\text{NaNO}_3$	Solid phase
38.70	39.62	$\text{KNO}_3$
41.60	66.31	"
46.35	100.10	$\text{KNO}_3 + \text{NaNO}_3$
39.08	98.99	$\text{NaNO}_3$
20.98	94.44	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, 2. 245.)

Solubility in  $\text{NaNO}_3 + \text{Aq}$  at  $20^\circ, 30^\circ, 40^\circ$  and  $91^\circ$ . Data, given in the original, show that each salt increases the solubility of the other. (Leather, Mem. Dept. Agric. India, 1914, 3. 177; Chem. Soc. 1915, 108. (2). 13.)

100 pts.  $\text{H}_2\text{O}$  dissolve 28.92 pts.  $\text{KNO}_3$ , 53.68 pts.  $\text{NaNO}_3$ , and 26.44 pts.  $\text{NaCl}$  at  $15.6^\circ$ , and solution has sp. gr. = 1.44. (Page and Keightley, Chem. Soc. (2) 10. 566.)

Solubility of  $\text{KNO}_3 + \text{NaNO}_3 + \text{NaCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% $\text{KNO}_3$	% $\text{NaNO}_3$	% $\text{NaCl}$	Solid phase
38.44	22.87	32.58	$\text{NaCl} + \text{KNO}_3$
38.57	44.40	27.67	"
42.55	63.26	23.59	$\text{NaNO}_3, \text{KNO}_3 + \text{NaCl}$
17.77	61.12	23.94	"
28.08	62.92	23.70	"
44.72	82.82	9.56	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, 2. 245.)

 $\text{KNO}_3 + \text{Sr(NO}_3)_2$ .

1 l.  $\text{H}_2\text{O}$  sat. with both salts at  $25^\circ$  contains 552 g.  $\text{KNO}_3 + 1074$  g.  $\text{Sr(NO}_3)_2$ . (Le Blanc and Noyes, Z. phys. Ch. 1890, 6. 386.)

Solubility of  $\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2$  at  $t^\circ$ .

$t^\circ$	% $\text{KNO}_3$	% $\text{Sr}(\text{NO}_3)_2$	Solid phase
20	22.90	5.49	$\text{KNO}_3$
	21.70	9.17	"
	21.01	17.10	"
	19.60	31.24	"
	19.49	34.91	"
	19.69	39.56	$\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	17.56	40.37	$\text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	12.65	41.12	"
	10	40.70	"
40	30.26	23.70	$\text{KNO}_3$
	26.90	38.52	$\text{KNO}_3 + \text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	22.50	40.22	$\text{Sr}(\text{NO}_3)_2, 4\text{H}_2\text{O}$
	11.19	44.19	"
	0	47.7	"

(Findlay, Morgan and Morris, Chem. Soc. 1914, 105. 779.)

 $\text{KNO}_3 + \text{TiNO}_3$ .

100 g.  $\text{H}_2\text{O}$  dissolve 43.5 g.  $\text{TiNO}_3 + 104.2$  g.  $\text{KNO}_3$  at  $58^\circ$ . (Rabe, Z. anorg. 1902, 31. 156.)

Solubility of mixed crystals of  $\text{KNO}_3 + \text{TiNO}_3$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

G. per l.		Sp. gr.
$\text{TiNO}_3$	$\text{KNO}_3$	
0.00	351.0	1.2632
2.37	329.0	1.1903
6.15	332.4	1.1956
17.64	333.7	1.2050
49.74	333.3	1.2196
63.60	321.0	1.2436
86.18	330.5	1.2617
123.8	428.3	1.2950
101.3	245.1	1.2050
116.1	0.0	1.0964

(Hers, Z. Kryst. Min. 1897, 23. 405.)

 $\text{KNO}_3 + \text{KBr}$ .Solubility in  $\text{KBr} + \text{Aq}$ .

1 litre of the solution contains

at $14.5^\circ$		at $25.2^\circ$	
Mol. $\text{KBr}$	Mol. $\text{KNO}_3$	Mol. $\text{KBr}$	Mol. $\text{KNO}_3$
0.0	2.228	0.0	3.217
0.356	2.026	0.38	3.026
0.784	1.835	0.93	2.689
1.092	1.730	1.37	2.492
1.577	1.589	2.08	2.216
2.542	1.406	2.87	1.958
3.536	1.308	3.55	1.807

(Touren, C. R. 1900, 130. 910.)

 $\text{KNO}_3 + \text{KCl}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts. of the two salts:

	At $12.9^\circ$	At $15.3^\circ$
$\text{KNO}_3$	18.8	18.9
$\text{KCl}$	28.5	29.8

(Kopp.)

100 pts.  $\text{H}_2\text{O}$  dissolve 315.2 pts.  $\text{KCl}$  and 19.1 pts.  $\text{KNO}_3$  at  $20.0^\circ$ . (Rüdorff, B. 6. 484.)

100 pts.  $\text{H}_2\text{O}$  dissolve 18.95 pts.  $\text{KNO}_3 + 32.84$  pts.  $\text{KCl}$ , or 51.79 pts. of the mixed salts at  $20^\circ$ . (Nicol, Phil. Mag. (5) 31. 385.)

Solubility of  $\text{KCl}$  with addition of  $\text{KNO}_3$  at  $17.5^\circ$ .

Sp. gr.	100 ccm. of solution contain g.		
	$\text{KCl}$	$\text{H}_2\text{O}$	$\text{KNO}_3$
1.1730	29.39	87.85	0
1.1980	27.50	85.63	6.58
1.2100	27.34	84.76	8.83
1.2250	26.53	83.58	12.48
1.2360	25.98	82.84	14.83
1.2390	25.96	82.65	15.22
1.2388	25.95	82.43	15.49
1.2410	26.24	82.63	15.33

$\text{KNO}_3$  separated out in last four solutions.

Solubility of  $\text{KNO}_3$  with addition of  $\text{KCl}$  at  $20.5^\circ$ .

Sp. gr.	100 ccm. of solution contain g.		
	$\text{KNO}_3$	$\text{H}_2\text{O}$	$\text{KCl}$
1.1625	27.68	88.51	0
1.1700	24.39	87.89	4.72
1.1765	22.44	87.47	7.74
1.1895	20.23	86.48	12.23
1.1983	18.96	85.69	15.15
1.2150	17.67	84.23	19.61
1.2265	17.11	83.40	22.17
1.2400	16.79	82.24	24.96

(Bodländer, Z. phys. Ch. 7. 359.)

## Solubility in KCl+Aq at t°.

t°	Sat. solution contains		
	% KNO <sub>3</sub>	% KCl	% total salt
-11.4	4.0	18.4	22.4
-11	3.9	18.1	22.0
-10	3.8	18.6	22.5
-4	...	19.7	...
+2.5	6.3	19.9	26.2
4.5	7.3	20.7	28.0
8.5	7.8	19.8	27.6
8.5	7.9	20.9	28.8
10.5	8.4	21.0	29.4
13.5	8.9	21.8	30.7
14	10.2	21.3	31.5
17	9.7	22.6	32.3
23	12.5	21.8	34.3
27	14.9	21.3	36.2
29	16.1	21.0	37.1
34	18.9	21.2	39.3
36	18.9	21.6	40.5
37.5	19.2	21.6	40.8
39	21.0	21.0	42.0
42.5	21.8	20.9	42.7
48	25.3	20.3	45.6
50	28.3	20.8	49.1
52	...	20.2	...
53	...	...	48.7
56	29.5	19.5	49.0
61	34.5	18.3	52.8
62	35.4	...	...
71	40.5	17.3	57.8
81	47.1	15.4	62.5
85	48.2	15.3	63.5
90	52.8	13.3	66.1
96	54.1	12.6	66.7
97	56.6	12.4	69.0
104	59.9	10.8	70.7
105	...	10.9	...
120	69.6	7.7	77.3
120	69.1	7.6	76.7

(Étard, A. ch. 1894, (7) 3. 285.)

## Solubility in KCl+Aq.

1 litre of the solution contains at			
14.5°		at 25.2°	
Mol. KCl	Mol. KNO <sub>3</sub>	Mol. KCl	Mol. KNO <sub>3</sub>
0.0	2.228	0.0	3.217
0.182	2.172	0.26	3.066
0.424	2.057	0.66	2.853
0.880	1.830	1.35	2.510
1.778	1.576	2.08	2.218
2.204	1.515	2.78	2.015
2.635	1.423	3.04	1.946
3.172	1.355	...	...

(Touren, C. R. 1900, 130. 909.)

Solubility of KCl in KNO<sub>3</sub>+Aq.

t°	Concentration of KNO <sub>3</sub> % mol. per l.	G. salt dissolved in 1 l. H <sub>2</sub> O	Molecular solubility
0°	0	283.55	3.81
"	1/4	284.25	3.81
"	1/2	283.60	3.81
"	1	287.60	3.86
25°	0	364.15	4.89
"	1/4	365.00	4.90
"	1/2	361.65	4.86
"	1	358.80	4.81
"	1 1/2	355.20	4.77

(Armstrong and Eyre, Proc. R. Soc. (A) 1910, 84. 127.)

Solubility in KCl+Aq at 20°, 30°, 40° and 91°. Data, given in the original, show that each salt diminishes the solubility in H<sub>2</sub>O of the other. (Leather, Mem. Dept. Agric. India, 1914, 3. 177; Chem. Soc. 1915, 108. (2) 13.)

KNO<sub>3</sub>+NaCl.

NaCl is sol. in sat. KNO<sub>3</sub>+Aq, and the mixed solution is capable of dissolving more KNO<sub>3</sub>. An amount of H<sub>2</sub>O, which, when pure, could only dissolve 100 pts. KNO<sub>3</sub>, can in this way be made to take up 152.64 pts. (Longchamp, A. ch. (2) 9. 8.)

Sol. in sat. NaCl+Aq.

100 pts. H<sub>2</sub>O dissolve:

	Longchamp 4° (1)	Rüdorff		Page and Keightley 15.6° (4)
		14° (2)	18° (3)	
NaCl	35.96	38.5	38.9	39.57
KNO <sub>3</sub>	26.01	28.7	36.1	32.32
	61.97	67.2	75.0	71.89

	Karsten 18.75°			Mulder At b.-pt. (8)
	(5)	(6)	(7)	
NaCl	36.53	38.25	39.19	37.9
KNO <sub>3</sub>	33.12	29.45	38.53	306.7
	69.65	67.70	77.72	344.6

1, 2, 3, 4, and 8. Both salts in excess.  
5. Sat. NaCl+Aq treated with KNO<sub>3</sub>.  
6. Sat. KNO<sub>3</sub>+Aq treated with NaCl.  
7. The two salts simultaneously treated with H<sub>2</sub>O.

100 pts. H<sub>2</sub>O dissolve 31.44 pts. KNO<sub>3</sub>, 139 pts. KCl, and 38.58 pts. NaCl at 15.6°, and solution has sp. gr.=1.33. (Page and Keightley.)

## Solubility in NaCl + Aq at t°.

t°	Sat. solution contains		
	% KNO <sub>3</sub>	% NaCl	% total salt
-22	7.3	22.5	29.8
-19.5	7.9	22.6	30.5
-15.5	8.7	22.1	31.8
-7	10.1	22.5	32.6
-6	10.9	23.0	33.9
-1	12.7	23.3	36.0
+1	12.9	23.8	36.7
+11	16.6	22.8	39.4
17	19.0	22.8	41.8
18	19.8	22.0	41.8
18	18.9	22.5	41.5
20.5	20.4	22.3	42.7
22	...	21.2	...
22	21.8	20.7	42.5
26	20.7	22.3	43.0
27	...	...	45.0
30.5	24.7	20.7	45.4
32.5	25.0	20.2	45.2
32.5	25.9	20.2	46.1
33	26.7	20.7	47.4
35	27.9	20.2	48.1
39	29.8	19.5	49.3
42.2	31.1	20.0	51.1
50	38.5	16.5	55.0
54	39.4	17.1	56.5
58.5	40.9	15.3	56.2
70	49.7	14.0	63.7
76	53.9	13.6	67.5
79	54.8	12.9	67.7
84	57.4	12.6	70.0
90	61.4	10.4	71.8
96	64.7	9.5	74.2
105	70.0	9.0	79.0
106	69.9	9.3	79.2
107	71.3	8.4	79.7
115	72.2	9.0	81.2
122	73.8	8.0	81.8
127	73.6	7.9	81.5
127	72.9	8.8	81.7
127	73.0	7.6	80.6
128	74.2	7.9	82.1
132	75.7	7.6	83.3
145	77.7	7.6	85.3
170	80.7	5.8	86.5
171	79.1	5.9	85.0

(Étard, A. ch. 1894, (7) 3. 233.)

100 g. H<sub>2</sub>O dissolve 41.14 g. KNO<sub>3</sub> and 38.25 g. NaCl at 25°; 168.8 g. KNO<sub>3</sub> and 39.81 g. NaCl at 80°. (Soch, J. phys. Ch. 1898, 1. 46.)

See also under NaCl.

Sol. in sat. CuSO<sub>4</sub> + Aq, forming a double salt, which soon separates out.

Very slowly and slightly sol. in MgSO<sub>4</sub> + Aq with pptn. of MgSO<sub>4</sub>. (Karsten.)

KNO<sub>3</sub> + K<sub>2</sub>SO<sub>4</sub>.

Sat. KNO<sub>3</sub> + Aq dissolves some K<sub>2</sub>SO<sub>4</sub>, and sat. K<sub>2</sub>SO<sub>4</sub> + Aq slowly dissolves some KNO<sub>3</sub>.

without pptn., but K<sub>2</sub>SO<sub>4</sub> is afterwards pptd. (Karsten.)

100 pts. H<sub>2</sub>O dissolve:

	Mulder 18.75° (1)	Karsten 18.75° (2)	Kopp		Mulder 18.75° (5)
			20° (3)	40° (4)	
KNO <sub>3</sub>	29.90	29.42	26.9	59.35	...
K <sub>2</sub> SO <sub>4</sub>	...	4.0	6.6	5.75	10.8

2. H<sub>2</sub>O sat. with KNO<sub>3</sub> and K<sub>2</sub>SO<sub>4</sub> simultaneously, or to a sat. solution of one salt the other was added.

3 and 4. H<sub>2</sub>O sat. with both salts simultaneously.

Mulder doubts the results of 3 and 4.

Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at t°.

t°	In 100 ccm. of the solution		Sp. gr. of solution
	G. KNO <sub>3</sub>	G. K <sub>2</sub> SO <sub>4</sub>	
15	216.5	50.7	1.165
25	308.5	47.66	1.210

(Euler, Z. phys. Ch. 1914, 40. 313.)

Slowly sol. in sat. Na<sub>2</sub>SO<sub>4</sub> at first without pptn., but afterwards K<sub>2</sub>SO<sub>4</sub> or Na<sub>2</sub>SO<sub>4</sub> separates out.

Sol. in sat. ZnSO<sub>4</sub> + Aq with pptn. of double salt. (Karsten.)

Sol. in sat. KClO<sub>3</sub> + Aq, from which solution it is not pptd. by salts which would ppt. it from aqueous solution. (Karsten.)

Hydrazine dissolves 21.7 pts. KNO<sub>3</sub> at 12.5–13°. (de Bruyn, R. t. c. 1899, 18. 297.)

Neither dissolved nor attacked by liquid NO<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)

Very sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in absolute alcohol; in dilute alcohol it dissolves proportional to the amount of H<sub>2</sub>O present, but always less is dissolved than the H<sub>2</sub>O would dissolve by itself. (Gerardin.)

100 pts. alcohol containing % by weight of alcohol dissolve pts. KNO<sub>3</sub> at 15°.

10 20 30 40 50 60 80% alcohol  
13.2 8.5 5.6 4.3 2.8 1.7 0.4 pts. KNO<sub>3</sub>.

(Schiff, A. 118. 365.)



Solubility in 100 pts. alcohol at  $t^{\circ}$ . D = sp. gr. of alcohol; S = solubility.

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S
12	18.1	12	14.6	10	10.20	14	8.8
21	25.0	21	21.7	10	10.19	25	13.6
33	40.4	36	37.8	13	11.74	34	20.3
43	58.6	41	45.0	18	14.52	44	31.3
53	79.1	56	72.9	20	16.35	47	34.2
61	94.5	..	..	31	25.81	60	52.3
62	95.7	..	..	34	28.63	..	..
..	..	..	..	40	36.66	..	..
..	..	..	..	41	37.20	..	..
..	..	..	..	50	50.14	..	..
..	..	..	..	53	56.01	..	..
..	..	..	..	61	72.24	..	..
..	..	..	..	62	73.36	..	..

D = 0.9573		D = 0.9390		D = 0.8967		D = 0.8429	
$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S	$t^{\circ}$	S
14	5.4	16	4.13	12	1.61	15	0.29
25	9.0	24	6.00	33	3.62	22	0.39
33	13.2	40	10.94	47	5.77	40	0.62
44	19.1	51	16.51	57	6.97	54	0.78
57	29.1	60	21.54	..	..	60	1.10
65	36.2	64	24.22	..	..	..	..

(Gerardin, A. ch. (4) 5. 151.)

Solubility of  $\text{KNO}_3$  in alcohol at  $18^{\circ}$ .

Sp. gr.	100 ccm. contain g.		
	Alcohol	Water	$\text{KNO}_3$
1.1475	..	89.63	25.12
1.1065	3.30	87.44	20.11
1.1010	5.24	86.26	18.60
1.0805	8.69	83.18	16.18
1.0655	14.08	77.93	14.54
1.0490	16.27	76.36	12.27
1.0375	19.97	72.93	10.85
0.9935	28.11	64.74	6.50
0.9585	37.53	54.21	4.11
0.9456	42.98	48.15	3.37
0.9050	51.23	27.32	1.95
0.8722	61.65	24.74	0.83
0.8375	69.60	13.95	0.20

(Bodländer, Z. phys. Ch. 7. 316.)

Solubility in alcohol.

Wt. % alcohol	G. $\text{KNO}_3$ per 100 g. alcohol	
	at $30^{\circ}$	at $40^{\circ}$
0	45.6	64.5
8.25	32.3	47.1
17.0	22.4	33.3
25.7	15.1	24.1
35.0	11.4 (34.5°)	16.7
44.9	7.0	11.6 (44°)
54.3	4.5	7.2 (55°)
65.0	2.7	4.4
75.6	1.3	2.0 (76.3°)
88.0	0.4	0.6 (88.5°)

(Bathrick, J. phys. Ch. 1896, 1. 160.)

Solubility of  $\text{KNO}_3$  in ethyl alcohol + Aq at  $30^{\circ}$ .

% by wt. $\text{H}_2\text{O}$	% by wt. alcohol	% by wt. $\text{KNO}_3$
68.7	0	31.3
69.2	10.1	20.7
67.3	17.0	15.7
64.1	23.8	12.1
58.8	32.2	9.0
50.8	43.1	6.1
39.8	56.9	3.3
33.9	63.8	2.3
22.3	76.8	0.88
7.5	92.3	0.15

(Schreinemakers, Z. phys. Ch. 1909, 65. 556.)

Solubility in ethyl alcohol at  $25^{\circ}$ .

Concentration of alcohol in g. mol. per l. $\text{H}_2\text{O}$	Solubility in 1 l. $\text{H}_2\text{O}$	Mol. solubility
0	384.48	3.80
$\frac{1}{4}$	368.30	3.64
$\frac{1}{2}$	354.40	3.50
1	327.00	3.22

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

Solubility of  $\text{KNO}_3$  in methyl alcohol + Aq at  $30^{\circ}$ .

% by wt. $\text{H}_2\text{O}$	% by wt. alcohol	% by wt. $\text{KNO}_3$
68.7	0	31.3
68.9	7.8	23.3
66.4	17.3	16.3
61.0	27.8	11.2
53.9	38.4	7.7
39.2	57.0	3.8
0.99	98.58	0.43

(Schreinemakers, Z. phys. Ch. 1909, 65. 556.)

Solubility of  $\text{KNO}_3 + \text{AgNO}_3$  in 51.6%  $\text{C}_2\text{H}_5\text{OH} + \text{Aq}$  at  $30^\circ$ .

% $\text{KNO}_3$	% $\text{AgNO}_3$	Solid phase
4.8	0	$\text{KNO}_3$
4.55	5.15	"
4.11	16.47	"
4.26	21.28	$\text{KNO}_3 + \text{AgNO}_3$ , $\text{KNO}_3$
2.62	36.94	$\text{AgNO}_3$ , $\text{KNO}_3 + \text{AgNO}_3$
0	37	$\text{AgNO}_3$

(Schreinemakers, Z. phys. Ch. 1909, 65. 556.)

100 g. 40% ethyl alcohol sat. with  $\text{KNO}_3 + \text{NaCl}$  at  $25^\circ$  contain 13.74 g.  $\text{KNO}_3 + 15.78$  g.  $\text{NaCl}$ . (Soch, J. phys. Ch. 1898, 2. 43.)

Insol. in propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 277.)

Almost insol. in ether. (Braconnot.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014.)

Solubility in acetone + Aq at  $40^\circ$ .

Wt. % acetone	G. $\text{KNO}_3$ per 100 g. solvent
0	64.5
8.5	51.3
16.8	38.9
25.2	22.8
34.3	24.7
44.1	17.0
53.9	11.9
64.8	7.2
76.0	3.0
87.6	0.7

(Bathrick, J. phys. Ch. 1896, 1. 160.)

100 pts. glycerine (sp. gr. 1.225) dissolve 10 pts.  $\text{KNO}_3$ . (Vogel, N. Rep. Ph. 18. 557.)

100 g. trichlorethylene dissolve 0.01 g.  $\text{KNO}_3$  at  $15^\circ$ . (Wester and Bruins, Pharm. Weekbl. 1914, 51. 1443.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

100 g.  $\text{H}_2\text{O}$  sat. with sugar and  $\text{KNO}_3$  dissolve 224.7 g. sugar + 41.9 g.  $\text{KNO}_3$ , or sat. solution contains 61.36 g. sugar + 11.45 g.  $\text{KNO}_3$  at  $31.25^\circ$ . (Köhler, Z. Ver. Zuckerind. 1897, 47. 447.)

Potassium hydrogen nitrate,  $\text{KNO}_3$ ,  $\text{HNO}_3$ .

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Groschuff, B. 1904, 37. 1489.)

Potassium dihydrogen nitrate,  $\text{KNO}_3 \cdot 2\text{HNO}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) 18. 320.)

Solubility in  $\text{H}_2\text{O}$ .

Solution temp.	% by wt. $\text{KNO}_3$	% by wt. $\text{HNO}_3$	% by wt. $\text{H}_2\text{O}$
mpt. $+22^\circ$	44.5	55.5	0
30.5	44.1	55.0	0.9
18.0	43.8	54.5	1.7
12.0	43.0	53.6	3.4
6.0	42.3	52.7	5.0
0	41.6	51.8	6.6

(Groschuff, Z. anorg. 1904, 40. 11.)

Potassium silver nitrate,  $\text{KNO}_3$ ,  $\text{AgNO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26. 357.)

$3\text{KNO}_3$ ,  $\text{AgNO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 106. 320.)

Potassium thallic nitrate,  $2\text{KNO}_3$ ,  $\text{Ti}(\text{NO}_3)_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Meyer, Z. anorg. 1900, 24. 361.)

Potassium thorium nitrate,  $4\text{KNO}_3$ ,  $\text{Th}(\text{NO}_3)_4$ .

Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius.)

Hygroscopic; very unstable. (Meyer, Z. anorg. 1901, 27. 379.)

Hydroscopic; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Meyer, Z. anorg. 1901, 27. 378.)

Potassium thorium hydrogen nitrate,  $3\text{KNO}_3$ ,  $\text{Th}(\text{NO}_3)_4$ ,  $3\text{HNO}_3$ .

Decomp. in the air. (Meyer, B. 1900, 33. 2140.)

$+4\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  of 1.2 sp. gr. Effloresces in the air. (Meyer, Z. anorg. 1901, 27. 380.)

Potassium uranyl nitrate,  $\text{K}(\text{UO}_2)(\text{NO}_3)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ . (Meyer, B. 1903, 36. 4057.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	In 100 pts. of the solution			Solid phase
	Pts. by wt. $\text{UO}_2$	Pts. by wt. K	Pts. by wt. $\text{NO}_3$	
0.5	31.98	1.72	...	Double salt + $\text{KNO}_3$
13.0	33.40	2.74	...	"
25.0 a)	37.08	4.05	23.49	"
b)	37.06	3.98	23.46	"
45.0	42.18	5.16	...	"
59.0	41.65	6.03	...	"
80.6 a)	43.72	6.42	...	Double salt
b)	43.70	6.34	...	"

Potassium uranyl nitrate is decomp. by  $\text{H}_2\text{O}$  at temp. below  $60^\circ$ ; above  $60^\circ$  it is sol. in  $\text{H}_2\text{O}$  without decomp.

(Rimbach, B. 1904, 37. 473.)

**Potassium nitrate barium sulphate,  $\text{KNO}_3$ ,  $2\text{BaSO}_4$ .**

Easily decomp. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Silberberger, M. 1904, 25. 251.)

**Potassium nitrate phosphomolybdate.**

See Phosphomolybdate nitrate, potassium.

**Potassium nitrate sulphate,  $\text{KNO}_3$ ,  $\text{KHSO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Jacquelin.)

**Potassium nitrate sulphotungstate,  $2\text{KNO}_3$ ,  $\text{K}_2\text{WS}_4$  (?).**

Very sol. in hot or cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius.)

**Potassium nitrate tungstate (?).**

100 pts. boiling  $\text{H}_2\text{O}$  dissolve 5 pts. salt. (Storer's Dict., p. 393.)

**Potassium nitrate zinc iodide.**

Permanent. Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Anthon.)

**Praseodymium nitrate,  $\text{Pr}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (von Schule, Z. anorg. 1898, 18. 355.)

**Praseodymium rubidium nitrate,**

$[\text{Pr}(\text{NO}_3)_3]\text{Rb}_3 \cdot 4\text{H}_2\text{O}$ .

Hydroscopic. (Jantsch, Z. anorg. 1911, 69. 230.)

**Praseodymium sodium nitrate,  $\text{Pr}(\text{NO}_3)_3$ ,  $2\text{NaNO}_3 \cdot \text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (von Schule, Z. anorg. 1898, 18. 356.)

**Praseodymium zinc nitrate,  $2\text{Pr}(\text{NO}_3)_3$ ,  $3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ .**

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 14.69 g. hydrous salt at  $16^\circ$ . (Jantsch, Z. anorg. 1912, 76. 321.)

**Radium nitrate.**

Has apparently the same solubility in  $\text{H}_2\text{O}$  as the corresponding Ba comp. (Curie, Disser. 1903.)

**Rhodium nitrate,  $\text{Rh}(\text{NO}_3)_3 \cdot 2\text{H}_2\text{O}$  (?).**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)

**Rhodium uranyl nitrate,**

$2(\text{UO}_2)(\text{NO}_3)_2 \cdot \text{Rh}_2(\text{NO}_3)_6 \cdot 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and acids; insol. in aq. alkalies. (Lancien, C. C. 1912, I. 208.)

**Rubidium nitrate,  $\text{RbNO}_3$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve 20.1 pts. at  $0^\circ$ ; 43.5 pts. at  $10^\circ$ . (Bunsen.)

### Solubility in $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	G. $\text{PbNO}_3$ per 100 g.		$t^\circ$	G. $\text{RbNO}_3$ per 100 g.	
	$\text{H}_2\text{O}$	Solu- tion		$\text{H}_2\text{O}$	Solu- tion
0	19.5	16.3	60	200	66.7
10	33.0	24.8	70	251	71.5
20	53.3	34.6	80	309	75.6
30	81.3	44.8	90	375	78.9
40	116.7	53.9	100	452	81.9
50	155.6	60.9	118.3	617	86.1

(Berkeley, Trans. Roy. Soc. 1904, 203. A. 207.)

100 g.  $\text{H}_2\text{O}$  dissolve 66.855 g.  $\text{RbNO}_3$  at  $25^\circ$ . (Haigh, J. Am. Chem. Soc. 1912, 34. 1148.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{RbNO}_3$  = 1.100835; of a 0.5 normal solution = 1.04989. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of  $\text{RbNO}_3 + \text{Aq}$ .

G.-equiv.  $\text{RbNO}_3$  per l.

at  $18^\circ$  = 0.5035 1.008

Sp. gr. at  $6^\circ/6^\circ$  1.05342 1.10566

Sp. gr. at  $18^\circ/18^\circ$  1.05228 1.10361

Sp. gr. at  $30^\circ/30^\circ$  1.05156 1.10222

G.-equiv.  $\text{RbNO}_3$  per l.

at  $18^\circ$  = 2.000 2.685

Sp. gr. at  $6^\circ/6^\circ$  1.20655

Sp. gr. at  $18^\circ/18^\circ$  1.20302 1.27066

Sp. gr. at  $30^\circ/30^\circ$  1.20036 1.26717

(Clausen, W. Ann. 1914, (4) 44. 1069.)

Easily sol. in  $\text{HNO}_3$ . (Schultz, Zeit. Ch. (2) 5. 531.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Rubidium hydrogen nitrate,  $\text{RbNO}_3$ ,  $\text{HNO}_3$ .**

Fairly stable in air. (Wells, Am. Ch. J. 1901, 26. 273.)

**Rubidium dihydrogen nitrate,  $\text{RbNO}_3$ ,  $2\text{HNO}_3$ .**

Decomp. rapidly in air. (Wells, Am. Ch. J. 1901, 26. 273.)

$2\text{RbNO}_3$ ,  $5\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Known only in solution in  $\text{HNO}_3 + \text{Aq}$ . (Ditte, A. ch. (5) 18. 320.)

**Rubidium silver nitrate,  $\text{RbNO}_3$ ,  $\text{AgNO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Russell and Maskelyne, Roy. Soc. Proc. 26. 357.)

**Rubidium thorium nitrate,  $\text{Rb}_2\text{Th}(\text{NO}_3)_6$ .**

Sl. sol. in  $\text{HNO}_3$ ; decomp. by  $\text{H}_2\text{O}$ . (Meyer, Z. anorg. 1901, 27. 384.)

**Rubidium uranyl nitrate,  $\text{Rb}(\text{UO}_2)(\text{NO}_3)_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ .  
(Meyer, B. 1903, 36. 4057.)

### Solubility of $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	In 100 pts. of the solution				Solid phase
	Pts. by wt. $\text{UO}_2$	Pts. by wt. $\text{NO}_3$	Pts. by wt. Rb	Pts. by wt. total salt	
25	a) 35.42	19.72	4.63	59.57	Double salt + $\text{RbNO}_3$
"	b) 35.40	19.76	4.67	59.64	"
80	a) 34.64	...	11.01	69.46	Double salt
"	b) 34.68	...	11.01	69.52	"

Rubidium uranyl nitrate is decomp. by  $\text{H}_2\text{O}$  at low temp.; at  $80^\circ$  it is sol. in  $\text{H}_2\text{O}$  without decomp.

(Rimbach, B. 1904, 37. 476.)

**Samarium nitrate,  $\text{Sm}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, C. N. 48. 74.)  
Very hygroscopic. (Demarçay, C. R. 1900, 130. 1187.)

**Samarium zinc nitrate,  $2\text{Sm}(\text{NO}_3)_3 \cdot 3\text{Zn}(\text{NO}_3)_2 \cdot 24\text{H}_2\text{O}$ .**

1 l. sat. solution in  $\text{HNO}_3 + \text{Aq}$  (sp. gr. 1.325) contains 36.47 g. hydrous salt at  $16^\circ$ .  
(Jantsch, Z. anorg. 1912, 76. 321.)

**Scandium nitrate, basic.**

Sol. in  $\text{H}_2\text{O}$ . (Nilson, B. 13. 1444.)  
 $\text{ScOH}(\text{NO}_3)_2 + \text{H}_2\text{O}$ . (Crookes, Roy. Soc. Proc. 1908, 80. A. 518.)  
 $\text{Sc}_2\text{O}(\text{NO}_3)_4$ . (Crookes.)

**Scandium nitrate,  $\text{Sc}(\text{NO}_3)_3$ .**

(Crookes, Roy. Soc. Proc. 1908, 80. A. 518.)  
 $+4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Crookes.)

**Silver nitrate,  $\text{AgNO}_3$ .**

100 pts.  $\text{H}_2\text{O}$  at  $11^\circ$  dissolve 127.7 pts.  
(Schnauss, Arch. Pharm. (2) 82. 260.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$  19.5° 54° 85° 110°  
121.9 227.3 500 714 1111 pts.  $\text{AgNO}_3$ .

(Kremers, Pogg. 92. 497.)

100 pts.  $\text{H}_2\text{O}$  dissolve 1622.5 pts. at  $125^\circ$ , and 1941.4 pts. at  $133^\circ$ . (Tilden and Shennstone, Phil. Trans. 1884. 23.)

Sat. solution boils at  $125^\circ$ . (Kremers.)

### Solubility in $\text{H}_2\text{O}$ at $t^\circ$ .

Sat.  $\text{AgNO}_3 + \text{Aq}$  contains %  $\text{AgNO}_3$  at  $t^\circ$ .

$t^\circ$	% $\text{AgNO}_3$	$t^\circ$	% $\text{AgNO}_3$
-7	46.2	36.5	75.7
-7	46.0	40.5	76.8
-5	47.6	45	77.1
-1	52.4	48	78.5
-1	51.9	73	84.0
+5	56.3	122	88.7
10	61.2	134	92.1
15.5	66.1	135	92.8
20	67.8	135	92.7
26	71.1	148	93.3
29	73.0	160	95.2
31	73.8	182	96.9

(Étard, A. ch. 1894, (7) 2. 526.)

100 g. sat.  $\text{AgNO}_3 + \text{Aq}$  at  $15.5^\circ$  contain 65.5 g.  $\text{AgNO}_3$ . (Greenish and Smith, Pharm. Jour. 1903, 71. 881.)

Solubility of  $\text{AgNO}_3$  in  $\text{H}_2\text{O}$  at  $30^\circ = 10.31$  mol.-litre. (Masson, Chem. Soc. 1911, 99. 1136.)

100 g.  $\text{AgNO}_3 + \text{Aq}$  sat. at  $30^\circ$  contain 73.0 g.  $\text{AgNO}_3$ . (Schreinemakers and de Baat, Arch. Néer. Sc. 1911, (2) 15. 415.)

100 g. sat.  $\text{AgNO}_3 + \text{Aq}$  contain 53.5 g.  $\text{AgNO}_3$  at  $0^\circ$ ; 66.7 g. at  $18^\circ$ . (Mylius, Z. anorg. 1912, 74. 411.)

Sp. gr. of aqueous solution, according to C. K. = Chemiker Kalender; K. M. = Kohlrausch by Mendelejeff (Z. anal. 27. 284); and K = Kohlrausch (W. Ann. 1879. 1), containing:

	5	10	15	20% $\text{AgNO}_3$
C. K.	1.041	1.080	1.125	1.160
K. M.	1.0440	1.0901	...	1.1969
K.	1.0422	1.0893	1.1404	1.1958
	25	30	35	40% $\text{AgNO}_3$
C. K.	1.206	1.251	...	...
K. M.	...	...	...	1.4791
K.	1.2555	1.3213	1.3945	1.4773

45 50%  $\text{AgNO}_3$ .  
K. 1.5705 1.6745

### Sp. gr. of $\text{AgNO}_3 + \text{Aq}$ at $25^\circ$ .

Concentration of $\text{AgNO}_3$	Sp. gr.
1-normal	1.1386
$\frac{1}{2}$ -normal	1.0692
$\frac{1}{4}$ -normal	1.0348
$\frac{1}{8}$ -normal	1.0173

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sol. in 500 pts.  $\text{HNO}_3$ ; 30 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $20^\circ$ ; and 6 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $100^\circ$ . (Schults, Zeit. Ch. 1869. 531.)

Insol. in conc.  $\text{HNO}_3$ . (Warren, C. C. 1897. I, 438.)

Solubility of  $\text{AgNO}_3$  in  $\text{HNO}_3 + \text{Aq}$  at  $25^\circ$ .

G. mol. per l.		G. $\text{AgNO}_3$ per l.	Sp. gr. $25^\circ$
$\text{HNO}_3$	$\text{AgNO}_3$		
0	10.31	1752	2.3921
0.404	9.36	1591	2.2754
0.962	8.08	1373	2.1243
1.698	6.54	1111	1.9402
2.834	4.526	769.1	1.7052
4.497	2.590	440.1	1.4980
5.992	1.698	288.6	1.4195
8.84	0.843	143.2	1.3818
12.53	0.347	58.90	1.3976

(Masson, Chem. Soc. 1911, 99. 1132.)

 $\text{AgNO}_3 + \text{NH}_4\text{NO}_3$ . Solubility of  $\text{AgNO}_3$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . See under  $\text{NH}_4\text{NO}_3$ . $\text{AgNO}_3 + \text{KNO}_3$ . Solubility of  $\text{AgNO}_3$  +  $\text{KNO}_3$  in  $\text{H}_2\text{O}$ . See under  $\text{KNO}_3$ . $\text{AgNO}_3 + \text{AgNO}_3$ .Solubility of  $\text{AgNO}_3 + \text{AgNO}_3$  at  $18^\circ$ .

G. per l.		G. per l.	
$\text{AgNO}_3$	$\text{AgNO}_3$	$\text{AgNO}_3$	$\text{AgNO}_3$
0.000	3.184	3.512	2.201
0.439	3.042	7.024	1.799
0.878	2.926	14.048	1.480
1.756	2.601		

(Naumann and Rucker, B. 1905, 38. 2293.)

See also under  $\text{AgNO}_3$ .Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in 4 pts. boiling alcohol.

Sol. in 10 pts. alcohol. (Dumas.)

Sol. in 11 pts. alcohol of 90%. (Hager.)

Solubility in 100 pts. alcohol of given vol. % at  $t^\circ$ .

$t^\circ$	95%	80%	70%	60%
15	3.8	10.3	22.1	30.5
50	7.3	...	...	58.1
75	18.3	42.0	...	89.0

$t^\circ$	50%	40%	30%	20%	10%
15	35.8	56.4	73.7	107	158
50	....	98.3	....	214	...
75	....	160	....	340	...

(Eder, J. pr. (2) 17. 44.)

100 pts. absolute methyl alcohol dissolve 3.72 pts. at  $19^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 3.1 pts. at  $19^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)Only traces are sol. in absolute alcohol or ether. 100 pts. of a mixture of 1 vol. alcohol (95 vol. %) + 1 vol. pure ether dissolve 1.6 pts.  $\text{AgNO}_3$  at  $15^\circ$ ; 100 pts. of 2 vols. alcohol + 1 vol. ether dissolve 2.3 pts.  $\text{AgNO}_3$ . (Eder, J. pr. 1878, (2) 17. 45.)Solubility of  $\text{AgNO}_3$  in ethyl alcohol +  $\text{Aq}$  at  $30^\circ$ .

% by wt. $\text{H}_2\text{O}$	% by wt. alcohol	% by wt. $\text{AgNO}_3$
27.0	...	73.0
27.71	2.8	69.49
30.80	13.67	55.53
32.10	20.13	47.77
31.40	25.85	42.75
28.95	37.26	33.79
27.91	44.54	27.55
20.92	64.42	14.66
6.83	86.54	6.63

(Schreinemakers, Z. phys. Ch. 1909, 65. 571.)

Solubility of  $\text{AgNO}_3 + \text{KNO}_3$  in alcohol. See under  $\text{KNO}_3$ .Sol. in methyl, ethyl, and isobutyl alcohols,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ , acetone and pyridine. (Wilcox, J. phys. Chem. 1910, 14. 587.)100 pts.  $\text{H}_2\text{O}$  sat. with ether dissolve 88.4 pts.  $\text{AgNO}_3$  at  $15^\circ$ . (Eder, l. c.)

Sol. in glycerine.

Sol. in benzonitrile. 100 g. benzonitrile dissolve about 105 g.  $\text{AgNO}_3$  at  $18^\circ$ . (Naumann and Schier, B. 1914, 47. 1369.)1 pt. acetonitrile dissolves about 1.5 pts.  $\text{AgNO}_3$ . (Scholl and Steinkopf, B. 1906, 39. 4398.)

Easily sol. in methyl, ethyl, and amyl amine. (Shinn, J. phys. Chem. 1907, 11. 538.)

Sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

0.35 pts. are sol. in 100 pts. acetone at  $14^\circ$ .0.35 " " " " 100 " " "  $59^\circ$ .

(Lassyznski, B. 1894, 27. 2287.)

Sol. in acetone and in methylal. (Eidmann, C. 1899, II. 1014.)

1 g.  $\text{AgNO}_3$  is sol. in 227 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 0.798$ . (Naumann, B. 1904, 37. 4339.)Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Sol. in urethane. (Castoro, Z. anorg. 1899, 20. 61.)

100 g.  $\text{C}_6\text{H}_6$  dissolve 0.022 g.  $\text{AgNO}_3$  at  $35^\circ$ ; 0.044 g. at  $40.5^\circ$ . (Linebarger, Am. J. Sci. 1895, 49. 48.)

Mol. weight determined in piperidine, pyridine and benzonitrile. (Werner, Z. anorg. 1897, 15. pp. 17, 23 and 32.)

Solubility of  $\text{AgNO}_3$  in pyridine at  $t^\circ$ .

$t^\circ$	G. $\text{AgNO}_3$ per 100 g. $\text{C}_5\text{H}_5\text{N}$	Solid phase
-48.5**	0	$\text{C}_5\text{H}_5\text{N}$
-50.5	3	"
-53	6	"
-59	9	"
-55	...	$\text{C}_5\text{H}_5\text{N} + \text{AgNO}_3, 6\text{C}_5\text{H}_5\text{N}$
-51.25	11.1	$\text{AgNO}_3, 6\text{C}_5\text{H}_5\text{N}$
-44	11.7	"
-40	12.2	"
-35	12.6	"
-30	13.9	"
-25	17.6	"
-24	...	" + $\text{AgNO}_3, 3\text{C}_5\text{H}_5\text{N}$
-22	18.8	$\text{AgNO}_3, 3\text{C}_5\text{H}_5\text{N}$
-10	20.03	"
0	22.34	"
+10	27.21	"
20	33.64	"
30	40.86	"
40	53.52	"
45	62.26	"
46	63.06	"
47	66.35	"
48	70.85	"
48.5	...	" + $\text{AgNO}_3, 2\text{C}_5\text{H}_5\text{N}$
45	69.85	$\text{AgNO}_3, 2\text{C}_5\text{H}_5\text{N}$
50	72.25	"
60	78.60	"
70	89.10	"
80	121.21	"
87	215.02	"
80	228.5	"
74	230.6	"
74	235.4	"
80	230.4	"
87	237.1	"
90	241.9	"
100	253.8	"
110	271.4	"

\* M. pt.

(Kahlenberg and Brewer, J. phys. Ch. 1908, 12. 283.)

Silver nitrate acetylde,  $\text{AgNO}_3, \text{AgHC}_2$ .

(Willgerodt, B. 1895, 23. 2108.)

 $\text{AgNO}_3, \text{Ag}_2\text{C}_2$ . Ppt. (Chavastelon, C. R. 1897, 124. 1365.) $2\text{AgNO}_3, \text{Ag}_2\text{C}_2$ . (Chavastelon.)Silver nitrate ammonia,  $\text{AgNO}_3, \text{NH}_3$ .Partly sol. in  $\text{H}_2\text{O}$ ; rather sol. in alcohol. Sl. sol. in ether. (Reychler, B. 16. 990.)Very sol. in liquid ammonia below  $-10^\circ$ . (Joannia, C. R. 1894, 118. 1151.) $\text{AgNO}_3, 2\text{NH}_3$ . Easily sol. in  $\text{H}_2\text{O}$ . (Mitscherlich.)

1 l. alcohol dissolves 0.0383 g. mols. (Kuri-low, C. C. 1903. II, 97.)

 $\text{AgNO}_3, 3\text{NH}_3$ . Completely sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 153.)Silver nitrate antimonide,  $\text{AgNO}_3, \text{Ag}_3\text{Sb}$ .Decomp. at once by  $\text{H}_2\text{O}$ . (Poleck and Thümmel, B. 16. 2435.)Silver nitrate arsenide,  $\text{AgNO}_3, \text{Ag}_3\text{As}$ .Decomp. at once by  $\text{H}_2\text{O}$ . (Poleck and Thümmel.)Silver nitrate bromide,  $\text{AgNO}_3, \text{AgBr}$ .Decomp. immediately by  $\text{H}_2\text{O}$  or alcohol, with separation of  $\text{AgBr}$ . (Risse, A. 111. 39.)Silver nitrate chloride,  $\text{AgNO}_3, \text{AgCl}$ .Quickly decomp. with  $\text{H}_2\text{O}$ ; more slowly with absolute alcohol; not decomp. by ether-alcohol. (Reichert, J. pr. 92. 237.)Silver nitrate cyanide,  $2\text{AgNO}_3, \text{AgCN}$ .Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Hellwig, Z. anorg. 1900, 25. 177.)Silver nitrate iodide,  $\text{AgNO}_3, \text{AgI}$ .Cold  $\text{H}_2\text{O}$  separates  $\text{AgI}$ , which redissolves on heating. (Stürenberg, Arch. Pharm. (2) 143. 12.) Sol. in little  $\text{H}_2\text{O}$  without decomp.; more  $\text{H}_2\text{O}$  separates  $\text{AgI}$ . (Kremers, J. pr. 71. 54.) Insol. in absolute alcohol. Sol. in conc.  $\text{AgNO}_3 + \text{Aq}$ . $2\text{AgNO}_3, \text{AgI}$ . Sol. in little but decomp. by more boiling  $\text{H}_2\text{O}$ . (Risse, A. 111. 39.)Silver nitrate mercuric oxide,  $\text{AgNO}_3, 2\text{HgO}$ .Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Finci, Gazz. ch. it. 1910, 41. (2) 548.)Silver nitrate phosphide,  $3\text{AgNO}_3, \text{Ag}_3\text{P}$ .

(Warren, C. N. 56. 113.)

Silver nitrate silicide,  $4\text{AgNO}_3, \text{AgSi}$ .

(Büchner, Ch. Ztg. 9. 484.)

Silver nitrate silicate,  $2\text{AgNO}_3, 3\text{Ag}_2\text{SiO}_4$ .Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , but  $\text{SiO}_2$  separates out after heating. (Rousseau and Tite, C. R. 114. 294.)Silver nitrate sulphide,  $\text{AgNO}_3, \text{Ag}_2\text{S}$ .Decomp. by  $\text{H}_2\text{O}$ . (Poleck and Thümmel, B. 16. 2435.)Silver nitrate sulphocyanide,  $2\text{AgNO}_3, \text{AgSCN}$ .Decomp. by  $\text{H}_2\text{O}$ , not by alcohol. (Hellwig, Z. anorg. 1900, 25. 178.)Sodium nitrate,  $\text{NaNO}_3$ .Deliquescent in moist air. Sol. in  $\text{H}_2\text{O}$  with absorption of heat. 75 pts.  $\text{NaNO}_3$  mixed with 100 pts.  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temperature  $18.5^\circ$ . (Rüddorf, B. 2. 68.)

Sol. in 1.58 pts. $\text{H}_2\text{O}$ at $-6^\circ$ .	
" 0.46 " " $+119^\circ$ .	(Marx.)
" 2.89 " " $2^\circ$ .	
" 1.12 " " $28^\circ$ .	(Osann.)
" 0.79 " " $47^\circ$ .	
" 1.14 " " $18.5^\circ$ .	(Kopp.)
" 1.136 " " $18.75^\circ$ .	(Karsten.)
" 1.16 " " $20^\circ$ .	(Schiff, A. 109. 326.)
" 2 " " $18.75^\circ$ .	(Abl.)

100 pts.  $H_2O$  at  $t^\circ$  dissolve pts.  $NaNO_3$ .

$t^\circ$	Pts. $NaNO_3$	$t^\circ$	Pts. $NaNO_3$
-6	68.80	50	111.13
0	79.75	60	119.94
10	84.30	70	129.63
16	87.63	80	140.72
20	89.55	90	153.63
30	95.37	100	168.20
40	102.31	120	225.30

(Poggiale, A. ch. (3) 8. 469.)

100 pts.  $H_2O$  at  $119^\circ$  dissolve 150 pts.  $NaNO_3$ . (Griffiths.)  
 $NaNO_3$  + Aq sat. at  $18.75^\circ$  has 1.3769 sp. gr., and 100 pts.  $H_2O$  have dissolved 88.001 pts.  $NaNO_3$ . (Karsten.)

$NaNO_3$  + Aq sat. in cold contains 33.3%  $NaNO_3$ . (Fourcroy.)

$NaNO_3$  + Aq sat. at  $12.5^\circ$  contains 34%  $NaNO_3$ . (Hassenfratz.)

100 pts.  $H_2O$  at  $15.5^\circ$  dissolve 33 pts.; at  $52^\circ$ , 100 pts.  $NaNO_3$ . (Ure's Dict.)

100 pts.  $H_2O$  dissolve pts.  $NaNO_3$  at  $t^\circ$ .

$t^\circ$	Pts. $NaNO_3$	$t^\circ$	Pts. $NaNO_3$
0	73.0	60.65	125.5
13.9	81.6	99.9	173.6
44.65	110.5	119.7	211.4

(Nordenskjöld, Pogg. 136. 312.)

100 pts.  $H_2O$  dissolve pts.  $NaNO_3$  at  $t^\circ$ .

$t^\circ$	Pts. $NaNO_3$	$t^\circ$	Pts. $NaNO_3$
0	70.94	70	142.31
10	78.57	80	153.72
20	87.97	90	165.55
30	98.26	100	178.18
40	109.01	110	194.26
50	120.00	119.4	213.43
60	131.11	...	...

(Maumené, C. R. 58. 81.)

100 pts.  $NaNO_3$  + Aq sat. at  $14^\circ$  contain 43.88 pts.  $NaNO_3$ ; at  $15^\circ$ , 44.53 pts.  $NaNO_3$ . (v. Hauer, J. pr. 98. 137.)

100 pts.  $H_2O$  dissolve 84.21-84.69 pts.  $NaNO_3$  at  $15.6^\circ$ , and sat. solution has sp. gr. 1.337-1.378. (Page and Keightley, Chem. Soc. (2) 10. 556.)

100 pts.  $H_2O$  dissolve pts.  $NaNO_3$  at  $t^\circ$ .

$t^\circ$	Pts. $NaNO_3$	$t^\circ$	Pts. $NaNO_3$
0	66.69	18	83.62
2	70.97	21	85.73
4	71.04	26	90.33
8	75.65	29	92.93
10	76.31	36	99.39
13	79.00	51	113.63
15	80.60	68	125.07

Solubility is constant from  $0^\circ$  to  $-15.7^\circ$ , when  $NaNO_3 + 7H_2O$  separates out. (Ditte, C. R. 80. 1164.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $NaNO_3$	$t^\circ$	Pts. $NaNO_3$
0	72.9	60	122
1	74.7	61	124
2	75.4	62	125
3	76.0	63	126
4	76.7	64	127
5	77.4	65	128
6	78.1	66	130
7	78.7	67	131
8	79.4	68	132
9	80.1	69	133
10	80.8	70	134
11	81.4	71	136
12	82.0	72	137
13	82.7	73	138
14	83.4	74	139
15	84.0	75	140
16	84.7	76	142
17	85.4	77	143
18	86.1	78	145
19	86.8	79	146
20	87.5	80	148
21	88.3	81	149
22	89.0	82	151
23	89.7	83	152
24	90.3	84	153
25	91.0	85	155
26	91.8	86	156
27	92.5	87	158
28	93.2	88	159
29	94.0	89	161
30	94.9	90	162
31	96.0	91	164
32	96	92	166
33	97	93	168
34	98	94	169
35	99	95	171
36	100	96	173
37	100	97	175
38	101	98	177
39	102	99	178
40	102	100	180
41	103	101	182
42	104	102	184
43	105	103	186
44	106	104	188
45	107	105	190
46	108	106	192
47	109	107	194
48	110	108	196
49	111	109	198
50	112	110	200
51	113	111	202
52	114	112	204
53	115	113	207
54	116	114	209
55	117	115	211
56	118	116	213
57	119	117	215
58	120	117.5	216.4
59	211	...	...

(Mulder, Scheik. Verhandel. 1864. 83.)

Sat. solution at b.-pt. contains 216.4 pts.  $\text{NaNO}_3$  (Mulder); 218.5 pts.  $\text{NaNO}_3$  (Marx); 213.4 pts.  $\text{NaNO}_3$  (Mauméné); 211.4 pts.  $\text{NaNO}_3$  (Nordenafjöld); 224.8 pts.  $\text{NaNO}_3$  (Legrand); 150 pts.  $\text{NaNO}_3$  (Griffiths).

Sat.  $\text{NaNO}_3 + \text{Aq}$  contains at:  
 120° 130° 172° 180° 199°  
 66.8 67.5 77.1 78.1 82.0%  $\text{NaNO}_3$ ,

220° 250° 255° 290° 313° (mpt.).  
 83.5 89.5 91.5 97.5 100%  $\text{NaNO}_3$ .  
 (Étard, A. ch. 1894, (7) 2. 527.)

100 g. sat.  $\text{NaNO}_3 + \text{Aq}$  contain 42.47 g.  $\text{NaNO}_3$  at 0°. (Coppadoro, Rass. Min. 1911, XVII, 35. 123.)

100 g. sat.  $\text{NaNO}_3 + \text{Aq}$  contain 49.16 g.  $\text{NaNO}_3$  at 30°. (Coppadoro, Rass. Min. 1912, 37. 7.)

100 g.  $\text{H}_2\text{O}$  dissolve 92.14 g.  $\text{NaNO}_3$  at 25°. (Haigh, J. Am. Chem. Soc. 1912, 34. 1148.)

The solubility of crystals on different faces has been determined by Lebrun. (Belg. Acad. Bull. 1913. 953.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at 19.5°.

% $\text{NaNO}_3$	Sp. gr.	% $\text{NaNO}_3$	Sp. gr.
12.067	1.0844	39.860	1.3176
22.726	1.1667	46.251	1.3805
31.987	1.2450	...	...

(Kremers, Pogg. 95. 120.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at 20.2°.

% $\text{NaNO}_3$	Sp. gr.	% $\text{NaNO}_3$	Sp. gr.
1	1.0065	26	1.1904
2	1.0131	27	1.1987
3	1.0197	28	1.2070
4	1.0264	29	1.2154
5	1.0332	30	1.2239
6	1.0399	31	1.2325
7	1.0468	32	1.2412
8	1.0537	33	1.2500
9	1.0606	34	1.2589
10	1.0676	35	1.2679
11	1.0746	36	1.2770
12	1.0817	37	1.2863
13	1.0889	38	1.2958
14	1.0962	39	1.3055
15	1.1035	40	1.3155
16	1.1109	41	1.3225
17	1.1184	42	1.3355
18	1.1260	43	1.3456
19	1.1338	44	1.3557
20	1.1418	45	1.3659
21	1.1498	46	1.3761
22	1.1578	47	1.3864
23	1.1659	48	1.3968
24	1.1740	49	1.4074
25	1.1822	50	1.4180

(Schiff, calculated by Gerlach, Z. anal. 8. 280.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at 18°.

% $\text{NaNO}_3$	Sp. gr.	% $\text{NaNO}_3$	Sp. gr.
5	1.0327	20	1.1435
10	1.0681	30	1.2278

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{NaNO}_3 + \text{Aq}$  at 20°, containing mols.  $\text{NaNO}_3$  in 100 mols.  $\text{H}_2\text{O}$ .

Mols. $\text{NaNO}_3$	Sp. gr.
2	1.05980
5	1.13813

(Nicol, Phil. Mag. (5) 16. 122.)

The saturated solution boils at 117.5°. (Mulder.)  
 " " " 118.9°. (Griffiths.)  
 " " " 119°. (Marx.)  
 " " " 118.4°. (Mauméné.)  
 " " " 119.7°. (Nordenafjöld.)  
 " " " 121°. (Legrand.)  
 " " " 122-123°. (Kremers.)

$\text{NaNO}_3 + \text{Aq}$  forms a crust at 118°, and contains 194 pts.  $\text{NaNO}_3$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed, 120.5°. (Gerlach, Z. anal. 26. 427.)

B.-pt. of  $\text{NaNO}_3 + \text{Aq}$  containing pts.  $\text{NaNO}_3$  to 100 pts.  $\text{H}_2\text{O}$ . G=according to Gerlach (Z. anal. 26. 433); L=according to Legrand (A. ch. (2) 59. 431).

B.-pt.	G	L	B.-pt.	G	L
101°	9	9.3	112°	121.5	120.3
102	18.5	18.7	113	133	131.3
103	28	28.2	114	144.5	142.4
104	38	37.9	115	156	153.7
105	48	47.7	116	168.5	165.2
106	58	57.6	117	181	176.8
107	68	67.7	118	194	188.6
108	78.5	77.9	119	207.5	200.5
109	89	88.3	120	222	212.6
110	99.5	98.8	121	...	224.8
111	110.5	109.5	...	...	...

50 pts.  $\text{NaNO}_3$  mixed with 100 pts. snow at -1° give a temp. of -17.5°. (Rüddorf, Pogg. 122. 337.)

#### Sp. gr. of $\text{NaNO}_3 + \text{Aq}$ at t°.

G. $\text{NaNO}_3$ dissolved in 100 g. $\text{H}_2\text{O}$	G. $\text{NaNO}_3$ in 100 g. of the solution	t°	Sp. gr.
4.166	4	17.8°	1.0276
11.111	10	13.9°	1.0704
25.000	20	12°	1.1441

(de Lannoy, Z. phys. Ch. 1895, 18. 465.)



Sp. gr. of  $\text{NaNO}_3 + \text{Aq}$  at  $20.1^\circ$ , when  $p$  = per cent strength of sol.;  $d$  = observed density;  $w$  = volume conc. in grams per cc. ( $\frac{pd}{100} = w$ )

$p$	$d$	$w$
42.05	1.3380	0.56267
35.65	1.2765	0.45510
31.72	1.2407	0.39365
23.24	1.1696	0.27180
17.370	1.1228	0.19505
11.915	1.0819	0.12888
9.665	1.0656	0.10300
7.039	1.0468	0.07369
4.241	1.0273	0.04357
1.589	1.0096	0.01604

(Barnes, J. phys. Chem. 1898, 2. 545.)

Sp. gr.  $20^\circ/4^\circ$  of a normal solution of  $\text{NaNO}_3$  = 1.05386; of a 0.5 normal solution = 1.02646. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of sat.  $\text{NaNO}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	G. $\text{NaNO}_3$ sol. in 100 g. $\text{H}_2\text{O}$	Sp. gr.
-10	68.0	1.342
0	43.0	1.358
10	80.5	1.377
20	88.0	1.387
30	96.2	1.406
40	104.9	1.418
50	114.0	1.437
60	124.6	1.456
70	136.0	1.467

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44. 1565.)

Sol. in 66 pts.  $\text{HNO}_3$ ; in 32 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $32^\circ$ ; in 4 pts.  $2\text{HNO}_3$ ,  $3\text{H}_2\text{O}$  at  $123^\circ$ . (Schultz, Zeit. Ch. (2) 5. 531.)

Solubility in  $\text{HNO}_3 + \text{Aq}$  at  $0^\circ$ .

G. per 100 cc. of solution		Sp. gr.
$\text{NaNO}_3$	$\text{HNO}_3$	
56.5	0.00	1.341
54.2	1.67	1.338
51.48	3.59	1.331
48.42	5.55	1.324
44.88	7.92	1.312
41.44	10.65	1.308
33.61	17.02	1.291
29.86	20.33	1.285
26.46	23.48	1.282
20.00	30.26	1.276
15.32	36.09	1.276
10.97	44.76	1.291

(Engel, C. R. 1887, 104. 911.)

Solubility of  $\text{NaNO}_3$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ .

G. per 100 g. $\text{H}_2\text{O}$		Sp. gr.
$\text{NH}_3$	$\text{NaNO}_3$	
13.87	75.03	1.253
17.28	73.99	1.233
20.38	73.18	1.212

(Fedotieff and Koltunoff, Z. anorg. 1914, 85. 251.)

$\text{NaNO}_3 + \text{Na}_2\text{CO}_3$ . (See  $\text{Na}_2\text{CO}_3$ .)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Very rapidly sol. in sat.  $\text{BaCl}_2 + \text{Aq}$  with pptn. of  $\text{Ba}(\text{NO}_3)_2$ .

Sol. in sat.  $\text{KCl} + \text{Aq}$ , with formation of  $\text{KNO}_3$ .

Sol. in sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (See  $\text{NH}_4\text{NO}_3$ .)

Sol. in sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$ , with partial pptn. of  $\text{Ba}(\text{NO}_3)_2$ . (See  $\text{Ba}(\text{NO}_3)_2$ .)

Sol. in sat.  $\text{Pb}(\text{NO}_3)_2 + \text{Aq}$ , with subsequent pptn. of  $\text{Pb}(\text{NO}_3)_2$ . (See  $\text{Pb}(\text{NO}_3)_2$ .)

$\text{NaNO}_3 + \text{KNO}_3$ .

Sol. in sat.  $\text{KNO}_3 + \text{Aq}$ ; solution thus made at  $18^\circ$  contains 54.33% mixed salt, or 100 pts.  $\text{H}_2\text{O}$  dissolve 118.98 pts. mixed salt, vis. 89.53 pts.  $\text{NaNO}_3$ , and 29.45 pts.  $\text{KNO}_3$ . (See  $\text{KNO}_3$ .)

$\text{NaNO}_3 + \text{Sr}(\text{NO}_3)_2$ .

If  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  sat. at  $14.5^\circ$  is sat. with  $\text{NaNO}_3$ , 100 pts.  $\text{H}_2\text{O}$  dissolve:

$\text{NaNO}_3$	83.7	66.4	....
$\text{Sr}(\text{NO}_3)_2$	....	51.0	62.0
		117.4	

(Mulder.)

$\text{NaNO}_3 + \text{NaNO}_2$ . See under  $\text{NaNO}_3$ .

$\text{NaNO}_3 + \text{NaCl}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 24.91 pts.  $\text{NaCl}$  + 54.55 pts.  $\text{NaNO}_3$  = 79.46 pts. of the two salts at  $20^\circ$ . (Nicol, Phil. Mag. (5) 31. 386.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $18.75^\circ$ :

	1	2	3	4	5	6
$\text{NaCl}$	36	25.22	24.96	24.98	....	24.6
$\text{NaNO}_3$	..	52.89	52.84	52.82	86.6	56.8

2. Sat.  $\text{NaCl} + \text{Aq}$  treated with  $\text{NaNO}_3$ .

3. Sat.  $\text{NaNO}_3 + \text{Aq}$  treated with  $\text{NaCl}$ .

4. Simultaneous treatment of the two salts by  $\text{H}_2\text{O}$ . (Karsten.)

6. Excess of both salts +  $\text{Aq}$  warmed and cooled to  $20^\circ$ . (Rüdorff, B. 6. 484.)

Solubility of NaCl with addition of  $\text{NaNO}_3$  at  $15.5^\circ$ .

Sp. gr.	100 ccm. contain in g.		
	NaCl	$\text{H}_2\text{O}$	$\text{NaNO}_3$
1.2025	31.78	88.47	0.00
1.2305	27.89	87.63	7.53
1.2580	26.31	86.25	13.24
1.2810	23.98	82.66	21.58
1.3090	22.30	80.42	28.18
1.3345	20.40	79.25	33.80
1.3465	19.40	77.37	37.88
1.3465	19.67	77.34	37.64

$\text{NaNO}_3$  separated in last two solutions.

Solubility of  $\text{NaNO}_3$  with addition of NaCl at  $15^\circ$ .

Sp. gr.	100 ccm. contain in g.		
	$\text{NaNO}_3$	$\text{H}_2\text{O}$	NaCl
1.3720	62.38	74.82	0
1.3645	56.56	75.69	4.00
1.3585	52.09	75.71	7.24
1.3530	47.08	76.86	11.36
1.3495	42.66	76.96	15.33
1.3485	39.90	77.14	17.81
1.3485	38.73	77.15	18.97
1.3485	38.02	77.49	19.34

NaCl separated in last two solutions.

(Bodländer, Z. phys. Ch. 7. 360.)

Solubility of  $\text{NaNO}_3$  in  $\text{NaCl} + \text{Aq}$  at  $15^\circ$ .

Sp. gr.	G. per 100 cc. sat. solution		
	NaCl	$\text{NaNO}_3$	$\text{H}_2\text{O}$
1.3720	0	62.38	74.82
1.3645	4.0	56.76	75.69
1.3585	7.24	52.09	75.71
1.3530	11.36	47.08	76.86
1.3495	15.33	42.66	76.96
1.3485	17.81	39.90	77.14
1.3485	18.97*	38.73*	77.15
1.3485	19.34*	38.02*	77.49

\* Solutions sat. with both salts.

(Bodländer, Z. phys. Ch. 1891, 7. 361.)

Solubility of  $\text{NaNO}_3 + \text{NaCl}$  (g. in 100 g.  $\text{H}_2\text{O}$ ) at  $25^\circ$ .

$\text{NaNO}_3$	NaCl	Solid phase
79.20	8.39	$\text{NaNO}_3$
68.38	16.32	"
56.56	23.74	$\text{NaNO}_3 + \text{NaCl}$
39.20	27.56	NaCl
20.17	31.48	"

(Uyeda, Mem. Col. Sc. Kyoto, 1910, 2. 245.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $20^\circ$ ,  $30^\circ$ ,  $40^\circ$  and  $91^\circ$ . Tables given in the original show that each salt diminishes the solubility of the other. (Leather, Mem. Dept. Agric. India, 1914, 3. 177; Chem. Soc. 1915, 106. (2) 13.)  
See also under NaCl.

$\text{NaNO}_3 + \text{NaOH}$ .

Solubility in  $\text{NaOH} + \text{Aq}$  at  $0^\circ$ .  $\text{NaNO}_3 =$  mols.  $\text{NaNO}_3$  (in mg.) in 10 ccm. of solution;  $\text{Na}_2\text{O} =$  mols.  $\text{Na}_2\text{O}$  (in mg.) in 10 ccm. of solution.

$\text{NaNO}_3$	$\text{Na}_2\text{O}$	$\text{NaNO}_3 + \text{Na}_2\text{O}$	Sp. gr.
66.4	0	66.4	1.341
62.5	2.875	65.375	1.338
57.15	6.1	63.25	1.333
47.5	12.75	60.25	1.327
29.5	26	55.5	1.326
17.5	39	56.5	1.332
13.19	45.875	59.065	1.356
6.05	60.875	66.925	1.401

(Engel, Bull. Soc. (3) 6. 16.)

Solubility in  $\text{NaOH} + \text{Aq}$  at  $0^\circ$ .

G. per 100 cc. solution		Sp. gr.
NaOH	$\text{NaNO}_3$	
0.0	56.50	1.341
2.30	53.19	1.338
4.89	48.63	1.333
10.21	40.42	1.327
20.83	25.10	1.326
31.25	14.89	1.332
36.76	11.22	1.356
48.75	5.15	1.401

(Engel, l. c.)

Easily sol. in  $\text{K}_2\text{SO}_4 + \text{Aq}$  without pptn.

Easily sol. in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  without pptn.

Sol. in  $\text{MgSO}_4 + \text{Aq}$ , at first to a clear solution, but afterwards  $\text{NaNO}_3$  is pptd.

Very sol. in sat.  $\text{CuSO}_4 + \text{Aq}$ , but double sulphate separates out.

Very sol. in  $\text{ZnSO}_4 + \text{Aq}$  with pptn. of double sulphate. (Karsten.)

Solubility of  $\text{NaNO}_3$  in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{NaNO}_3$	% $\text{Na}_2\text{S}_2\text{O}_3$	Solid phase
9	33.31	12.26	$\text{NaNO}_3$
	22.57	23.41	" + $\text{Na}_2\text{S}_2\text{O}_3$ , $5\text{H}_2\text{O}$
	4.22	34.77	$\text{Na}_2\text{S}_2\text{O}_3$ , $5\text{H}_2\text{O}$
25	35.42	12.72	$\text{NaNO}_3$
	25.40	24.25	"
	19.90	31.81	" + $\text{Na}_2\text{S}_2\text{O}_3$ , $5\text{H}_2\text{O}$
	18.02	32.83	$\text{Na}_2\text{S}_2\text{O}_3$ , $5\text{H}_2\text{O}$
	4.33	40.50	"

(Kremann and Rothmund, Z. anorg. 1914, 86. 373.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Easily sol. in liquid  $\text{HF}$ . (Franklin, Z. anorg. 1905, 46, 2.)

Hydrazine dissolves 26.6 pts.  $\text{NaNO}_3$  at  $12.5-13^\circ$ . (de Bruyn, R. t. c. 1899, 18, 297.)

100 pts. alcohol of 0.9 sp. gr. dissolve 10.5 pts.  $\text{NaNO}_3$ ; 0.872 sp. gr., 6 pts.; 0.834 sp. gr., 0.38 pt.; insol. in alcohol of 0.817 sp. gr. (Kirwan.)

100 pts. alcohol of 61.4% by weight dissolve 21.2 pts.  $\text{NaNO}_3$  at  $26^\circ$ . (Pohl, W. A. B. 6, 600.)

100 pts. alcohol of  $82^\circ$  Tr. dissolve 7.4 pts.  $\text{NaNO}_3$  at  $19.5^\circ$ .

100 pts. alcohol of  $93^\circ$  Tr. dissolve 0.93 pt.  $\text{NaNO}_3$  at  $19.5^\circ$ . (Wittstein.)

100 pts. alcohol containing % alcohol by weight dissolve pts.  $\text{NaNO}_3$  at  $15^\circ$ , or 100 pts. solution contain %  $\text{NaNO}_3$ :

	10	20	30	40	60	80% alcohol.
	65.3	48.8	35.5	25.8	11.4	2.8 pts. $\text{NaNO}_3$ .
	39.5	32.8	26.2	20.5	10.2	2.7% $\text{NaNO}_3$ .

(Schiff.)

100 pts. wood-spirit of 40% dissolve 32.3 pts.  $\text{NaNO}_3$ . (Schiff, A. 118, 365.)

#### Solubility in alcohol at $16.5^\circ$ .

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	$\text{NaNO}_3$
1.3745	0	75.25	62.20
1.3162	6.16	70.82	54.64
1.2576	11.60	68.10	46.06
1.2140	16.49	65.04	39.87
1.1615	22.17	61.67	32.31
1.0855	32.22	52.92	23.41
1.0558	37.23	48.50	19.85
1.0050	43.98	42.78	13.74
0.9420	52.60	32.13	9.47
0.9030	60.00	25.65	4.65
0.8610	63.16	21.31	1.63

(Bodländer, Z. phys. Ch. 7, 317.)

100 pts. absolute methyl alcohol dissolve 0.41 pt. at  $25^\circ$ .

100 pts. absolute ethyl alcohol dissolve 0.036 pt. at  $25^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)

#### Solubility in alcohol at $40^\circ$ .

Wt. % alcohol	G. $\text{NaNO}_3$ per 100 g. alcohol + Aq.
0	104.5
8.22	90.8
17.4	73.3
26.0	61.6
36.0	48.4
42.8	40.6
55.3	27.1
65.1	18.1
77.0	9.4
87.2	4.2

(Bathrick, J. phys. Ch. 1896, 1, 162.)

#### Solubility in alcohol at $30^\circ$ .

Wt. % alcohol in solvent	G. $\text{NaNO}_3$ per 100 g.	
	Solution	Water
0	49.10	96.45
5	46.41	91.15
10	43.50	85.55
20	37.42	74.75
30	31.31	65.10
40	25.14	55.95
50	18.94	46.75
60	12.97	37.25
70	7.81	28.25
90	1.21	12.25

(Taylor, J. phys. Ch. 1897, 1, 723.)

#### Solubility in ethyl alcohol at $25^\circ$ .

(Concentration of alcohol in g. mol. per 1000 g.  $\text{H}_2\text{O}$ .)

Normality	Solubility in 1000 g. $\text{H}_2\text{O}$	Mol. solubility
	920.30	10.83
$\frac{1}{2}$	908.80	10.70
$\frac{1}{2}$	896.60	10.54
1	870.95	10.24
2	825.35	9.70

(Armstrong and Eyre, Proc. R. Soc. 1910 (A), 84, 127.)

Very sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6, 184.)

#### Solubility of $\text{NaNO}_3$ in acetone at $40^\circ$ .

Wt. % acetone	G. $\text{NaNO}_3$ per 100 g. acetone + Aq.
0.0	105
8.47	91.2
16.8	78.3
25.2	66.4
34.3	57.9
44.1	46.2
53.9	32.8
64.8	23.0
76.0	10.8
87.6	3.2

(Bathrick, J. phys. Ch. 1896, 1, 162.)

Solubility of  $\text{NaNO}_3$  in acetone at  $30^\circ$ .

Wt. % acetone in solvent	G. $\text{NaNO}_3$ per 100 g.	
	Solution	Water
0	49.10	96.45
5	46.96	93.20
9.09	45.11	90.40
20	40.10	83.70
30	35.08	77.20
40	29.80	70.75
50	24.34	64.40
60	18.55	59.95
70	13.15	50.50
80	7.10	38.20
90	1.98	20.20

(Taylor, Z. phys. Ch. 1897, 2. 723.)

Sol. in glycerine.

Insol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 533.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sodium thorium nitrate,  $\text{NaTh}(\text{NO}_3)_4 + 9\text{H}_2\text{O}$ .Hydroscopic; sol. in dil.  $\text{HNO}_3$  and Aq. (Meyer, Z. anorg. 1901, 27. 381.)Sodium nitrate sulphate,  $\text{NaNO}_3, \text{Na}_2\text{SO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 12. 44.)  
+  $\text{H}_2\text{O}$ . Min. *Darapskils*.Sodium nitrate tungstosilicate,  $3\text{Na}_4\text{W}_{12}\text{SiO}_{40} \cdot 4\text{NaNO}_3 + 45\text{H}_2\text{O}$ .

(Wyruboff, Chem. Soc. 1897, 72. (2) 174.)

Strontium nitrate,  $\text{Sr}(\text{NO}_3)_2$ .Sol. in 5 pts. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}$ . (Dumas.)

" 2 " " 0.5 " " (Wittstein.)

" 2 " at  $18.75^\circ$ . (Abl.)100 pts. sat.  $\text{Sr}(\text{NO}_3)_2$  + Aq at  $19-20^\circ$  contain 45.49 pts.  $\text{Sr}(\text{NO}_3)_2$ . (v. Hauer, J. pr. 98. 137.)1 pt.  $\text{Sr}(\text{NO}_3)_2$  dissolves in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$
0	2.32	25	1.10	75	0.99
10	1.73	50	1.02	100	0.94

(Kremers, Pogg. 92. 499.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$ , 39.5 pts.  $\text{Sr}(\text{NO}_3)_2$  (Mulder); at  $0^\circ$ , 40.16 pts.  $\text{Sr}(\text{NO}_3)_2$  (Poggiale); at  $0^\circ$ , 43.1 pts.  $\text{Sr}(\text{NO}_3)_2$  (Kremers); at  $100^\circ$ , 101.1 pts.  $\text{Sr}(\text{NO}_3)_2$  (Mulder); at  $100^\circ$ , 106.5 pts.  $\text{Sr}(\text{NO}_3)_2$  (Kremers, Pogg. 92. 499); at  $100^\circ$ , 119.25 pts.  $\text{Sr}(\text{NO}_3)_2$  (Poggiale).

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Sr}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Sr}(\text{NO}_3)_2$	$t^\circ$	Pts. $\text{Sr}(\text{NO}_3)_2$
0	39.5	36	90.7	73	96.0
1	41.2	37	90.8	74	96.2
2	42.8	38	91.0	75	96.4
3	44.3	39	91.1	76	96.5
4	45.8	40	91.3	77	96.7
5	47.3	41	91.4	78	96.8
6	48.8	42	91.5	79	97.0
7	50.3	43	91.6	80	97.2
8	51.8	44	91.8	81	97.4
9	53.4	45	91.9	82	97.5
10	54.9	46	92.1	83	97.7
11	56.5	47	92.2	84	97.9
12	58.0	48	92.3	85	98.0
13	59.6	49	92.5	86	98.2
14	61.2	50	92.6	87	98.4
15	62.8	51	92.8	88	98.6
16	64.4	52	92.9	89	98.8
17	66.0	53	93.1	90	99.0
18	67.6	54	93.2	91	99.2
19	69.2	55	93.4	92	99.4
20	70.8	56	93.5	93	99.6
21	72.5	57	93.6	94	99.8
22	74.1	58	93.8	95	100.0
23	75.8	59	93.9	96	100.2
24	77.4	60	94.0	97	100.4
25	79.0	61	94.2	98	100.6
26	80.7	62	94.3	99	100.9
27	82.4	63	94.5	100	101.1
28	84.1	64	94.6	101	101.3
29	85.8	65	94.8	102	101.6
30	87.6	66	94.9	103	101.8
31	89.5	67	95.1	104	102.0
31.3	90.0	68	95.2	105	102.3
32	90.2	69	95.4	106	102.5
33	90.3	70	95.6	107	102.7
34	90.5	71	95.7	107.9	102.9
35	90.6	72	95.9	...	...

(Mulder, Scheik. Verhandel. 1864. 114.)

Sat.  $\text{Sr}(\text{NO}_3)_2$  + Aq contains at:

$-6^\circ$   $+14^\circ$   $20^\circ$   $32^\circ$   
24.5 35.9 39.8 46.9%  $\text{SrNO}_3$ ,

$53^\circ$   $56^\circ$   $76^\circ$   $94^\circ$   $110^\circ$   
47.2 47.8 49.1 50.4 50.2%  $\text{SrNO}_3$ .

(Étard, A. ch. 1894, (7) 2. 528.)

79.27 g. anhydrous  $\text{Sr}(\text{NO}_3)_2$  are sol. in 100 g.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Parsons and Carson, J. Am. Chem. Soc. 1910, 32. 1335.)

Solubility of  $\text{Sr}(\text{NO}_3)_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{Sr}(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$	Sp. gr.
0.58	40.124	1.2856
14.71	60.867	1.3938
26.40	82.052	1.4883
29.06	87.648	1.5110
30.28	88.577	1.5144
32.58	88.943	1.5141
39.74	90.086	1.5128
47.73	91.446	1.5115
61.34	93.856	1.5105
68.96	95.576	1.5106
78.98	97.865	1.5109
88.94	100.136	1.5117

(Berkeley and Appleby, Proc. R. Soc. 1911, (A) 85. 503.)

100 g. of the sat. solution contain at  $20^\circ$ , 41.43 g.  $\text{Sr}(\text{NO}_3)_2$ . (Findlay, Chem. Soc. 1914, 105. 782.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $19.5^\circ$ .

$\text{Sr}(\text{NO}_3)_2$	Sp. gr.	$\text{Sr}(\text{NO}_3)_2$	Sp. gr.
1	1.009	21	1.192
2	1.017	22	1.202
3	1.025	23	1.213
4	1.034	24	1.223
5	1.041	25	1.233
6	1.049	26	1.246
7	1.059	27	1.257
8	1.068	28	1.268
9	1.076	29	1.280
10	1.085	30	1.292
11	1.095	31	1.304
12	1.103	32	1.316
13	1.113	33	1.330
14	1.122	34	1.340
15	1.131	35	1.354
16	1.140	36	1.367
17	1.150	37	1.381
18	1.160	38	1.395
19	1.170	39	1.410
20	1.181	40	1.422

(Kremers, calculated by Gerlach, Z. anal. 8. 286.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $23.4^\circ$ . a=no. of grms.  $\times \frac{1}{2}$  mol. wt. dissolved in 1000 grms.  $\text{H}_2\text{O}$ ; b=sp. gr. if a is  $\text{Sr}(\text{NO}_3)_2$ ,  $4\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt. = 142; c=sp. gr. if a is  $\text{Sr}(\text{NO}_3)_2$ ,  $\frac{1}{2}$  mol. wt. = 106.

a	b	c	a	b	c
1	1.078	1.081	5	1.303	1.350
2	1.146	1.155	6	1.345	1.407
3	1.205	1.224	7	1.383	...
4	1.257	1.284	...	...	...

(Favre and Valsen, C. R. 79. 968.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $17.5^\circ$ .

% $\text{Sr}(\text{NO}_3)_2$	Sp. gr.	% $\text{Sr}(\text{NO}_3)_2$	Sp. gr.
10	1.083	40	1.422
20	1.180	Sat. sol.	1.52
30	1.294	....	....

(Gerlach, Z. anal. 27. 283.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{Sr}(\text{NO}_3)_2$	Sp. gr.
14.0°	5	1.0420
14.3°	10	1.0859
14.5°	15	1.1319
14.5°	20	1.1816
14.5°	25	1.2364
14.4°	34.33	1.3470

(Long, W. Ann. 1880, 11. 39.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

10.29 21.19 32.61%  $\text{Sr}(\text{NO}_3)_2$ .  
1.0885 1.124 1.3067

(Wagner, W. Ann. 1883, 18. 266.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0822
$\frac{1}{r}$ "	1.0419
$\frac{1}{r}$ "	1.0208
$\frac{1}{r}$ "	1.0104

(Wagner, Z. phys. Ch. 1890, 5. 40.)

$\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  containing 10.50%  $\text{Sr}(\text{NO}_3)_2$  has sp. gr  $20^\circ/20^\circ = 1.0905$ .

$\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  containing 25.51%  $\text{Sr}(\text{NO}_3)_2$  has sp. gr.  $20^\circ/20^\circ = 1.2440$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  at  $20^\circ$  containing M g. mols. of salt per liter.

M 0.01 0.025 0.05 0.075  
Sp. gr. 1.001525 1.004207 1.008391 1.012646

M 0.10 0.25 0.50 0.75  
Sp. gr. 1.018834 1.04201 1.08312 1.12386

M 1.00  
Sp. gr. 1.16354

(Jones and Pearce, Am. Ch. J. 1907, 38. 705.)

B.-pt. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$ , containing pts.  $\text{Sr}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{Sr}(\text{NO}_3)_2$	B.-pt.	Pts. $\text{Sr}(\text{NO}_3)_2$
100.5°	12	104°	81.4
101	24	104.5	89.6
101.5	34.8	105	97.6
102	45	105.5	105
102.5	54.4	106	112.2
103	63.6	106.3	116.5
103.5	72.6	...	...

(Gerlach, Z. anal. 26. 448.)

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  boils at 106.8°, and contains 112.9 pts. salt to 100 pts.  $\text{H}_2\text{O}$ . (Griffiths.)

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  boils at 107.5–108° (Kremers); 107.9° (Mulder).

Sat.  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  forms a crust at 106.3°, and contains 116.5 pts.  $\text{Sr}(\text{NO}_3)_2$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed was 107°. (Gerlach, Z. anal. 26. 427.)

Very sl. sol. in conc.  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Wurtz.)

Insol. in  $\text{HNO}_3 + \text{Aq}$ . (Schultz, Zeit. Ch. (2) 5. 537.)

Solubility in  $\text{Sr}(\text{OH})_2, 8\text{H}_2\text{O} + \text{Aq}$  at 25°.

Sp. gr. 25°/25°	G. $\text{Sr}(\text{OH})_2$ as $\text{Sr}(\text{OH})_2$ in 100 g. $\text{H}_2\text{O}$	G. $\text{Sr}(\text{NO}_3)_2$ in 100 g. $\text{H}_2\text{O}$
1.492	0.38	79.47
1.494	0.78	80.83

(Parsons, J. Am. Chem. Soc. 1910, 32. 1388.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1896, 20. 829.)

Sol. in 8500 pts. absolute alcohol. Sol. in 60,000 pts. of a mixture of 1 pt. ether and 1 pt. alcohol. (Rose, Pogg. 110. 296.)

Sol. in 4189 pts. abs. alcohol and in 199.87 pts. ordinary rectified spirits. (Hill, Pharm. J. 1888 (3) 19. 420.)

Solubility in ethyl alcohol + Aq at 25°.

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Sr}(\text{NO}_3)_2$ in the solution
99.4	99.38	0.02
79.2	77.15	2.60
59.9	53.6	10.5
40.65	32.35	20.5
20.6	13.8	33.2
18.8	12.35	34.3
16.25	10.45	35.7
15.05	9.5	36.7
10.0	6.0	40.05
6.0	3.45	42.7
0	0	46.6

$\text{Sr}(\text{NO}_3)_2$  is the solid phase in the solutions which are rich in alcohol;  $\text{Sr}(\text{NO}_3)_2 + 4\text{H}_2\text{O}$  in

the solutions which contain small amounts of alcohol.

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 39.)

Not completely insol. in boiling amyl alcohol, 30 ccm. dissolving about 1 mg. (Browning, Sill. Am. J. 143. 52.)

Perfectly anhydrous  $\text{Sr}(\text{NO}_3)_2$  is sol. in 83044 pts. absolute ether-alcohol (1:1). (Fresenius, Z. anal. 32. 190.)

Solubility in organic solvents.

Solvent	% $\text{Sr}(\text{NO}_3)_2$ in the solution at 25°
Methyl alcohol	1.26
Ethyl alcohol	0.02
Propyl alcohol	0.02
Isobutyl alcohol	0.01
Amyl alcohol	0.003
Acetone	0.02

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 44.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

The composition of the hydrates formed by  $\text{Sr}(\text{NO}_3)_2$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $\text{Sr}(\text{NO}_3)_2$ , and of the conductivity and sp. gr. of  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$ . (Jones, Am. Ch. J. 1905, 34. 305.)

$+4\text{H}_2\text{O}$ . Efflorescent.

Solubility in ethyl alcohol + Aq at 25°.

% $\text{C}_2\text{H}_5\text{OH}$ in the solvent	% $\text{C}_2\text{H}_5\text{OH}$ in the solution	% $\text{Sr}(\text{NO}_3)_2$ in the solution
0	0	44.25
4	1.7	42.8
6	2.6	42.1
10.8	4.95	40.4
16.0	7.95	37.6
20	12.35	34.3

(D'Ans and Siegler, Z. phys. Ch. 1913, 82. 39.)

Tellurium nitrate, basic,  $4\text{TeO}_3, \text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Very hygroscopic. Easily decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ , but more sol. when dil. than conc. (Klein and Morel, Bull. Soc. (2) 43. 205.)

Tellurium nitrate,  $\text{TeNO}_3$ .

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014.)

**Terbium nitrate**,  $\text{Tb}(\text{NO}_3)_3 \cdot 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Urbain, C. R. 1906, 146. 128.)

**Thallous nitrate**,  $\text{TlNO}_3$ .

1 pt.  $\text{TlNO}_3$  dissolves, according to C=Crookes; L=Lamy:

at 15°	18°	58°	107°
in 9.4	10.3	2.3	0.17 pts. $\text{H}_2\text{O}$ .
C	L	L	L

Sat.  $\text{TlNO}_3 + \text{Aq}$  contains at:

3.5°	18°	32°	58°	95°
4.2	8.8	13.2	30.4	74.5% $\text{TlNO}_3$

107°	135°	145°	150°	155°
85	95	95.2	96.5	97% $\text{TlNO}_3$ .

(Étard, A. ch. 1894, (7) 2. 527.)

Solubility in  $\text{H}_2\text{O}$  at 4°.

t°	G. $\text{TlNO}_3$ in 100 g. $\text{H}_2\text{O}$	g. mol. $\text{TlNO}_3$ in 1 l.
0	3.91	0.149
10	6.22	0.230
20	9.55	0.357
25	...	0.433
30	14.3	0.522
40	20.9	0.755
50	30.4	1.07
60	46.2	1.58
70	69.5	2.29
80	111	3.40
90	200	5.32
100	414	8.29
105	594	10.25

(Berkeley, Trans. Roy. Soc. 1904, 203. A, 211.)

Sp. gr. of  $\text{TlNO}_3 + \text{Aq}$  at 25°.

Concentration of $\text{TlNO}_3 + \text{Aq}$	Sp. gr.
$\frac{1}{2}$ -normal	1.0562
$\frac{1}{5}$ -"	1.0283

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Solubility of  $\text{TlNO}_3 + \text{KNO}_3$ . (See  $\text{KNO}_3$ .)

Insol. in alcohol. (Lamy.)

Sol. in acetone. (Eidmann, Dissert. 1899; Naumann, B. 1904, 37. 4328.)

**Thallous hydrogen nitrate**,  $\text{TlNO}_3, 2\text{HNO}_3$ .

(Wells, Am. Ch. J. 1901, 26. 273.)

$\text{TlNO}_3, 3\text{HNO}_3$ . (Ditte.)

**Thallic nitrate**,  $\text{Ti}(\text{NO}_3)_3 \cdot 3\text{H}_2\text{O}$ .

Effloresces in the air. (Meyer, Z. anorg. 1900, 24. 361.)

+6 $\text{H}_2\text{O}$ , or 8 $\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Thallous thallic nitrate**,  $2\text{TlNO}_3, \text{Ti}(\text{NO}_3)_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1901, 26. 278.)

**Thallous uranyl nitrate**,  $\text{Ti}(\text{UO}_2)(\text{NO}_3)_3$ .

Decomp. in moist air. Decomp. by  $\text{H}_2\text{O}$ . (Meyer, B. 1903, 36. 4058.)

**Thorium nitrate**,  $\text{ThO}_2, 2\text{N}_2\text{O}_5 + 6\text{H}_2\text{O}$ .

Crystallized. Sl. hygroscopic. (Fukse, Zeit. angew. Ch. 1897, 10. 116.)

+12 $\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$  and alcohol.

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Thorium zinc nitrate**,  $\text{ZnTh}(\text{NO}_3)_6 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3$ ; very hygroscopic. (Meyer, Z. anorg. 1901, 27. 386.)

**Thulium nitrate**,  $\text{Tm}_2(\text{NO}_3)_6 + 8\text{H}_2\text{O}$ .

Deliquescent. Can readily be cryst. from  $\text{HNO}_3$ . (James, J. Am. Chem. Soc. 1911, 33. 1344.)

**Tin (stannous) nitrate, basic**,  $2\text{SnO}, \text{N}_2\text{O}_5$ .

Difficultly sol. with partial decomp. in  $\text{H}_2\text{O}$ . (Weber, J. pr. (2), 26. 121.)

**Tin (stannous) nitrate**,  $\text{Sn}(\text{NO}_3)_2 + 20\text{H}_2\text{O}$ .

Deliquescent, and easily decomp. (Weber, J. pr. (2) 26. 121.)

**Tin (stannic) nitrate, basic**,  $4\text{SnO}_2, \text{N}_2\text{O}_5 + 4\text{H}_2\text{O}$ .

(Thomas, Bull. Soc. 1896 (3) 15. 312.)

**Tin (stannic) nitrate**,  $\text{Sn}(\text{NO}_3)_4$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. very soon on standing. Stable in presence of conc.  $\text{HNO}_3 + \text{Aq}$  at 90°, but decomp. at 100°. (Monte-martini, Gazz. ch. it. 23. 384.)

Insol. in moderately conc.  $\text{HNO}_3$ ; readily decomp. by  $\text{H}_2\text{O}$ . (Engel, C. R. 1897, 124. 710.)

**Titanium nitrate**,  $5\text{TiO}_2, \text{N}_2\text{O}_5 + 6\text{H}_2\text{O}$ .

Sol. to a slight milkiness in cold  $\text{H}_2\text{O}$ . Decomp. on boiling. (Merr, J. pr. 99. 157.)

**Uranyl nitrate, basic**.

Sol. in  $\text{H}_2\text{O}$ . (Ordway, Sill. Am. J. (2) 26. 209.)

**Uranyl nitrate**,  $\text{UO}_2(\text{NO}_3)_2$ .

+ $\text{H}_2\text{O}$ . (de Forcrand, C. R. 1913, 156. 1046.)

Sol. in fuming  $\text{HNO}_3$  from which it can be cryst.

+2 $\text{H}_2\text{O}$ . 52.39% is sol. in dry ether at 7°.

54.25% " " " " " 10°.

(Lebeau, Bull. Soc. 1911, (4) 2. 300.)

+2H<sub>2</sub>O. (Vasilieff, C. C. 1910, II. 1527.)  
 +3H<sub>2</sub>O. Mpt. 121.5°. (Vasilieff.)  
 Cryst. out of hot HNO<sub>3</sub>+Aq. (Ditte.)  
 100 pts. HNO<sub>3</sub> dissolve 39 pts. at 14°. (Ditte, A. ch. 1879, (5) 18. 337.)  
 +4H<sub>2</sub>O. (de Coninck, C. C. 1901, I. 1354.)  
 +6H<sub>2</sub>O. Deliquescent in moist, and efflorescent in dry air. Sol. in 0.5 pt. cold H<sub>2</sub>O, in 0.3 pt. absolute alcohol, and in 4.0 pts. ether. (Buchols.)  
 Melts in crystal H<sub>2</sub>O at 59.4°. (Ordway.)  
 1 pt. is sol. in 2 pts. H<sub>2</sub>O at 12.9°-14.2°. (de Coninck, C. R. 1900, 131. 1220.)

Solubility in H<sub>2</sub>O at t°.

t°	% by wt. UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub> · 6H <sub>2</sub> O
-18.1	54.90
-12.1	58.00
- 2.2	62.13
0	63.01
+12.3	67.36
25.6	72.83
36.7	78.05
45.2	82.96
71.8	86.32

(Vasilieff, J. Russ. Phys. Chem. Soc. 1910, 42. 570.)

Sp. gr. of (UO<sub>2</sub>)(NO<sub>3</sub>)<sub>2</sub>+Aq at t°.

t°	% salt	Sp. gr.
11.5	1	1.0049
12.4	2	1.0096
15.1	3	1.01401
14.1	4	1.0187
16.7	5	1.0230
14.1	6	1.0281
15.7	7	1.0236
15.2	8	1.0378
16.5	9	1.0410
15.2	10	1.0462
13.7	11	1.0504
11.5	12	1.0550
14.5	13	1.0594
11.3	14	1.0643
12.5	15	1.0680
13.2	16	1.0718

(de Coninck, C. R. 1900, 131. 1219.)

Sp. gr. of a sat. aq. solution = 1.7536 at 17°, containing 54.77% UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub>.

Sp. gr. = 1.0257 when 2.80% UO<sub>2</sub>(NO<sub>3</sub>)<sub>2</sub> is present. (Vassiliev, C. C. 1912, I, 1430.)

Sp. gr. of solution in HNO<sub>3</sub>+Aq.

Pts. of salt in 100 pts. HNO <sub>3</sub> sp. gr. 1.153	1	2	3	4	5
Temp.	11.0°	11.8°	11.8°	12.0°	11.6°
Sp. gr. of the solution	1.1585	1.1614	1.1663	1.1698	1.1751

(de Coninck, C. R. 1901, 132. 90.)

Sp. gr. of solution in H<sub>2</sub>SO<sub>4</sub>+Aq.

Pts. of salt in 100 pts. H <sub>2</sub> SO <sub>4</sub> sp. gr. 1.138	1 pt.	2 pts.	3 pts.	4 pts.	5 pts.
Temp.	11.2°	11.8°	10.7°	12.0°	11.4°
Sp. gr. of solution	1.1427	1.1450	1.1511	1.1540	1.1576

(de Coninck.)

Very sol. in dil. HBr and selenic acid (d = 1.4). Sol. in conc. H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, dil. HCl and less sol. in conc. HCl. (de Coninck, C. R. 1900, 131. 1220.)

## Sp. gr. of solution in HBr+Aq of sp. gr. 1.21.

Sp. gr.	% salt dissolved
1.2122	1
1.2168	2
1.2198	3
1.2250	4
1.2305	5

(de Coninck, Belg. Acad. Bull. 1901. 222.)

Insol. in KOH+Aq, NaOH+Aq or NH<sub>4</sub>OH+Aq. Sol. in lime water. (de Coninck, C. R. 1900, 131. 1220.)

Sl. attacked by liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 830.)

At 15°, uranyl nitrate is sol. in comm. methyl alcohol, dil. and conc. ethyl alcohol, propyl and isobutyl alcohol, comm. amyl alcohol, acetone, ether, ethyl acetate, dil. and conc. formic acid and dil. acetic acid; sl. sol. in comm. essence of terebenthine; insol. in benzene (cryst.), comm. toluene and xylene, ligroin, CHCl<sub>3</sub>, glycerine and CS<sub>2</sub>. (de Coninck, C. R. 1900, 131. 1220.)

1 pt. is sol. in 55 pts. methyl alcohol at ca. 11.8°.

1 pt. is sol. in 30 pts. ethyl alcohol (85°) at ca. 12.9°.

1 pt. is sol. in 65 pts. acetone at ca. 12.0°.

1 pt. is sol. in 5.6 pts. acetic acid (d = 1.035) at ca. 14.25°.

(de Coninck, C. R. 1900, 131. 1304.)

1 pt. sol. in 23.5 pts. methyl alcohol at 11.2°.

1 " " " 16.0 " ether " 11.9°.

1 " " " 18.4 " ethyl acetate " 10.3°.

1 " " " 5.3 " conc. formic acid at 15.1°.

(de Coninck, C. R. 1901, 132. 91.)

## Sp. gr. of solution in comm. methyl alcohol at t°.

t°	% salt	Sp. gr. referred to H <sub>2</sub> O
11	1	0.8902
12.9	2	0.8938
12.2	3	0.9003
10.7	4	0.9068
12.8	5	0.9108

(de Coninck, C. R. 1900, 131. 1304.)



Sp. gr. of solution in ethyl alcohol (85°) at t°.

$d_s$  = sp. gr. referred to alcohol.

$d_1$  = sp. gr. referred to  $H_2O$ .

t°	% salt	$d_1$	$d_s$
11.9	1	0.8918	1.0060
12.2	2	0.8979	1.0127
11.6	3	0.9023	1.0177
13.1	4	0.9056	1.0227
11.7	5	0.9131	1.0280

(de Coninck, C. R. 1900, 131. 1219.)

Sp. gr. of solution in acetic acid ( $d = 1.055$ ) at t°.

$d_1$  = sp. gr. referred to  $H_2O$ .

$d_s$  = sp. gr. referred to acetic acid.

t°	% salt	$d_1$	$d_s$
14.0	1	1.0387	1.0034
13.8	2	1.0434	1.0080
14.8	3	1.0469	1.0100
16.9	4	1.0505	1.0148
14.6	5	1.0564	1.0205
10.4	6	1.0626	1.0265
11.7	7	1.0662	1.0300

(de Coninck, C. R. 1900, 131. 1304.)

When excess of  $UO_2(NO_3)_2$  is shaken with ether at 7°, two layers are formed, the ether layer containing 59 g. salt per 100 g. solution and the aqueous layer 62.5 g. salt per 100 g. solution. (Lebeau, C. R. 1911, 152. 440.)

Sol. in nearly all proportions in glycerine. (Postans, Pharm. J. 1883, (3) 13. 752.)

Sol. in methyl acetate (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Sol. in acetone. (Eidmann, C. C. 1899. II, 1014; Naumann, B. 1904, 37. 4328.)

+18 $H_2O$ . Sat. aq. solution has  $D_{17}^{17} = 1.7536$ . (Vasilieff, J. Russ. phys. Chem. Soc. 1911, 43. 1183.)

**Uranyl nitrate ammonia,  $(UO_2)(NO_3)_2 \cdot 2NH_3$ .**

(v. Unruh, Dissert. 1909.)

$(UO_2)(NO_3)_2 \cdot 3NH_3$ . (v. Unruh.)

$(UO_2)(NO_3)_2 \cdot 4NH_3$ . (v. Unruh.)

**Uranyl nitrate phosphate,  $UO_2H_4(PO_4)_2 \cdot UO_2(NO_3)_2 \cdot 14H_2O$ .**

Easily sol. in warm  $H_2O$ , with gradual decomp. Easily sol. in  $HNO_3$ ,  $HCl$ , or  $H_2SO_4$  + Aq. Sol. in acetic acid with decomp. (Heintz, A. 151. 216.)

**Divanadyl nitrate (?)**.

Known only in solution. Decomp. on evaporation.

**Ytterbium nitrate, basic.**

Easily sol. in  $H_2O$ .

**Ytterbium nitrate.**

Very sol. in  $H_2O$ .

+3 $H_2O$ . Ppt. (Cleve, Z. anorg. 1902, 32. 140.)

+4 $H_2O$ . (Cleve.)

**Yttrium nitrate, basic,  $2Y_2O_3 \cdot 3N_2O_5 + 9H_2O$ .**

Deliquescent in moist air. Decomp. by cold or boiling  $H_2O$ . Sol. in a solution of yttrium nitrate without decomp. (Bahr and Bunsen, A. 137. 1.)

**Yttrium nitrate,  $Y(NO_3)_3 + 6H_2O$ .**

Easily sol. in  $H_2O$ , alcohol, or ether. (Cleve.)

141.6 grams are sol. in 100 grams  $H_2O$  at 25°. (James, J. Am. Chem. Soc. 1910, 32. 876.)

**Zinc nitrate, basic,  $8ZnO \cdot N_2O_5 + 2H_2O$ .**

Insol. in  $H_2O$ . (Grouvelle, A. ch. 19. 137.)

$6ZnO \cdot N_2O_5 + 8H_2O = Zn(NO_3)_2 \cdot 5Zn(OH)_2 + 3H_2O$ . (Bertels, J. B. 1784. 274.)

$5ZnO \cdot N_2O_5 + 5\frac{1}{2}H_2O$ . Insol. in cold, somewhat sol. in hot  $H_2O$ . (Havermann.)

+6 $H_2O$ . Slowly decomp. by cold  $H_2O$ . (Rousseau and Tite.)

$9ZnO \cdot 2N_2O_5$ . Decomp. by  $H_2O$ . (Vogel and Reischauer, N. Jahrb. Pharm. 11. 137.)

$4ZnO \cdot N_2O_5 + 2H_2O$ . (Schindler.)

+3 $H_2O$ . (Ordway, Sill. Am. J. (2) 32. 14; Gerhardt, J. Pharm. (3) 12. 61.)

Insol. in  $H_2O$ ; sol. in dil. acids. (Athanasco, Bull. Soc. 1896, 15. 1080.)

$2ZnO \cdot N_2O_5 + 3H_2O$ . Decomp. by  $H_2O$ , and slowly by alcohol. (Wells, Am. Ch. J. 9. 304.)

$7ZnO \cdot 4N_2O_5 + 14H_2O = 4Zn(NO_3)_2 \cdot 3Zn(OH)_2 + 11H_2O$ . (Bertels.)

**Zinc nitrate,  $Zn(NO_3)_2$ .**

Very deliquescent. Easily sol. in  $H_2O$  or alcohol.

Sp. gr. of  $Zn(NO_3)_2$  + Aq. F. = according to Franz (J. pr. (2) 6. 274) at 17.5°; O. = according to Oudemans (Z. anal. 7. 410) at 14°:

	5	10	15%Zn(NO <sub>3</sub> ) <sub>2</sub>	
F.	1.0496	1.0968	1.1476	
O.	1.0425	1.087	1.1355	
	20	25	30%Zn(NO <sub>3</sub> ) <sub>2</sub>	
F.	1.2024	1.2640	1.3268	
O.	1.1875	1.245	1.305	
	35	40	45	50%Zn(NO <sub>3</sub> ) <sub>2</sub>
F.	1.906	1.4572	1.5258	1.5984
O.	.....	.....	.....	.....

Calculated for  $Zn(NO_3)_2 + 6H_2O$ :

	10	20	30	40	50% salt.
	1.05361	1.1131	1.1782	1.2496	1.3292

(Oudemans.)

$Zn(NO_3)_2$  + Aq when heated soon decomposes, with formation of an insol. basic salt. (Ordway.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at room temp. containing:

15.955 30.626 44.5%  $\text{Zn}(\text{NO}_3)_2$ .  
1.1155 1.2291 1.4367

(Wagner, W. Ann. 1883, 18. 270.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 25°.

Concentration of $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$	Sp. gr.
1-normal	1.0758
$\frac{1}{2}$ " "	1.0404
$\frac{1}{3}$ " "	1.0191
$\frac{1}{4}$ " "	1.0096

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 16°.

$\frac{1}{2}$ $\text{Zn}(\text{NO}_3)_2$ g. per 1000 g. of solution	Sp. gr. 16°/16°
0.0000	1.000000
0.9950	1.000814
2.0061	1.001646
4.1535	1.003413
8.1824	1.006733
17.7760	1.014702
34.5920	1.028890
68.6780	1.058644

(Dijken, Z. phys. Ch. 1897, 24. 108.)

Sp. gr. of  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  at 17.3°, when p = per cent strength of solution; d = observed density; w = volume conc. in grams per cc.

$$\left(\frac{pd}{100} = w.\right)$$

p	d	w
47.28	1.5504	0.73310
41.32	1.4579	0.60240
30.86	1.3136	0.40535
29.21	1.2933	0.37780
19.65	1.1830	0.23246
14.39	1.1284	0.16232
11.36	1.0988	0.12478
7.091	1.0597	0.07515
5.923	1.0491	0.06213
1.574	1.0118	0.01593
1.210	1.0087	0.01221

(Barnes, J. Phys. Chem. 1898, 2. 545.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . 100 pts.  $\text{HNO}_3$  dissolve 28 pts. at 13°; 55 pts. at 55°. (Ditte, A. ch. 1879, (5) 18. 335.)

+  $2\text{H}_2\text{O}$ . (Vasilieff, C. C. 1909, II. 1966.)

+  $3\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

37° 40° 41° 43° 45.5° mpt.  
66.38 67.42 68.21 69.26 77.77%  $\text{Zn}(\text{NO}_3)_2$ .

(Funk, Z. anorg. 1899, 20. 401.)

+  $6\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

—18° —15° —13° —12°  
44.63 45.26 45.51 45.75%  $\text{Zn}(\text{NO}_3)_2$ .

0° +12.5° 18° 25°  
48.66 52.00 53.50 55.90%  $\text{Zn}(\text{NO}_3)_2$ .

36.4° (mpt.) 36° 33.5°  
63.63 64.73 65.83%  $\text{Zn}(\text{NO}_3)_2$ .

(Funk, Z. anorg. 1899, 20. 400.)

100 g.  $\text{Zn}(\text{NO}_3)_2 + \text{Aq}$  sat. at 0° contain 48.7 g.  $\text{Zn}(\text{NO}_3)_2$ ; at 18°, 53.5 g.  $\text{Zn}(\text{NO}_3)_2$ . (Mylius, Z. anorg. 1910, 74. 411.)

Melts in its crystal  $\text{H}_2\text{O}$  at 36.4° (Ordway), 50° (Pierre); boils at 131° (Ordway).

Sp. gr. of solution sat. at 18° = 1.664, and contains 53.9%  $\text{Zn}(\text{NO}_3)_2$ . (Mylius, B. 1897, 30. 1718.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

+  $9\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Sat. solution contains at:

—25° —22.5° —20° —18°  
40.12 40.75 42.03 43.59%  $\text{Zn}(\text{NO}_3)_2$ .

Cryohydrate is formed at —29°.

(Funk, Z. anorg. 1899, 20. 401.)

**Zinc nitrate ammonia,  $\text{Zn}(\text{NO}_3)_2 \cdot 4\text{NH}_3$ .**

Ppt. (Ephraim, B. 1915, 48. 638.)

+  $\frac{3}{2}\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (André, C. R. 100. 639.)

$13\text{ZnO}, 3\text{N}_2\text{O}_5, 2\text{NH}_3 + 18\text{H}_2\text{O}$ .

Insol. in cold, decomp. by warm  $\text{H}_2\text{O}$ . (André, C. R. 1885, 100. 640.)

**Zinc nitrate cupric oxide,**

$\text{Zn}(\text{NO}_3)_2 \cdot 3\text{CuO} + 3\text{H}_2\text{O}$ .

(Mailhe, A. ch. 1902, (7) 27. 169.)

**Zinc nitrate hydrazine,  $\text{Zn}(\text{NO}_3)_2 \cdot 3\text{N}_2\text{H}_4$ .**

Decomp. by hot  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH}$ . (Franzen, Z. anorg. 1908, 60. 279.)

**Zirconium nitrate, basic,  $3\text{ZrO}_2 \cdot 2\text{N}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ .

$\text{ZrO}_2 \cdot \text{N}_2\text{O}_5$ . Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

+  $\text{H}_2\text{O}$ . As above.

**Zirconium nitrate,  $\text{Zr}(\text{NO}_3)_4 + 5\text{H}_2\text{O}$  (?).**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Nitric oxide,  $\text{NO}$ .**

See Nitrogen dioxide.

**Nitrilobromosmic acid.**

**Ammonium nitrilopentabromosmate,**  
 $[\text{OsNBr}_5](\text{NH}_4)_2 + \text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$ . Decomp. in dil. aq. solution.

Stable in  $\text{HBr} + \text{Aq}.$

Insol. in organic solvents. (Werner, B. 1906, 39. 501.)

**Cæsium hydrogen nitrilopentabromosmate,**  
 $[\text{OsNBr}_5]_2\text{Cs}_2\text{H}.$

Sl. sol. in  $\text{H}_2\text{O}$ . (Werner.)

**Potassium nitrilotetrabromosmate,**  
 $[\text{OsNBr}_4]\text{K} + 2\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$ . Decomp. in aq. solution. Stable in  $\text{HBr} + \text{Aq}.$  Insol. in organic solvents. (Werner.)

**Rubidium nitrilopentabromosmate,**  
 $[\text{OsNBr}_5]\text{Rb}_2.$

Sol. in  $\text{H}_2\text{O}$ . Decomp. in dil. aq. solution after a short time. (Werner.)

**Nitrilochlorosmic acid.**

**Ammonium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)(\text{NH}_4)_2.$

Sol. in  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HCl} + \text{Aq}.$  (Werner, B. 1901, 34. 2702.)

**Cæsium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2\text{Cs}_2.$

Sol. in  $\text{H}_2\text{O}$ . (Werner.)

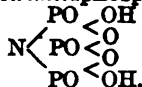
**Potassium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2\text{K}_2.$

Sol. in  $\text{H}_2\text{O}$ ; pptd. by  $\text{HCl}$ ; insol. in organic solvents. (Werner.)

**Rubidium nitrilopentachlorosmate,**  
 $(\text{OsNCl}_5)_2\text{Rb}_2.$

Sol. in  $\text{H}_2\text{O}$ ; decomp. in dil. neutral solution. (Werner.)

**Nitrilotrimetaphosphoric acid,  $\text{H}_2\text{NP}_3\text{O}_7 =$**



Known only in solution. (Mente, A. 248. 260.)

**Aluminum nitrilotrimetaphosphate.**

Insol. in  $\text{H}_2\text{O}$ , conc.  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}.$  Slowly sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . Sol. in warm  $\text{NaOH} + \text{Aq}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$  without decomp. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  (Mente.)

**Barium —,  $\text{BaNP}_3\text{O}_7.$**

Insol. in dil. or conc. acids. Decomp. by boiling  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}.$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  (Mente.)

**Cadmium nitrilotrimetaphosphate.**

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  or boiling  $(\text{NH}_4)_2\text{CO}_3$ , or  $\text{NaOH} + \text{Aq}.$  (Mente.)

**Calcium —,  $\text{CaNP}_3\text{O}_7 + \text{H}_2\text{O}.$**

Sol. in conc.  $\text{HCl} + \text{Aq}$  by long boiling, and more easily in fuming  $\text{HNO}_3 + \text{Aq}.$  Insol. in  $\text{NH}_4\text{OH}$  or  $\text{NaOH} + \text{Aq}.$  (Mente.)

**Chromium —.**

Slowly sol. in dil. acids. Easily sol. in ammonia. Sol. in cold  $\text{NaOH} + \text{Aq}.$  (Mente.)

**Cobalt —,  $\text{CoNP}_3\text{O}_7 + \text{H}_2\text{O}.$**

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in dil. acids. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  Decomp. by  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}.$  (Mente.)

**Copper —.**

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  Decomp. by  $\text{NaOH} + \text{Aq}.$  (Mente.)

**Ferric —,  $\text{Fe}_2(\text{NP}_3\text{O}_7)_2.$**

Insol. in conc. acids. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  Decomp. by  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}.$  (Mente.)

**Lead —.**

Insol. in dil. acids. Sol. in fuming  $\text{HNO}_3$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  Sol. in  $\text{NaOH} + \text{Aq}.$  (Mente.)

**Magnesium —,  $\text{MgNP}_3\text{O}_7 + \text{H}_2\text{O}.$**

Slowly sol. in  $\text{HCl} + \text{Aq}.$  Sol. in  $\text{H}_2\text{SO}_4$ , or fuming  $\text{HNO}_3$  with addition of  $\text{Br}_2$ . Insol. in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  (Mente.)

**Manganous —,  $\text{MnNP}_3\text{O}_7 + \text{H}_2\text{O}.$**

Insol. in dil. acids. Very sl. sol. in  $\text{NaOH} + \text{Aq}.$  Insol. in  $\text{Na}_2\text{CO}_3$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}.$  (Mente.)

**Mercurous —,  $\text{Hg}_2\text{NP}_3\text{O}_7.$**

Insol. in dil. acids,  $\text{NH}_4\text{OH}$ ,  $\text{NaOH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  Easily sol. in fuming  $\text{HNO}_3$ . (Mente.)

**Nickel —,  $\text{NiNP}_3\text{O}_7 + \text{H}_2\text{O}.$**

Insol. in dil. acids,  $\text{NH}_4\text{OH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  (Mente.)

**Zinc —,  $\text{ZnNP}_3\text{O}_7 + 2\text{H}_2\text{O}.$**

Easily sol. in  $\text{NH}_4\text{OH}$ ,  $\text{NaOH}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}.$  (Mente.)

**Nitrosulphonic acid,  $\text{N}(\text{SO}_3\text{H})_2.$**

Not known in free state. (Raschig, A. 241. 161.)

**Potassium nitrosulphonate,  $\text{N}(\text{SO}_3\text{K})_2 + 2\text{H}_2\text{O}.$**

Soluble in  $\text{H}_2\text{O}$ . (Raschig, A. 241. 161.)

Is identical with "potassium ammoniumsulphonate" of Claus.

Insol. in cold  $H_2O$  (Claus); sol. in 50 pts.  $H_2O$  at  $23^\circ$  (Fremy); in  $H_2O$  at scarcely  $40^\circ$  without change. Decomp. by boiling. (Claus.)

**Potassium sodium nitrilosulphonate**,  $N(SO_3K)_2(SO_3Na)$ .

Nearly insol. in cold  $H_2O$ . (Raschig, A. 241. 161.)

**Sodium nitrilosulphonate**,  $N(SO_3Na)_2$ .

Not isolated on account of its extreme solubility in  $H_2O$ . (Raschig, A. 241. 161.)

**Nitrilodisulphophosphoric acid**,  $NP(SH)_2$ .

Decomp. by  $H_2O$ . (Stock, B. 1906, 39. 2001.)

**Ammonium nitrilodisulphophosphate**,  $NP(SNH_2)_2$ .

Easily sol. in  $H_2O$ . Not decomp. by boiling with alkali. Decomp. by acid. (Stock.)

Easily sol. in liquid  $NH_3$ . (Stock, B. 1903, 36. 315.)

**Ammonium hydrogen nitrilodisulphophosphate**,  $SHP(SNH_2)N$ .

Not decomp. by boiling with alkali. Decomp. by acids. (Stock, B. 1906, 39. 1999.)

**Barium nitrilodisulphophosphate**,  $BaNP(S_2 + H_2O)$ .

Sol. in  $H_2O$  with decomp. Decomp. by hot  $H_2O$ . Not decomp. by warming with alkali. Decomp. by acid. (Stock.)

**Lead nitrilodisulphophosphate**,  $NPS_2Pb$ .

Sol. in liquid  $NH_3$ . Solution decomp. rapidly with separation of  $PbS$ . (Stock.)

**Sodium nitrilodisulphophosphate**,  $NPSNa_2$ .

Not decomp. by boiling with alkali. Decomp. by acid. (Stock.)

**Nitrilosulphuric acid**.

**Ammonium nitrilosulphate**,  $N(SO_2NH_2)_2 + 2H_2O$ .

Rather sl. sol. in  $H_2O$ , but much more sol. than K salt. (Divers and Haga, Chem. Soc. 1901, 79. 1094.)

**Sodium nitrilosulphate**,  $N(SO_2Na)_2 + 5H_2O$ .

Very sol. in  $H_2O$ . (Divers and Haga, Chem. Soc. 1901, 79. 1097.)

**Nitrilosulphurous acid**.

**Ammonium nitrilosulphite**,  $NH(SO_2NH_2)_2$ .

Somewhat deliquescent. Very sol. in  $H_2O$ . Slowly decomp. in solution. Decomp. by boiling with  $HCl$ . (Divers, Proc. Chem. Soc. 1901, 17. 163.)

**Nitritocobaltic chloride**.

Sol. in 200 pts. cold  $H_2O$ . (Jørgensen, Z. anorg. 5. 172.)

**Nitritoplatindiamine nitrate**,  $(NO_2)_2Pt(N_2H_5NO_2)_2$ .

Sol. in cold  $H_2O$  with decomp.; violently decomp. on warming. (Hadow, Chem. Soc. (2) 4. 345.)

**Nitritopurplecobaltic comps.**

See Xanthocobaltic comps.

**Nitritopurpleorhodium comps.**

See Xanthorhodium comps.

**Nitrocarbamic acid**.

**Potassium nitrocarbamate**,  $NO_2.NK$ . COOK.

Decomp. by  $H_2O$ . (Thiele, B. 1894, 27. 1909.)

**Nitro cobalt**,  $Co_2NO_2$ .

Decomp. by  $H_2O$ . (Sabatier and Senderens, C. R. 116. 236.)

**Nitro copper**,  $CuNO_2$ .

Violently decomp. by  $H_2O$ . (Sabatier and Senderens, C. R. 116. 756.)

**Nitroferriicyanhydric acid**.

See Nitroprussic acid.

**Nitrogen**,  $N_2$ .

Nearly insol. in all known solvents.

1 vol. recently boiled  $H_2O$  absorbs 0.0147 vol. N at  $15.5^\circ$ . (Henry, 1903.)

1 vol. recently boiled  $H_2O$  absorbs 0.025 vol. N. (Dalton.)

1 vol. recently boiled  $H_2O$  absorbs 0.0156 vol. N at ord. temp. (Dalton.)

1 vol.  $H_2O$  at  $t^\circ$  and 760 mm. absorbs V vols. N gas reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.02035	7	0.01713	14	0.01500
1	0.01981	8	0.01675	15	0.01478
2	0.01932	9	0.01640	16	0.01458
3	0.01884	10	0.01607	17	0.01441
4	0.01838	11	0.01577	18	0.01426
5	0.01794	12	0.01549	19	0.01413
6	0.01752	13	0.01523	20	0.01403

(Bunsen.)

Coefficient of absorption =  $0.020346 - 0.00053887t + 0.000011156t^2$ . (Bunsen.)

1 l.  $H_2O$  absorbs ccm. N from atmospheric air at 760 mm. pressure and  $t^\circ$ .

$t^\circ$	ccm. N	$t^\circ$	ccm. N
0	19.29	15	13.95
5	17.09	20	12.80
10	15.36	25	11.81

(Dittmar, Challenger Exped. Report, vol. i.)

$t^\circ$	ccm. N	$t^\circ$	ccm. N
0	19.14	15	13.73
5	16.93	20	12.63
10	15.14	25	11.80

(Hamberg, 1885.)

Absorption of N by  $H_2O$  at  $t^\circ$  and 760 mm.  
 $\beta$  = coefficient of absorption.

$t^\circ$	$\beta$	$t^\circ$	$\beta$	$t^\circ$	$\beta$
0	0.02388	18	0.01696	36	0.01252
1	2337	19	1667	37	1233
2	2288	20	1639	38	1215
3	2241	21	1611	39	1198
4	2196	22	1584	40	1182
5	2153	23	1557	41	1166
6	2111	24	1530	42	1151
7	2070	25	1504	43	1137
8	2031	26	1478	44	1124
9	1993	27	1453	45	1111
10	1956	28	1428	46	1099
11	1920	29	1404	47	1088
12	1885	30	1380	48	1078
13	1851	31	1357	49	1069
14	1818	32	1334	50	1061
15	1786	33	1312	60	1000
16	1755	34	1291	100	1000
17	1725	35	1271	...	...

(Bohr and Bock, W. Ann. 44. 318.)

Absorption of N by  $H_2O$  at  $t^\circ$  and 760 mm.  
 $\beta$  = coefficient of absorption;  $\beta_1$  = "Solubility" (see under Oxygen).

$t^\circ$	$\beta$	$\beta_1$
0	0.02348	0.02334
1	2291	2276
2	2236	2220
3	2182	2166
4	2130	2113
5	2081	2063
6	2032	2013
7	1986	1966
8	1941	1920
9	1898	1877
10	1857	1834
11	1819	1795
12	1782	1758
13	1747	1722
14	1714	1687

Absorption of N by  $H_2O$  at  $t^\circ$ .—Continued.

$t^\circ$	$\beta$	$\beta_1$
15	0.1682	0.1654
16	1651	1622
17	1622	1591
18	1594	1562
19	1567	1534
20	1542	1507
21	1519	1482
22	1496	1457
23	1473	1433
24	1452	1410
25	1432	1387
26	1411	1365
27	1392	1344
28	1374	1323
29	1356	1303
30	1340	1284
31	1321	1263
32	1304	1243
33	1287	1224
34	1270	1204
35	1254	1185
36	1239	1167
37	1224	1149
38	1210	1131
39	1196	1114
40	1183	1097
41	1171	1082
42	1160	1067
43	1149	1052
44	1139	1037
45	1129	1023
46	1120	1009
47	1111	0995
48	1102	0982
49	1094	0968
50	1087	0955
52	1072	0929
54	1058	0902
56	1045	0876
58	1033	0849
60	1022	0822
62	1011	0794
64	1001	0765
66	0992	0736
68	0983	0707
70	0976	0676
72	0970	0645
74	0965	0614
76	0961	0581
78	0959	0546
80	0957	0510
82	0956	0472
84	0955	0432
86	0954	0388
88	0953	0343
90	0952	0294
92	0951	0242
94	0950	0187
96	0949	0128
98	0948	0066
100	0947	0000

(Winkler, B. 24. 3606.)

Coefficient of absorption for  $H_2O = 0.01432$  at  $25^\circ$ ; 0.01621 at  $20^\circ$ ; 0.01789 at  $15^\circ$ ; 0.02003 at  $10^\circ$ ; 0.02173 at  $5^\circ$ . (Braun, Z. phys. Ch. 1900, 33. 730.)

Solubility in  $H_2O$  at various pressures.

V = volume of the absorbing liquid.

P = Hg-pressure in metres.

$\lambda$  = coefficient of solubility.

V	$t^\circ$	P	$\lambda$
33.134 ccm.	19.4	0.8910	0.01617
		1.0453	0.01616
		1.2488	0.01611
		1.4764	0.01608
		1.8111	0.01602
		2.3961	0.01597
		2.9074	0.01585
		3.3411	0.01579
		4.1382	0.01561
		4.5958	0.01554
32.152 ccm.	24.9	5.1103	0.01546
		5.8349	0.01528
		6.2767	0.01515
		7.1059	0.01499
		7.5815	0.01487
		8.1074	0.01473
		0.8977	0.01498
		1.0129	0.01493
		1.1887	0.01491
		1.5573	0.01487
		1.9846	0.01482
		2.5171	0.01478
		2.8781	0.01463
		3.2956	0.01455
		4.0947	0.01440
		4.5581	0.01434
		5.0529	0.01426
		5.5935	0.01413
		6.1956	0.01408
		7.0333	0.01382
		7.5596	0.01377
		74.1846	0.01369

(Cassuto, Phys. Zeit. 1904, 5. 236.)

Coefficient of absorption for  $H_2O = 0.01565$  at  $20.18^\circ$ . (Hüfner, Z. phys. Ch. 1907, 57. 615.)

Absorption of  $N_2$  by distilled  $H_2O$  at  $t^\circ$ .

$a$  = ccm. of  $N_2$  absorbed by 1 l. of  $H_2O$  at  $t^\circ$  and 760 mm.

$t^\circ$	$a$	$t^\circ$	$a$	$t^\circ$	$a$
0	23.00	17	16.29	34	12.93
1	22.50	18	16.03	35	12.79
2	22.02	19	15.78	36	12.65
3	21.55	20	15.54	37	12.52
4	21.09	21	15.29	38	12.39
5	20.64	22	15.06	39	12.27
6	20.20	23	14.84	40	12.15
7	19.77	24	14.63	41	12.04
8	19.35	25	14.43	42	11.92
9	18.94	26	14.23	43	11.80
10	18.54	27	14.04	44	11.68
11	18.16	28	13.87	45	11.57
12	17.80	29	13.71	46	11.46
13	17.46	30	13.55	47	11.35
14	17.14	31	13.39	48	11.24
15	16.84	32	13.23	49	11.13
16	16.56	33	13.08	50	11.02

(Fox, Trans. Faraday Soc. 1909, 5. 73.)

Solubility in  $H_2O$  at  $25^\circ = 0.1561$ . (Drucker and Moles, Z. phys. Ch. 1910, 75. 418.)

Solubility of  $N_2$  in  $H_2O$  at  $25^\circ = 0.0231$ . (Calculated according to special formula, for which see original article.) (Findlay and Creighton, Chem. Soc. 1911, 99. 1315.)

Coefficient of absorption for  $H_2O = 0.01689$  at  $15^\circ$ ; 0.01670 at  $16.2^\circ$ ; 0.01622 at  $17.2^\circ$ . (Müller, Z. phys. Ch. 1912, 81. 493.)

1 l. sea water (sp. gr. 1.027) absorbs ccm. N from atmosphere at  $t^\circ$  and 760 mm. pressure—

$t^\circ$	According to Törnøe	According to Dittmar	According to Hamburg
0	14.40	15.60	14.85
5	13.25	13.86	13.32
10	12.10	12.47	12.06
15	10.95	11.34	11.04
20	...	10.41	10.25
25	...	9.62	9.62

No. of ccm. of  $N_2$  (containing 1.185% argon) absorbed by 1 l. of sea-water from a free dry atmosphere of 760 mm. pressure at given temperatures.

Cl per 1000	$0^\circ$	$4^\circ$	$8^\circ$	$12^\circ$	$16^\circ$	$20^\circ$	$24^\circ$	$28^\circ$
0	18.64	17.02	15.63	14.45	13.45	12.50	11.86	11.25
4	17.77	16.27	14.98	13.88	12.94	12.15	11.46	10.89
8	16.90	15.51	14.32	13.30	12.44	11.70	11.07	10.52
12	16.03	14.75	13.66	12.72	11.93	11.25	10.67	10.16
16	15.18	14.00	13.00	12.15	11.73	10.81	10.27	9.80
20	14.31	13.24	12.34	11.57	10.92	10.36	9.87	9.44

(Fox, Trans. Faraday Soc. 1909, 5. 77.)

Absorption of  $N_2$  by  $H_2SO_4 + Aq$  at  $t^\circ$ .

$\alpha$  = coefficient of absorption.

Normality of the acid	$t^\circ$	$\alpha$
0	20.9	0.0156
4.9	20.9	0.0091
8.9	20.9	0.0072
10.7	21.2	0.0066
20.3	21.1	0.0049
24.8	21.5	0.0048
29.6	20.8	0.0051
34.3	20.9	0.0100
35.8	21.1	0.0129

(Bohr, Z. phys. Ch. 1910, 71. 49.)

Absorption of  $N_2$  by  $BaCl_2 + Aq$ .

$\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Per cent of $BaCl_2$ in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
13.830	0.00783	0.00923	0.01036	0.01166	0.01270
11.927	0.00855	0.00976	0.01139	0.01249	0.01368
6.903	0.01044	0.01184	0.01317	0.01474	0.01598
6.738	0.01036	0.01182	0.01340	0.01494	0.01628
3.870	0.01137	0.01323	0.01480	0.01660	0.01802
3.325	0.01190	0.01346	0.01502	0.01681	0.01826

(Braun, Z. phys. Ch. 1900, 33. 733.)

Absorption of  $N_2$  by  $NaCl + Aq$ .

$\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Per cent of $NaCl$ in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
11.732	0.00470	0.00857	0.00810	0.00930	0.01016
10.945	0.00565	0.00703	0.00824	0.00912	0.01052
8.135	0.00749	0.00872	0.01014	0.01131	0.01266
8.033	0.00729	0.00871	0.00995	0.01121	0.01248
6.595	0.00802	0.00972	0.01120	0.01252	0.01380
6.400	0.00826	0.00975	0.01134	0.01259	0.01375
4.196	0.00990	0.01151	0.01294	0.01451	0.01579
3.880	0.01005	0.01168	0.01316	0.01475	0.01615
2.120	0.01131	0.01311	0.01469	0.01638	0.01795
2.100	0.01133	0.01314	0.01467	0.01656	0.01805
0.686	0.01295	0.01477	0.01640	0.01833	0.01994
0.671	0.01304	0.01484	0.01642	0.01845	0.02000

(Braun, l. c.)

At  $-191.5^\circ$  liquid oxygen dissolves 458 times its vol. or 50.7 per cent of its weight of gaseous nitrogen. (Erdmann, B. 1904, 37. 1191.)

At  $18^\circ$  and 760 mm. 100 vols.  $H_2O$  or alcohol of 0.84 sp. gr. absorb 4.2 vols.  $N$  gas. (de Saussure, 1814.)

1 vol. alcohol at  $t^\circ$  and 760 mm. dissolves  $V$  vols.  $N$  gas reduced to  $0^\circ$  and 760 mm.

$t^\circ$	$V$	$t^\circ$	$V$
0	0.12634	13	0.12192
1	0.12593	14	0.12166
2	0.12553	15	0.12142
3	0.12514	16	0.12119
4	0.12476	17	0.12097
5	0.12440	18	0.12076
6	0.12405	19	0.12056
7	0.12371	20	0.12030
8	0.12338	21	0.12021
9	0.12306	22	0.12005
10	0.12276	23	0.11990
11	0.12247	24	0.11976
12	0.12219	..	...

(Bunsen's Gasometry.)

1 vol. alcohol absorbs  $0.126338 - 0.000418t + 0.0000060t^2$  vols.  $N$  gas. (Carius, A. 94. 136.)

Solubility in alcohol at  $25^\circ$ .

Vol. $H_2O$	Vol. % alcohol	Solubility
100	0	0.01634
80	20	0.01536
67	33	0.01719
0	100	0.1432

(Just, Z. phys. Ch. 1901, 37. 361.)

1 vol. ether absorbs 0.15 vol.  $N$  (Döbereiner); 1 vol. caoutchine absorbs 5 vols.  $N$  in 5 weeks (Himly).

Solubility of  $N_2$  in ether = 0.2580 at  $0^\circ$ ; 0.2561 at  $10^\circ$ . (Christoff, Z. phys. Ch. 1912, 79. 459.)

Solubility in organic solvents

Solvent	Solubility at $25^\circ C$ .	Solubility at $20^\circ C$ .	$\frac{ds}{dt}$
Glycerine	Not measurable		
Water	0.01634	0.01705	-0.000142
Aniline	0.09074	0.02992	+0.000164
Carbon bisulphide	0.05560	0.05290	+0.00114
Nitrobenzene	0.06255	0.06082	+0.000346
Benzene	0.1159	0.114	+0.0009
Glacial acetic acid	0.1190	0.1172	+0.00036
Xylene	0.1217	0.1185	+0.00062
Amyl alcohol	0.1225	0.1208	+0.00034
Toluene	0.1235	0.1186	+0.00098
Chloroform	0.1348	0.1282	+0.00132
Methyl alcohol	0.1415	0.1348	+0.00134
Ethyl alcohol (99.8%)	0.1432	0.1400	+0.00064
Acetone	0.1460	0.1393	+0.00154
Amyl acetate	0.1542	0.1512	+0.0006
Ethyl acetate	0.1727	0.1678	+0.00098
Isobutyl acetate	0.1734	0.1701	+0.00066

(Just, Z. phys. Ch. 1901, 37. 361.)

Coefficient of absorption for petroleum = 0.117 at  $20^\circ$ ; 0.135, at  $10^\circ$ . (Griewass and Walfisz, Z. phys. Ch. 1. 70.)

Absorption of  $N_2$  by propionic acid + Aq. $\alpha t^\circ$  = coefficient of absorption at  $t^\circ$ .

Per cent of propionic acid in the solution	$\alpha 25^\circ$	$\alpha 20^\circ$	$\alpha 15^\circ$	$\alpha 10^\circ$	$\alpha 5^\circ$
11.220	0.01301	0.01463	0.01593	0.01779	0.01951
11.023	0.01295	0.01447	0.01585	0.01800	0.01977
9.537	0.01336	0.01471	0.01634	0.01823	0.02040
9.155	0.01329	0.01469	0.01630	0.01845	0.02026
6.066	0.01335	0.01478	0.01637	0.01855	0.02077
5.891	0.01338	0.01480	0.01648	0.01872	0.02089
4.081	0.01365	0.01541	0.01683	0.01919	0.02095
3.816	0.01371	0.01547	0.01674	0.01915	0.02067

(Braun, Z. phys. Ch. 1900, 33. 732.)

Solubility of  $N_2$  in isobutyric acid + Aq at  $t^\circ$ .P = Corrected pressure at end of experiment in mm. Hg at  $0^\circ$ .S = Solubility of  $N_2$ .

Solvent	$t^\circ$	P	S
Pure isobutyric acid	25.05	262.6	0.1609(?)
		388.3	0.1640
		566.1	0.1647
		662.4	0.1656
		785.5	0.1656
37.5% solution of isobutyric acid + Aq	23.02	832.2	0.1656
		246.2	0.0393
		492.2	0.0393
		563.6	0.0393
Vapor pressure = 21.6 mm.		836.3	0.0400
		867.3	0.0401
" Vapor pressure = 30.6 mm.	29.02	231	0.0373
		468.4	0.0384
		480.7	0.0383
		536	0.0385
		656	0.0384
		720	0.0386

(Drucker and Moles, Z. phys. Ch. 1910, 75. 434.)

Absorption of  $N_2$  by chloralhydrate + Aq. $t^\circ$  = temp. of the solution.

P = % chloralhydrate in the solution.

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ . $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
15.6	15.8	0.01574	0.01580
15.4	28.2	0.01418	0.01422
16.4	37.25	0.01288	0.01300
16.9	47.0	0.01260	0.01275
17.0	56.52	0.01230	0.01245
15.3	71.5	0.01415	0.01420
14.8	78.8	0.01447	0.01495

(Müller, Z. phys. Ch. 1912, 81. 499.)

Absorption of  $N_2$  by organic substances + Aq at  $15^\circ$ .

P = % of the organic substance in the solvent.

 $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ . $S 15^\circ$  = Solubility at  $15^\circ$ .

Organic substance used	P	$\beta 15^\circ$	$S 15^\circ$
Chloralhydrate	0	0.01725	
	0	0.01675	0.01796
	0	0.01706	
	6.9	0.0164	0.0173
	14.0	0.0154	0.0162
	15.0	0.0152	0.0160
	23.6	0.0134	0.0141
	26.1	0.0141	0.0149
	37.6	0.0123	0.0130
	48.9	0.0115	0.0121
	49.3	0.0118	0.0124
	61.3	0.0114	0.0120
	70.9	0.0131	0.0138
	71.2	0.0130	0.0137
	78.3	0.0152	0.0160
	79.1	0.0156	0.0165
Glycerine	0	0.01707	
	0	0.01708	
	15.7	0.01425	
	15.7	0.01376	
	29.9	0.01087	
	46.6	0.00840	
	57.6	0.00698	
	67.1	0.00635	
	72.8	0.00552	
	74.7	0.00597	
	77.0	0.00527	
	85.1	0.00482	
	87.3	0.00492	
	88.5	0.00536	
	99.25	0.00524	

(Hammel, Z. phys. Ch. 1915, 90. 121.)

Absorption of  $N_2$  by glycerine + Aq. $t^\circ$  = temp. of the solution.

P = % glycerine in the solution.

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ . $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
16.1	25.0	0.01240	0.01266
15.6	42.2	0.00966	0.00976
14.7	51.5	0.00759	0.00759
14.9	58.0	0.00703	0.00703
15.9	80.25	0.00520	0.00530
16.2	90.0	0.00570	0.00583
18.0	95.0	0.00578	0.00716

(Müller, Z. phys. Ch. 1912, 81. 496.)



Solubility of  $N_2$  in glycerine + Aq at  $25^\circ$ .  
 $G$  = % by wt. of glycerine in the solvent.  
 $S$  = solubility of  $N_2$ .  
 $P$  = corrected pressure at end of experiment in mm. Hg at  $0^\circ$ .

G	P	S
16	598.4	0.0103
"	915.5	0.0103
29.7	556.5	0.0067
"	846.5	0.0068
48.9	617.7	0.0052
"	859.8	0.0051
74.5	558.5	0.0025
84.1	637.3	0.0024
"	757.0	0.0024

(Drucker and Moles, Z. phys. Ch. 1910, 75. 418.)

Absorption of  $N_2$  by sucrose + Aq.  
 $t^\circ$  = temp. of the solution.  
 $P$  = % sucrose in the solution.  
 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ .  
 $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
16.2		0.01670	0.01700
17.2		0.01622	0.01688
16.8	11.38	0.01432	0.01480
16.9	20.00	0.01233	0.01280
17	29.93	0.01025	0.01053
17.8	30.12	0.01033	0.01090
18	47.89	0.00742	0.00785
17.7	48.57	0.00658	0.00700

(Müller, Z. phys. Ch. 1912, 81. 493.)

Absorption of  $N_2$  by organic substances + Aq at  $t^\circ$ .

$V$  = absorbed volume reduced to  $0^\circ$  and 760 mm.

$a$  = coefficient of absorption.

Solution	Vol. of solution ccm.	$t^\circ$	V ccm.	$a$
N-dextrose	409.94	20.18	4.55	0.01215
$\frac{1}{2}$ N-dextrose	409.94	20.21	5.14	0.01380
$\frac{1}{4}$ N-dextrose	409.94	20.2	5.51	0.01480
N-levulose	409.94	20.25	4.27	0.01221
N-arabinose	409.94	20.21	4.40	0.01203
N-erythritol	409.94	20.25	4.87	0.01321
N-alanine	409.94	20.19	4.445	0.01213
N-glycocoll	409.94	20.16	4.47	0.01212
N-urea	409.94	20.18	5.37	0.01477
N-acetamide	409.94	20.22	5.385	0.01475

(Hüfner, Z. phys. Ch. 1907, 57. 618-621.)

**Nitrogen bromide,  $NBr_3$ .**

Decomp. under  $H_2O$ .

**Nitrogen bromophosphide,  $PBr_2N$ .**

Insol. in  $H_2O$ . Sol. in ether, less sol. in  $CS_2$  or  $CHCl_3$ . (Beeson, C. R. 114. 1479.)

**Nitrogen bromosulphide.**

See Nitrogen sulphobromide.

**Nitrogen chloride,  $NCl_3$ .**

Very unstable. Explodes when heated to  $93^\circ$  or by contact with other substances. Insol. in  $H_2O$ , but is decomp. thereby (in 24 hours by cold  $H_2O$ ). Sol. in  $CS_2$ ,  $PCl_5$ , and  $S_2Cl_2$ . (H. Davy, Phil. Trans. 1813, 1. 242.) Sol. in  $C_6H_6$ ,  $CS_2$ ,  $CHCl_3$ ,  $CCl_4$ . (Hentschel B. 1897, 30. 1434.)

**Nitrogen chlorophosphide,  $N_2P_2Cl_4$ .**

Insol. in  $H_2O$ , but slowly decomp. thereby. Insol. in hot  $H_2SO_4$ ,  $HCl$ , or  $HNO_3$  + Aq. Decomp. by hot fuming  $HNO_3$ . Sol. in alcohol; very sol. in ether, but these solutions gradually decompose. Sol. in  $CS_2$ ,  $CHCl_3$ ,  $C_6H_6$ , and oil of turpentine.

Sol. in  $POCl_3$ . (Gladstone, Chem. Soc. 3. 138.)

**Nitrogen chlorosulphide.**

See Nitrogen sulphochloride.

**Nitrogen fluoride.**

Very explosive. (Warren, C. N. 55. 289.)

**Nitrogen monoiodamine,  $NH_2I$ .**

Very rapidly decomp. by  $H_2O$  into  $N_2H_4I_2$ . (Raschig, A. 230. 212.)

**Nitrogen diiodamine,  $NHI_2$ .**

Properties as triioddiamine.

**Nitrogen triioddiamine,  $NH_3I_3$ ,  $NI_3$ .**

Decomp. by  $H_2O$ . (Raschig, A. 230. 212.) Insol. in absolute alcohol. Sol. with decomp. in  $HCl$  + Aq. (Bunsen.)

**Nitrogen iodide,  $N_2I_2$ .**

See Triaziodide.

**Nitrogen iodide,  $NI_3$ .**

Insol. in  $H_2O$ , but slowly decomp. thereby. Sol. in  $HCl$  + Aq. Sol. in  $KCN$  + Aq. (Milton, J. pr. 17. 1.)

Sol. in  $Na_2S_2O_3$  + Aq. (Guyard, C. R. 97. 526.)

Sol. in  $KSCN$  + Aq. (Raschig, A. 230. 212.)

**Nitrogen iodide ammonia,  $NI_3 \cdot 3NH_3$ ;  $NI_3 \cdot 2NH_3$ ; and  $NI_3 \cdot NH_3$ .**

(Hugot, C. R. 1900, 130. 507.)  $NI_3 \cdot 12NH_3$ . Ppt.; insol. in ether. (Ruff, B. 1900, 33. 3028.)

**Nitrogen monoxide,  $N_2O$ .**

- (a.) *Liquid.* Miscible with alcohol or ether.  
 (b.) *Gas.*

1 vol.  $H_2O$  absorbs 0.78–0.86 vol.  $N_2O$  at ordinary temp. (Henry); 0.80 vol. at ordinary temp. (Dalton); 0.76 vol. at ordinary temp. (de Saussure); 0.708 vol. at 18° (Pfeisch); 0.54 vol. (Davy).

1 vol.  $H_2O$  at  $t^\circ$  and 760 mm. absorbs  $V$  vols.  $N_2O$ , reduced to  $0^\circ$  and 760 mm.

$t^\circ$	$V$	$t^\circ$	$V$
0	1.3052	13	0.8304
1	1.2605	14	0.8034
2	1.2172	15	0.7778
3	1.1752	16	0.7535
4	1.1346	17	0.7306
5	1.0954	18	0.7090
6	1.0575	19	0.6898
7	1.0210	20	0.6700
8	0.9858	21	0.6525
9	0.9520	22	0.6364
10	0.9196	23	0.6216
11	0.8885	24	0.6082
12	0.8588	..	...

**(Bunsen's Gasometry.)**

1 vol.  $H_2O$  absorbs 1.30521–0.0453620 $t^\circ$  + 0.00068430 $t^2$  vols.  $N_2O$  at  $t^\circ$  and 760 mm. (Bunsen.)

Coefficient of absorption by  $H_2O$  = 0.01883 at 15°. (Steiner, Z. phys. Ch. 1895, 18. 14.)

Coefficient of absorption by  $H_2O$  = 0.600 at 23.5°; 0.773 at 15.5°; 0.951 at 8.1°. (Gordon, Z. phys. Ch. 1895, 18. 4.)

**Absorption of  $N_2O$  by  $H_2O$  at  $t^\circ$ .**

$t^\circ$	Coefficient of absorption
25	0.5752
20	0.6654
15	0.7896
10	0.9479
5	1.1403

**(Roth, Z. phys. Ch. 1897, 24. 123.)**

Solubility in  $H_2O$  at 25° = 0.5942; at 20° = 0.6756; at 15° = 0.7784; at 10° = 0.9101; at 5° = 1.067. (For formula for "solubility," see under oxygen.) (Geffcken, Z. phys. Ch. 1904, 49. 278.)

Solubility of  $N_2O$  in  $H_2O$  = 0.592 at 25° and 758–1362 mm. pressure. (Findlay and Creighton, Chem. Soc. 1910, 97. 538.)

100 vols.  $H_2SO_4$  (sp. gr. = 1.84) absorb 75.7 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.80) absorb 66.0 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.705) absorb 39.1 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.45) absorb 41.6 vols.  $N_2O$ ; 100 vols.  $H_2SO_4$  + Aq (sp. gr. = 1.25) absorb 33.0 vols.  $N_2O$ .

$CaCl_2$  + Aq, and  $NaCl$  + Aq absorb considerable amounts of  $N_2O$ . (Lunge, B. 14. 2188.)

**Absorption by acids + Aq.**

$M$  = content in gram-equivalents per liter.  
 $S$  = solubility (see under Oxygen).

**Absorption of  $N_2O$  by  $HNO_3$  + Aq.**

$M$	$S$ 25°	$S$ 15°
0.610	0.5969	0.7770
0.614	0.5980	0.7766
1.253	0.6045	0.7767
1.254	0.6061	0.7767
2.405	0.6156	0.7735
2.435	0.6149	0.7737

(Geffcken, Z. phys. Ch. 1904, 49. 278.)

**Absorption of  $N_2O$  by  $HCl$  + Aq.**

$M$	$S$ 25°	$S$ 15°
0.549	0.5775	0.7550
0.550	0.5759	0.7528
1.089	0.5670	0.7360
1.093	0.5657	0.7347
2.300	0.5546	0.7103
2.340	0.5564	0.7122

(Geffcken.)

**Absorption of  $N_2O$  by  $\frac{H_2SO_4}{2}$  + Aq.**

$M$	$S$ 25°	$S$ 15°
0.523	0.5648	0.7328
0.528	0.5657	0.7340
1.050	0.5426	0.6997
1.054	0.5419	0.6984
2.042	0.5083	0.6440
2.047	0.5087	0.6428
2.971	0.4819	0.6024
2.963	0.4820	0.6030
3.897	0.4569	0.5648
3.973	0.4577	0.5640

(Geffcken.)

**Absorption of  $N_2O$  by  $H_3PO_4$  + Aq at  $t^\circ$ .**

$t^\circ$	% of $H_3PO_4$				
	3.38%	4.72%	8.84%	9.89%	13.35%
5	1.057	1.0365	0.9883	0.9635	0.9171
10	0.8827	0.8665	0.8296	0.8101	0.7711
15	0.7388	0.7258	0.6977	0.6826	0.6505
20	0.6253	0.6147	0.5926	0.5810	0.5555
25	0.5427	0.5329	0.5143	0.5054	0.4860

(Roth, Z. phys. Ch. 1897, 24. 134.)

100 vols. conc.  $FeSO_4$  + Aq absorb 19.5 vols.  $N_2O$ .

Solubility of  $N_2O$  in a solution containing 47.7 g.  $Fe(OH)_3$  per litre at 25° = 0.5799; 47.9 g.  $Fe(OH)_3$  per litre at 25° = 0.5787. (Geffcken, Z. phys. Ch. 1904, 49. 299.)

100 vols. KOH+Aq (sp. gr. = 1.12) absorb 18.7 vols.  $N_2O$ ; 100 vols. KOH+Aq sat. with pyrogallol absorb 18.1 vols.  $N_2O$ ; 100 vols. NaOH+Aq (sp. gr. = 1.1) (7% NaOH) absorb 23.1 vols.  $N_2O$ ; 100 vols. NaOH+Aq sat. with pyrogallol absorb 28.0 vols.  $N_2O$ .

Absorption of  $N_2O$  by KOH+Aq.

M = content in gram-equivalents per litre.

S = solubility (see under oxygen).

M	S 25°	S 15°
0.541	0.5087	0.6591
0.542	0.5093	0.6595
1.074	0.4252	0.5427
1.082	0.4221	0.5392

(Geffcken, Z. phys. Ch. 1904, 49. 278.)

Coefficient of solubility of  $N_2O$  in salts+Aq at t°.

Salt	Concentration of salt		Coeff. of absorption at			
	G. per 100 g. solution	G. mol. per l.	5°	10°	15°	20°
CaCl <sub>2</sub>	5.79	0.547	0.819	0.697	0.591	0.500
	9.86	0.964	0.608	0.586	0.509	0.435
	13.99	1.416	0.510	0.441	0.380	0.328
LiCl	1.35	0.319	0.986	0.831	0.700	0.599
	3.85	0.928	0.878	0.743	0.629	0.536
	11.48	2.883	0.606	0.512	0.437	0.382
Li <sub>2</sub> SO <sub>4</sub>	2.37	0.219	0.934	0.792	0.670	0.569
	5.46	0.521	0.795	0.665	0.557	0.474
	8.56	0.836	0.646	0.555	0.477	0.415
MgSO <sub>4</sub>	5.90	0.521	0.766	0.664	0.561	0.471
	7.66	0.687	0.708	0.586	0.486	0.414
	10.78	0.997	0.569	0.491	0.417	0.346
KCl	4.90	0.676	0.879	0.751	0.643	0.555
	7.64	1.037	0.799	0.693	0.591	0.494
	14.58	2.187	0.654	0.574	0.500	0.430
	22.08	3.414	0.544	0.459	0.390	0.339
K <sub>2</sub> SO <sub>4</sub>	2.62	0.154	0.986	0.831	0.701	0.605
	4.78	0.285	0.918	0.763	0.637	0.542
NaCl	6.20	1.107	0.800	0.682	0.585	0.509
	8.88	1.614	0.713	0.603	0.510	0.434
	12.78	2.391	0.634	0.532	0.449	0.386
Na <sub>2</sub> SO <sub>4</sub>	5.76	0.427	0.808	0.677	0.584	0.495
	8.53	0.646	0.692	0.574	0.482	0.416
	12.44	0.974	0.559	0.486	0.417	0.354
SrCl <sub>2</sub>	3.31	0.215	0.928	0.788	0.671	0.578
	5.73	0.380	0.848	0.709	0.610	0.556
	13.24	0.939	0.644	0.547	0.463	0.390

(Gordon, Z. phys. Ch. 1895, 18. 5.)

Absorption of  $N_2O$  by salts+Aq at 15°. M = number of molecules of salt per litre. a = coefficient of absorption.

Salt	M	a
KCl	3.554	0.0892
	2.909	0.1012
	1.755	0.1279
	1.051	0.1489
	0.526	0.1667
KNO <sub>3</sub>	2.430	0.1180
	1.820	0.1311
	1.541	0.1391
	0.879	0.1559
	0.482	0.1683
K <sub>2</sub> CO <sub>3</sub>	4.352	0.0160
	2.939	0.0285
	2.156	0.0462
	1.376	0.0761
	0.690	0.1183
	0.341	0.1501
	0.209	0.1628
NaCl	4.815	0.0595
	2.801	0.0925
	2.049	0.1130
	0.825	0.1548
NaNO <sub>2</sub>	5.711	0.0578
	3.980	0.0810
	2.656	0.1052
	1.413	0.1370
Na <sub>2</sub> CO <sub>3</sub>	0.679	0.1603
	1.218	0.0839
	0.819	0.1082
	0.438	0.1385
Na <sub>2</sub> SO <sub>4</sub>	0.207	0.1639
	1.364	0.0775
	0.638	0.1254
LiCl	0.335	0.1519
	3.734	0.0990
	1.800	0.1370
MgSO <sub>4</sub>	0.835	0.1619
	2.501	0.0499
	1.631	0.0797
	0.936	0.1159
ZnSO <sub>4</sub>	0.433	0.1501
	2.180	0.0605
	1.277	0.0961
	0.899	0.1175
CaCl <sub>2</sub>	0.397	0.1525
	2.962	0.0519
	2.556	0.0619
	1.827	0.0839
	1.122	0.1138
	0.578	0.1450
	0.321	0.1619

(Steiner, Z. phys. Ch. 1895, 18. 14-5.)

Coefficient of absorption of  $N_2O$  by  $NaCl + Aq$  at  $t^\circ$ .

$t^\circ$	Per cent of $NaCl$			
	0.990	1.808	3.886	5.865
5	1.0609	1.0032	0.9131	0.8428
10	0.8812	0.8383	0.7699	0.7090
15	0.7339	0.7028	0.6495	0.5976
20	0.6191	0.5962	0.5520	0.5088
25	0.5363	0.5190	0.4775	0.4424

(Roth, Z. phys. Ch. 1897, 24. 139.)

Absorption of  $N_2O$  by salts +  $Aq$  at  $20^\circ$ .

C = concentration of the solution in terms of normal.

$\alpha$  = coefficient of absorption.

Absorption of  $N_2O$  by  $KNO_3 + Aq$  at  $20^\circ$ .

P	C	$\alpha$
0	...	0.6270
1.063	0.1061	0.6173
2.720	0.2764	0.6002
5.389	0.5630	0.5713
10.577	1.1683	0.5196

Absorption of  $N_2O$  by  $NaNO_3 + Aq$  at  $20^\circ$ .

P	C	$\alpha$
0	...	0.6270
1.124	0.1336	0.6089
2.531	0.3052	0.5876
5.077	0.6286	0.5465
8.701	1.1200	0.4926

(Knopp, Z. phys. Ch. 1904, 48. 107.)

Absorption of  $N_2O$  by salts +  $Aq$ .

M = content in gram-equivalents per litre.

S = solubility.

Salt	M	S $25^\circ$	S $15^\circ$
$NH_4Cl$	0.598	0.5532	0.7203
	0.600	0.5504	0.7185
	1.158	0.5223	0.6800
	1.166	0.5200	0.6775
KI	0.550	0.5367	0.6950
	0.557	0.5344	0.6916
	0.886	0.5025	0.6466
	0.913	0.5012	0.6442
	0.514	0.5428	0.7074
	0.545	0.5406	0.7036
LiCl	0.558	0.5276	0.6884
	0.561	0.5278	0.6877
	1.067	0.4760	0.6163
	1.059	0.4773	0.6146

Absorption of  $N_2O$  by salts +  $Aq$ .—  
*Continued.*

Salt	M	S $25^\circ$	S $15^\circ$
KBr	0.546	0.5306	0.6877
	0.550	0.5318	0.6892
	0.937	0.4908	0.6352
	0.959	0.4899	0.6334
RbCl	0.439	0.5399	0.7050
	0.444	0.5386	0.7053
	0.977	0.4873	0.6306
	0.993	0.4846	0.6276
	0.558	0.5218	0.6782
	0.559	0.5217	0.6787
	1.070	0.4673	0.6046
	1.102	0.4639	0.6020

(Geffcken, Z. phys. Ch. 1904, 49. 278.)

Solubility of  $N_2O$  in a solution containing 39.6 g.  $As_2S_3$  per litre at  $25^\circ = 0.5819$ ; 42.4 g.  $As_2S_3$  per litre at  $25^\circ = 0.5833$ . (Geffcken.)

1 vol. alcohol at  $t^\circ$  and 760 mm. absorbs V vols.  $N_2O$  gas reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V
0	4.1780	13	3.3734
1	4.1088	14	3.3200
2	4.0409	15	3.2678
3	3.9741	16	3.2169
4	3.9085	17	3.1672
5	3.8442	18	3.1187
6	3.7811	19	3.0714
7	3.7192	20	3.0253
8	3.6585	21	2.9805
9	3.5990	22	2.9368
10	3.5408	23	2.8944
11	3.4838	24	2.8532
12	3.4279	..	...

(Bunsen's Gasometry.)

Coefficient of absorption = 4.17805 - 0.0698160t + 0.0006090t<sup>2</sup>. (Carius.)

At  $18^\circ$  and 760 mm., 100 vols.  $H_2O$  absorb 76 vols.  $N_2O$ ; 100 vols. alcohol of 0.840 sp. gr. absorb 153 vols.; 100 vols. rectified naphtha of 0.784 sp. gr. absorb 254 vols.; 100 vols. oil of lavender of 0.880 sp. gr. absorb 275 vols.; 100 vols. olive oil of 0.915 sp. gr. absorb 150 vols.; 100 vols. sat.  $KCl + Aq$  (29%  $KCl$ ) of 1.212 sp. gr. absorb 29 vols. (de Saussure, 1814.)  
1 vol. oil of turpentine absorbs 2.5-2.7 vols.  $N_2O$ . (de Saussure.)

Absorption of  $N_2O$  by glycerine +  $Aq$  at  $t^\circ$ .

$t^\circ$	% by weight of glycerine			
	3.460%	6.726%	12.120%	16.244%
25	0.5558	0.5415	0.5268	0.5083
20	0.6468	0.6303	0.6050	0.5851
15	0.7672	0.7454	0.7098	0.6857
10	0.9172	0.8871	0.8411	0.8102
5	1.0967	1.0552	0.9990	0.9586

(Roth, Z. phys. Ch. 1897, 24. 128.)

Absorption of  $N_2O$  by urea + Aq at  $t^\circ$ .

$t^\circ$	% by weight of urea				
	3.312%	4.974%	6.366%	7.296%	9.966%
25	0.5686	0.5669	0.5588	0.7502	0.5689
20	0.6533	0.6558	0.6539	0.6553	0.6508
15	0.7708	0.7732	0.7605	0.7722	0.7614
10	0.9209	0.9201	0.9086	0.9208	0.9007
5	1.1040	1.0964	1.0880	1.1012	1.0685

(Roth, Z. phys. Ch. 1897, 24. 124.)

Absorption of  $N_2O$  by sugar + Aq at  $15^\circ$ .

Number of molecules of $C_{12}H_{22}O_{11}$ per litre	Coefficient of absorption
1.699	0.0692
0.993	0.1284
0.520	0.1561

(Steiner, Z. phys. Ch. 1895, 18. 15.)

Absorption of  $N_2O$  by organic substances + Aq.

C = concentration of the solution in terms of normal.

 $\alpha$  = coefficient of absorption.Absorption of  $N_2O$  by chloral hydrate + Aq at  $20^\circ$ .

P	C	$\alpha$
0	...	0.6270
2.947	0.184	0.6182
6.848	0.445	0.6128
13.48	0.942	0.5960
16.15	1.165	0.5891
19.60	1.474	0.5793
24.02	1.911	0.5675

(Knopp, Z. phys. Ch. 1904, 48. 106.)

Absorption of  $N_2O$  by propionic acid + Aq at  $20^\circ$ .

P	C	$\alpha$
0	...	0.6270
1.492	0.2045	0.6323
5.702	0.816	0.6369
13.680	2.140	0.6504
15.011	2.385	0.6534
25.589	4.645	0.7219

(Knopp, Z. phys. Ch. 1904, 48. 107.)

Absorption of  $N_2O$  by oxalic acid + Aq at  $t^\circ$ .

$t^\circ$	Coeff. of abs. in $H_2C_2O_4$ + Aq of given % strength	
	8.122%	3.699%
25	0.5786	0.5643
20	0.6694	0.6538
15	0.7940	0.7745
10	0.9526	0.9264
5	1.1450	1.1094

(Roth, Z. phys. Ch. 1897, 24. 130.)

Coefficient of absorption for petroleum = 2.11 at  $20^\circ$ ; 2.49 at  $10^\circ$ . (Gniess and Walfisz, Z. phys. Ch. 1. 70.)The solubility of  $N_2O$  in various colloidal solutions has been determined by Findlay and Creighton (Chem. Soc. 1910, 97. 538), for which see original article.Nitrogen dioxide,  $NO$ .1 vol.  $H_2O$  absorbs 0.1 vol.  $NO$  gas at ordinary temp. (Davy); 1 vol. absorbs 0.05 vol. (Henry); 1 vol. absorbs 1/27 vol. (Dalton.)Absorption of  $NO$  by  $H_2O$  at 760 mm. pressure. $\beta$  = Coefficient of absorption. $\beta'$  = "Solubility."

$t^\circ$	$\beta$	$\beta'$	$t^\circ$	$\beta$	$\beta'$
0	0.07381	0.07337	55	0.03040	0.02570
5	6461	6406	60	2954	2375
10	5709	5640	65	2877	2169
15	5147	5061	70	2810	1947
20	4706	4599	75	2751	1706
25	4323	4189	80	2700	1439
30	4004	3838	85	2665	1146
35	3734	3529	90	2648	9817
40	3507	3254	95	2638	0439
45	3311	3000	100	2628	0000
50	3152	2771			

(Winkler, B. 1901, 34. 1414.)

205.69 cc.  $H_2O$  absorb 9.6798 cc.  $NO$  at  $20^\circ$  and 760 mm. (Hüfner, Z. phys. Ch. 1907, 59. 420.)Sol. in conc.  $HNO_3$  + Aq.100 vols.  $HNO_3$  + Aq of 1.3 sp. gr. agitated with  $NO$  gas take up 20 vols.  $NO$ . If acid is twice as strong or one-half as strong, the quantity  $NO$  is proportional to the amount of  $HNO_3$ . Very dil.  $HNO_3$  + Aq absorbs scarcely more  $NO$  than pure  $H_2O$ . (Dalton.)100 pts.  $HNO_3$  + Aq of 1.4 sp. gr. absorb 90 pts.  $NO$  (Dalton); sol. in  $Br_2$  and very sl. sol. in conc.  $H_2SO_4$ . (Berthelot.)1 ccm. conc.  $H_2SO_4$  of 1.84 sp. gr. absorbs 0.035 ccm.  $NO$ ; of 1.50 sp. gr., 0.017 ccm.  $NO$ . (Lunge, B. 18. 1391.)

Absorption of NO by  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$  and 760 mm.

$\alpha$  = Coefficient of solubility.

$\text{H}_2\text{SO}_4$	$\alpha$	$\text{H}_2\text{SO}_4$	$\alpha$
98%	not constant	70%	0.0113
90%	0.0193	60%	0.0118
80%	0.0117	50%	0.0120

(Tower, Z. anorg. 1906, 50. 387.)

Very sol. in aqueous solutions of ferrous salts, especially the sulphate. (Priestley.)

1 vol.  $\text{FeSO}_4 + \text{Aq}$  of 1.081 sp. gr., containing 1 grain  $\text{FeSO}_4$  to 6 grains  $\text{H}_2\text{O}$ , absorbs 6 vols. NO. (Dalton.)

Absorption by ferrous salts + Aq is proportional to the amount of Fe present, irrespective of the acid or concentration of the solution. Between  $0^\circ$  and  $10^\circ$ , about 2 mols. NO are absorbed for each atom of Fe; between  $10^\circ$  and  $15^\circ$ , 1 mol. NO for 2 atoms of Fe; and at  $25^\circ$ , only 1 mol. NO for  $2\frac{1}{2}$  to 3 atoms of Fe. The amount of NO absorbed also varies with the pressure. The sp. gr. of the ferrous salt solution is greater after the absorption of NO than before. The solutions are decomp. by heat, and at  $100^\circ$  all NO is given off. (Gay, A. ch. (6) 5. 145.)

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $25^\circ$ .

A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{FeSO}_4$ .

V = vol. NO (in litres) absorbed.

A	V	A	V
1.2	1.47	7.2	5.52
1.8	2.01	12.0	6.46
2.4	2.55	18.6	8.01
4.82	4.40	36.0	10.40

(Kohlschütter, B. 1907, 40. 877.)

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $t^\circ$ .

205.69 cc.  $\text{FeSO}_4 + \text{Aq}$  contain 0.0221 g. Fe.  
Coefficient of absorption = 0.06087 at  $20.09^\circ$ .

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.1	704.9	14.42
20.1	683.5	14.10
20.1	668.6	13.80
20.2	651.9	13.58
20.05	632.9	13.15
20.0	613.7	12.98

Absorption of NO by  $\text{FeSO}_4 + \text{Aq}$  at  $t^\circ$ .—  
*Continued.*

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0296 g. Fe.

Coefficient of absorption = 0.06505.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.05	677.5	14.30
20.05	655.3	14.07
20.04	639.1	13.81
20.00	620.2	13.39
20.15	600.5	13.20
20.14	581.2	12.92

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0409 g. Fe.

Coefficient of absorption = 0.06684.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.04	667.6	16.79
20.02	650.6	16.65
20.00	613.1	15.71
20.00	594.6	15.41
20.10	577.1	15.32

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0513 g. Fe.

Coefficient of absorption = 0.07981.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.10	644.8	18.82
20.10	623.8	18.47
20.08	606.4	18.02
20.10	589.7	17.56
20.10	571.1	17.19
20.10	553.1	16.95

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.0663 g. Fe.

Coefficient of absorption = 0.08059.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.10	697.3	21.91
20.10	678.9	21.60
20.10	660.4	21.18
20.08	638.2	20.71
20.04	620.7	20.28
20.00	602.5	19.87

205.69 cc. of  $\text{FeSO}_4 + \text{Aq}$  contain 0.099 g. Fe.  
Coefficient of absorption = 0.11661.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.10	649.9	34.26
20.15	631.1	33.82
20.20	618.4	33.26
20.00	603.3	32.76
19.85	588.6	32.34
19.85	574.2	31.95

(Hüfner, Z. phys. Ch. 1907, 59. 419.)

Absorption of NO by  $\text{NiSO}_4 + \text{Aq}$  at  $t^\circ$ .  
205.69 cc.  $\text{NiSO}_4 + \text{Aq}$  contain 0.0506 g. Ni.  
Coefficient of absorption = 0.08311.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.2	654.7	23.00
20.2	629.8	22.54
20.2	609.5	22.03
20.15	591.7	21.65
20.14	573.4	21.18

(Hüfner, *l. c.*)

Absorption of NO by  $\text{CoSO}_4 + \text{Aq}$  at  $t^\circ$ .  
205.69 cc.  $\text{CoSO}_4 + \text{Aq}$  contain 0.0598 g. Co.  
Coefficient of absorption = 0.09146.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.15	678.3	23.47
20.16	653.5	23.01
20.20	636.6	22.55
20.30	615.9	21.99
20.40	600.0	21.56

(Hüfner, *l. c.*)

Absorption of NO by  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$ .  
205.69 cc.  $\text{MnCl}_2 \cdot 4\text{H}_2\text{O} + \text{Aq}$  contain 0.0697 g. Mn.  
Coefficient of absorption = 0.06111.

$t^\circ$	Pressure mm.	NO absorbed ccm.
20.0	711.96	14.25
20.05	686.5	13.99
20.2	657.4	13.49
20.3	638.9	13.05
20.45	621.0	12.81

(Hüfner, *l. c.*)

Coefficient of absorption for  $\text{FeSO}_4 + \text{Aq}$  of concentration used by Hüfner (*Z. phys. Ch.* 1907, 59. 417) = 0.180 at  $20^\circ$ . Hüfner's results are incorrect because he assumed that the absorption-coefficient of NO always had the same value, whereas it does not. NO is reduced by  $\text{FeSO}_4 + \text{Aq}$ . (Usher, *Z. phys. Ch.* 1908, 62. 624.)

Coefficient of absorption for  $\text{CoSO}_4 + \text{Aq}$  sat. at  $20^\circ$  = 0.0288. (Usher, *Z. phys. Ch.* 1908, 62. 624.)

Coefficient of absorption for  $\text{NiSO}_4 + \text{Aq}$  of the concentration used by Hüfner (*cf. Z. phys. Ch.* 1907, 59. 422) = 0.048 at  $20^\circ$ .

Coefficient of absorption for  $\text{NiSO}_4 + \text{Aq}$  sat. at  $20^\circ$  = 0.0245. (Usher, *l. c.*)

Coefficient of absorption for  $\text{MnCl}_2 + \text{Aq}$  sat. at  $20^\circ$  = 0.0082. (Usher, *Z. phys. Ch.* 1908, 62. 624.)

Absorption of NO by  $\text{FeCl}_2 + \text{Aq}$  at  $22^\circ$ .  
A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{FeCl}_2$ .  
V = vol. NO (in litres) absorbed.

A	V
2.5	3.30
5.18	4.83
10.35	6.56
20.7	8.32
51.8	11.89

(Kohlschütter, B. 1907, 40. 878.)

Absorption by  $\text{HCl} + \text{FeCl}_2 + \text{Aq}$ .  
10.37 l. 30%  $\text{HCl}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 15.64 l. NO.  
10.37 l. 10%  $\text{HCl}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 6.17 l. NO.

(Kohlschütter, *l. c.*)

Absorption by salts +  $\text{FeCl}_2 + \text{Aq}$ .  
10.37 l. sat.  $\text{NaCl} + \text{Aq}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 6.549 l. NO.  
10.37 l. sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  containing 1 mol.  $\text{FeCl}_2$  in solution absorb 6.549 l. NO.

(Kohlschütter, *l. c.*)

Solubility of NO in  $\text{Fe}(\text{NO}_3)_3 + \text{Aq}$  at  $23^\circ$ .  
A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{Fe}(\text{NO}_3)_3$ .  
V = vol. NO (in litres) absorbed.

A	V
3.25	2.77
6.50	4.16
13.00	5.54
26.00	6.61

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2 + \text{Aq}$ .  
A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
V = vol. NO (in litres) absorbed.

A	V
0.231	0.120
0.277	0.098
0.371	0.052

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2 + \text{conc. HCl}$ .  
A = vol. conc.  $\text{HCl}$  (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
V = vol. NO (in litres) absorbed.

A	V	A	V
0.389	0.801	7.499	3.931
0.410	0.933	12.500	3.606
0.840	2.838	18.750	3.153
1.230	3.426	28.650	1.976
2.462	3.989		

(Kohlschütter, *l. c.*)

Absorption of NO by  $\text{CuCl}_2$  + acetic acid.  
 A = vol. acetic acid (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V
252	51.77
504	39.67
1269	81.60

(Kohlschütter, l. c.)

Absorption of NO by  $\text{CuCl}_2$  + 98% formic acid.  
 A = vol. 98% formic acid (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V
27.9	12.76
56.0	13.17
140.0	14.34
280.0	18.68
1400.0	27.29

(Kohlschütter, l. c.)

Absorption of NO by  $\text{CuCl}_2$  + acetone.  
 A = vol. acetone (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
4.667	14.04	291.60	40.99
29.16	24.01	583.20	67.22
58.33	24.60	1166.40	81.96

(Kohlschütter, l. c.)

Absorption of NO by  $\text{CuCl}_2$  + methyl alcohol.  
 A = vol. methyl alcohol (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
1.60	3.30	20.50	6.15
8.22	5.60	82.25	4.90

(Kohlschütter, l. c.)

Absorption of NO by  $\text{CuCl}_2$  + ethyl alcohol.  
 A = vol. ethyl alcohol (in litres) containing 1 mol.  $\text{CuCl}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
1.50	8.70	38.41	18.15
3.84	12.38	76.83	18.05
12.80	15.43	192.10	15.92

(Kohlschütter, l. c.)

Absorption of NO by  $\text{CuBr}_2$  + Aq.  
 A = vol.  $\text{H}_2\text{O}$  (in litres) containing 1 mol.  $\text{CuBr}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V
0.37	0.515
0.62	0.120
0.925	0.000

(Kohlschütter, l. c.)

Absorption of NO by  $\text{CuBr}_2$  + ethyl alcohol.  
 A = vol. alcohol (in litres) containing 1 mol.  $\text{CuBr}_2$ .  
 V = vol. NO (in litres) absorbed.

A	V	A	V
2.625	16.02	131.20	22.23
5.25	19.26	262.50	23.46
13.12	20.51	656.10	30.46
43.74	21.13		

(Kohlschütter, l. c.)

Sol. in stannous and chromous salts + Aq. (Peligot.)

Not absorbed by  $\text{Fe}_2(\text{SO}_4)_3$  + Aq. (Dalton.)  
 1 vol. absolute alcohol absorbs 0.31606-0.003487t + 0.000049t<sup>2</sup> vols. NO between 0° and 25°. (Bunsen.)

1 vol. alcohol at t° and 760 mm. absorbs V vols. NO gas reduced to 0° and 760 mm.

t°	V	t°	V
0	0.31606	13	0.27901
1	0.31262	14	0.27685
2	0.30928	15	0.27478
3	0.30604	16	0.27281
4	0.30290	17	0.27094
5	0.29985	18	0.26917
6	0.29690	19	0.26750
7	0.29405	20	0.26592
8	0.29130	21	0.26444
9	0.28865	22	0.26306
10	0.28609	23	0.26178
11	0.28363	24	0.26060
12	0.28127	..	...

(Bunsen's Gasometry.)

Abundantly absorbed by  $\text{CS}_2$ . (Friedburg, C. N. 48. 97.)

Nitrogen trioxide,  $\text{N}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$  at 0°. If large amt. of  $\text{H}_2\text{O}$  is present, the solution is quite stable at ordinary temp. (Fremy, C. R. 79. 61.)

Sol. in  $\text{HNO}_3$  + Aq.

Sol. in conc.  $\text{H}_2\text{SO}_4$  to form  $\text{HNO}_3\text{SO}_4$ .

Sol. in ether.



**Nitrogen trioxide stannic chloride,  $N_2O_3, SnCl_4$ .**

Decomp. by  $H_2O$ . (Weber, Pogg. 118. 471.)

**Nitrogen tetroxide,  $NO_2$  or  $N_2O_4$ .**

Sol. in  $H_2O$  at  $0^\circ$  with decomp. Miscible with very conc.  $HNO_3$ . Absorbed abundantly by  $CS_2$ ,  $CHCl_3$ , and  $C_6H_5Cl$ . (Friedburg, C. N. 47. 52.)

Sol. in  $C_6H_5NO_2$ .

Sl. sol. in  $H_2S + Aq$ .

Sol. in  $H_2SO_4$  or conc.  $HNO_3 + Aq$ .

$H_2PO_4$  absorbs some liquid  $NO_2$ . (Frankland, Chem. Soc. 1901, 79. 1362.)

**Nitrogen pentoxide,  $N_2O_5$ .**

Very deliquescent. Combines with  $H_2O$  to form  $HNO_3$  with evolution of heat.

**Nitrogen hexoxide,  $NO_3$ .**

Decomposes upon air or with  $H_2O$ . (Hautefeuille and Chappins, C. R. 92. 80, 134; 94. 1111, 1306.)

**Nitrogen oxybromide.**

See Nitrosyl and Nitroxyl bromide.

**Nitrogen oxychloride.**

See Nitrosyl and Nitroxyl chloride.

**Nitrogen oxyfluoride.**

See Nitrosyl fluoride and Nitroxyl fluoride.

**Nitrogen phosphochloride,  $P_3N_3Cl_4$ .**

See Nitrogen chlorophosphide.

**Nitrogen selenide,  $NSe$ .**

Very explosive. Insol. in  $H_2O$ . Sol. in  $HNO_3 + Aq$ , and  $NaClO + Aq$ . (Espenschied, A. 113. 101.)

Insol. in  $H_2O$ , ether, absolute alcohol; very sl. sol. in  $CS_2$ ,  $C_6H_6$ , and glacial acetic acid. Decomp. by  $HCl$  or  $KOH + Aq$ . (Verneuil, Bull. Soc. (2) 38. 548.)

**Nitrogen sulphide,  $N_2S_4$ .**

Insol. in  $H_2O$ . Decomp. by hot  $H_2O$ . Sl. sol. in alcohol, ether, wood alcohol, oil of turpentine. Easily sol. in  $CS_2$ . Slowly decomp. by  $HCl + Aq$  or  $KOH + Aq$ , rapidly by  $HNO_3 + Aq$ . 15 g. dissolve in 1 kilo. of  $CS_2$ . (Fordos and Gélis, C. R. 31. 702.)

Sol. in  $CHCl_3$ . (Demarçay, C. R. 91. 854.)

Sol. in warm glacial acetic acid with decomp. on boiling. (Ruff and Geisel, B. 1904, 37. 1591.)

**Nitrogen pentasulphide,  $N_2S_5$ .**

Sol. in ether and most organic solvents; insol. in  $H_2O$ ; fairly stable in ethereal solution, but decomp. by light. (Muthmann, Z. anorg. 1897, 13. 206.)

**Nitrogen sulphobromide,  $N_2S_4Br$ .**

Decomp. by boiling  $H_2O$  and by dil. alkalis, also by boiling with alcohol. (Muthmann, B. 1897, 30. 630.)

$N_2S_4Br$ . Decomp. by moist air. (Clever, B. 1896, 29. 340-341.)

$N_2S_4Br$ . Decomp. by moist air. Very unstable. (Clever.)

$N_2S_4Br$ . Insol. most solvents; unstable. (Clever.)

**Nitrogen sulphochloride,  $N_2S_4Cl_4$ .**

Unstable on air. Sol. in warm  $CHCl_3$ ; crystallizes out on cooling. (Demarçay, C. R. 91. 854, 1066.)

Demarçay calls this comp. thiasyl chloride.

Sol. in hot dry benzene, and in  $CCl_4$ ; decomp. by moist air. (Andreocci, Z. anorg. 1897, 14. 249.)

$N_2S_4Cl_2$ . Partly sol. in  $H_2O$ . (Demarçay, C. R. 92. 726.)

Demarçay calls this compound dithiotetra-thiasyl dichloride.

$N_2S_4Cl_2 = N_2S_3, SCl_2$ . Decomp. on air. (Fordos and Gélis.)

Demarçay (C. R. 92. 726) calls this comp. thiodithiasyl dichloride.

$N_2S_4Cl_2$ . Sol. in  $H_2O$  with subsequent decomp. More sol. than 8 in  $CS_2$ . (Soubeiran, A. ch. 67. 71.)

Is a mixture of  $S_2Cl_2$  and  $N_2S_4$ . (Fordos and Gélis, C. R. 31. 702.)

$N_2S_4Cl_2$ . Sl. sol. in warm, insol. in cold  $CHCl_3$ . (Demarçay, C. R. 92. 726.)

"Thiothiasyl chloride." (Demarçay.)

$N_2S_4Cl_2$ . Sol. in  $H_2O$ . Insol. in most solvents. Sl. sol. in  $CHCl_3$ . Easily sol. in thionyl chloride. (Demarçay, C. R. 91. 854, 1066.)

Demarçay calls the compound thiotri-thiasyl chloride =  $(NS)_3 \equiv S-Cl$ .

$N_2S_4Cl_2 = 2N_2S_3, SCl_2$ . Decomp. on air. (Michaelis.)

$N_2S_4Cl_2 = 3N_2S_2, SCl_2$ . Not decomp. on air. Decomp. by  $H_2O$  containing ammonia.

**Nitrogen sulphodiodide,  $N_2S_4I$ .**

Readily decomp. by  $H_2O$ . (Muthmann and Seitter, B. 1897, 30. 627.)

**Nitrohydroxylaminic acid,  $H_2N_2O_3$ .**

Known only in solution. (Angeli, Gass. ch. it. 1897, 27 (2) 357.)

**Barium nitrohydroxylamine,  $Ba.N_2O_3 + H_2O$ .**

Ppt. More stable in the air than the sodium salt. Not decomp. by prolonged boiling with  $H_2O$ . (Angeli, Gass. ch. it. 1890, 26. 17-25.)

**Cadmium nitrohydroxylamine,  $Cd.N_2O_3 + H_2O$ .**

As Ba salt. (Angelico and Fanara, Gass. ch. it. 1901, 31. (2) 21.)

**Calcium nitrohydroxylamine**,  $\text{CaN}_2\text{O}_5 + \frac{1}{2}\text{H}_2\text{O}$ .  
(Angeli, *Gazz. ch. it.* 1900, **30**. (1) 593.)

**Calcium nitrohydroxylamine**,  $\text{CaN}_2\text{O}_5 + 3\frac{1}{2}\text{H}_2\text{O}$ .  
(Angelico and Fanara, *Gazz. ch. it.* 1901, **31**. (2) 15.)

**Lead nitrohydroxylamine**,  $\text{PbN}_2\text{O}_5$ .  
(Angeli, *Gazz. ch. it.* 1900, **30**. (1) 593.)

**Potassium nitrohydroxylamine**,  $\text{K}_2\text{N}_2\text{O}_5$ .  
Like Na salt. More hygroscopic. (Angeli, *Gazz. ch. it.* 1897, **27**. (2) 357.)  
Sol. in  $\text{H}_2\text{O}$ . (Angeli, *Gazz. ch. it.* 1900, **30**. (1) 593.)

**Silver nitrohydroxylamine**,  $\text{Ag}_2\text{N}_2\text{O}_5$ .  
Ppt. (Angeli, *C. C.* 1901, **I**. 1192.)

**Sodium nitrohydroxylamine**,  $\text{Na}_2\text{N}_2\text{O}_5$ .  
Very sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. Aqueous solution is readily decomp. by boiling. (Angeli, *Gazz. ch. it.* 1896, **26**. (2) 17.)

**Strontium nitrohydroxylamine**,  $\text{SrN}_2\text{O}_5 + \text{H}_2\text{O}$ .  
(Angeli, *Gazz. ch. it.* 1900, **30**. (1) 593.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$ . (Angelico and Fanara, *Gazz. ch. it.* 1901, **31**. (2) 15.)

**Nitroiodic acid**,  $\text{I}_2\text{O}_4(\text{NO})_2$ .  
See Nitrosoiodic acid.

**Nitronitrous acid**.

**Platinum potassium nitronitrite**,  $\text{K}_2\text{Pt}(\text{NO})_2 \cdot \text{N}_2\text{O}_4$ .  
Decomp. by heat. (Miolati, *C. C.* 1896, **II**. 1088.)

**Nitroplatinous acid**.  
See Platonitrous acid.

**Nitroprussic acid**,  $\text{H}_2\text{FeC}_5\text{N}_5\text{O} + \text{H}_2\text{O} = \text{H}_2\text{Fe}(\text{CN})_5\text{NO} + \text{H}_2\text{O}$ .  
Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Playfair, *A.* 74. 317.)

**Nitroprussides**.

The alkali and alkali-earth nitroprussides are sol. in  $\text{H}_2\text{O}$ , and the solutions are not pptd. by alcohol. The others are mostly insol. in  $\text{H}_2\text{O}$ .

**Ammonium nitroprusside**,  
 $(\text{NH}_4)_2\text{Fe}(\text{CN})_5(\text{NO})$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ ; not pptd. therefrom by alcohol. (Playfair.)

**Barium nitroprusside**,  $\text{BaFe}(\text{CN})_5\text{NO} + 4\text{H}_2\text{O}$ .  
Verv sol. in  $\text{H}_2\text{O}$ .  
 $+6\text{H}_2\text{O}$ .

**Cadmium nitroprusside**,  $\text{CdFe}(\text{CN})_5\text{NO}$ .  
Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in dil. or conc.  $\text{HNO}_3 + \text{Aq}$  even when boiling. Not attacked by  $\text{NH}_4\text{OH}$  or  $\text{KOH} + \text{Aq}$ . (Norton, *Am. Ch. J.* 10. 222.)

**Calcium nitroprusside**,  $\text{CaFe}(\text{CN})_5\text{NO} + 4\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Playfair.)

**Cobalt nitroprusside**,  $\text{CoFe}(\text{CN})_5\text{NO}$ .  
Ppt. (Norton, *Am. Ch. J.* 10. 222.)  
 $+4\text{H}_2\text{O}$ .

**Copper nitroprusside**,  $\text{CuFe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$  or alcohol.

**Ferrous nitroprusside**,  $\text{FeFe}(\text{CN})_5\text{NO} + x\text{H}_2\text{O} (?)$ .  
Insol. in  $\text{H}_2\text{O}$ .

**Mercurous nitroprusside**,  $\text{Hg}_2\text{Fe}(\text{CN})_5\text{NO}$ .  
Insol. in  $\text{H}_2\text{O}$ . Unstable. (Norton, *Am. Ch. J.* 10. 222.)

**Nickel nitroprusside**,  $\text{NiFe}(\text{CN})_5\text{NO}$ .  
As the Co salt. (Norton.)

**Potassium nitroprusside**,  $\text{K}_2\text{Fe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$ .  
Sl. deliquescent. Sol. in 1 pt.  $\text{H}_2\text{O}$  at  $16^\circ$ .  
 $\text{K}_2\text{Fe}(\text{CN})_5\text{NO}$ ,  $2\text{KOH}$ . Very sol. in  $\text{H}_2\text{O}$ .

**Silver nitroprusside**,  $\text{Ag}_3\text{Fe}(\text{CN})_5\text{NO}$ .  
Insol. in  $\text{H}_2\text{O}$ , alcohol, or  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Sodium nitroprusside**,  $\text{Na}_2\text{Fe}(\text{CN})_5\text{NO} + 2\text{H}_2\text{O}$ .  
Sol. in  $2\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and in less hot  $\text{H}_2\text{O}$ .

**Zinc nitroprusside**,  $\text{ZnFe}(\text{CN})_5\text{NO}$ .  
Very sl. sol. in cold, more in hot  $\text{H}_2\text{O}$ .

**Nitrosisulphonic acid**.

**Cupric nitrosisulphonate**,  $\text{NO} \begin{smallmatrix} \text{O} \\ \diagup \text{SO}_2 \diagdown \end{smallmatrix} \text{Cu}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Raschig, *B.* 1907, **40**. 4583.)

**Nitrosobromoruthenic acid**.

**Silver nitrosobromoruthenate ammonia**,  
 $\text{Ag}_2\text{Ru}(\text{NO})\text{Br}_2 \cdot \text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Very sol. in  $\text{Na}_2\text{S}_2\text{O}_5 + \text{Aq}$ . (Brisard, *Bull. Soc.* 1895, (3) 13. 1093.)

**Nitrosobromosmic acid.****Potassium nitrosobromosmate,  $K_2Os(NO)Br_2$ .**

Stable in aqueous solution. (Wintrebert, A. ch. 1903, (7) 28. 132.)

**Nitrosochloroplatinic acid.****Potassium nitrosochloroplatinate,**

Sol. in  $H_2O$ . (Vèzes, C. R. 110. 757.)

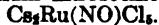
**Nitrosochlororuthenic acid.****Ammonium nitrosochlororuthenate,**

Sol. in  $H_2O$ . (Joly, C. R. 107. 991.)

5 pts. are sol. in 100 pts.  $H_2O$  at  $25^\circ$ .

22 " " " " " " " "  $60^\circ$ .

(Howe, J. Am. Chem. Soc. 1894, 16. 390.)

**Cæsium nitrosochlororuthenate,**

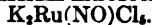
0.20 pt. is sol. in 100 pts.  $H_2O$  at  $25^\circ$ .

0.56 " " " " " " " "  $100^\circ$ .

(Howe.)

+ $2H_2O$ . Very sol. in  $H_2O$ . 105.8 pts. are

sol. in 100 pts.  $H_2O$ . (Howe.)

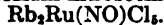
**Potassium nitrosochlororuthenate,**

Sol. in  $H_2O$ . (Joly.)

12 pts. are sol. in 100 pts.  $H_2O$  at  $25^\circ$ .

80 " " " " " " " "  $60^\circ$ .

(Howe.)

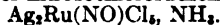
**Rubidium nitrosochlororuthenate,**

Sol. in boiling  $H_2O$  without decomp.

0.57 pt. is sol. in 100 pts.  $H_2O$  at  $25^\circ$ .

2.13 " " " " " " " "  $60^\circ$ .

(Howe.)

**Silver nitrosochlororuthenate ammonia,**

Decomp. by  $H_2O$ . Sl. sol. in  $NH_4OH + Aq$ .

Very sol. in  $Na_2S_2O_3 + Aq$ . (Brizard, Bull. Soc. 1895, (3) 13. 1092.)

**Nitrosoiodic acid,  $I_2O_4(NO)_2$  (?)**

Decomp. with  $H_2O$ , alcohol, ether, or acetic ether. Slowly sol. in  $H_2SO_4$ . (Kämmerer, J. pr. 83. 65.)

**Nitrososulphonic acid.****Potassium dinitrososulphonate,  $N_2O.O.K.$** 

Sol. in  $H_2O$ . Very unstable. (Hantzsch, B. 1894, 27. 3288.)

**Potassium nitrosodisulphonate,  $ON(SO_3K)_2$ .**

Sol. in  $H_2O$ . Very explosive. (Hantzsch, B. 1895, 28. 996 and 2744.)

**Potassium nitrosotrisulphonate,  $ON(SO_3K)_3$** 

Sol. in  $H_2O$ . (Hantzsch, B. 1895, 28. 2750.)

**Sodium nitrosotrisulphonate,  $NO_2(SO_3)_2Na$ .**

Decomp. by  $H_2O$ . (Traube, B. 1913, 46. 2521.)

**Nitrososulphuric acid,**

Not known in free state.

**Ammonium dinitrososulphate,**

Sol. in  $H_2O$ . Insol. in hot alcohol. (Pelouze, A. 15. 240.)

**Barium —,  $Ba(NO)_2SO_4$ .**

Sol. in  $H_2O$ . (Divers and Haga, Chem. Soc. 47. 364.)

**Barium potassium —,  $BaK_2(SN_2O_4)_2$ .**

Sol. in much  $H_2O$  to form a clear liquid, but the solution gradually deposits  $BaSO_4$ . (Hantzsch, B. 1894, 27. 3271.)

**Cupric nitrosodisulphate,  $Cu(NO)(SO_3)_2$ .**

(Sabatier, Bull. Soc. 1897, (3) 17. 787.)

**Lead dinitrososulphate.**

Insol. in  $H_2O$ . (Divers and Haga, Chem. Soc. 47. 364.)

**Potassium —,  $K_2(NO)_2SO_4$ .**

Decomp. by  $H_2O$  at ordinary temp. Insol. in alcohol. (Pelouze, A. ch. 60. 160.)

Sol. in about 8 pts.  $H_2O$  at  $14.5^\circ$ . Less sol. in presence of  $KOH$ . (Divers and Haga, Chem. Soc. 1895, 67. 455.)

**Sodium —,  $Na_2(NO)_2SO_4$ .**

More sol. than K salt. (Pelouze.)

Sl. sol. in  $H_2O$ ; very unstable moist or dry; decomp. by  $H_2O$ . (Divers, C. N. 1895, 72. 266.)

**Nitrososulphurous acid.****Ruthenium sodium nitrososulphite,**

Sl. sol. in cold  $H_2O$ . (Miolati, Gazz. ch. it. 1900, 30. 511.)

**Nitrosulphide of iron.**

See Ferroletranitrososulphonic acid.

**Binitrosulphide of iron.**

Roussin's comp. is ammonium ferroleptanitrososulphonate, which see.

**Nitrosulphonic acid,  $\text{HNSO}_3 = \text{HO} \cdot \text{SO}_3 \cdot \text{NO}_2$ .**

(*Lead chamber crystals.*) Rapidly sol. in  $\text{H}_2\text{O}$  with decomp. When brought into large amount of  $\text{H}_2\text{O}$ , no gas is evolved. (Fremy, C. R. 70. 61.)

Sol. in  $\text{H}_2\text{SO}_4$  without decomp. Sol. in cold  $\text{H}_2\text{SO}_4 + \text{Aq}$  of sp. gr. 1.7–1.55. (Weber, J. pr. 100. 37.)

Sl. sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  of 1.6 sp. gr. (Dana.) More difficultly sol. in dil. than conc.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Müller.)

**Potassium nitrosulphonate,  $\text{KOSO}_2\text{NO}_2(?)$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Schultz-Sellack, B. 4. 113.)

**Nitrosulphonic anhydride (?),  $\text{N}_2\text{O}_5, 2\text{SO}_3 = \text{S}_2\text{O}_5(\text{NO}_2)_2$ .**

Rapidly sol. in  $\text{H}_2\text{O}$  with decomp. Abundantly sol. in cold  $\text{H}_2\text{SO}_4$ . (Rose, Pogg. 47. 605.)

Insol. in cold, slowly sol. in warm  $\text{H}_2\text{SO}_4$ . (Prevostaye, A. ch. 73. 362.)

**Nitrosulphonic chloride,  $\text{NO}_2\text{SO}_2\text{Cl} = \text{NO}_2\text{SO}_2\text{Cl} (?)$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in fuming  $\text{H}_2\text{SO}_4$  without decomp. Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Weber, Pogg. 123. 333.)

**Dinitrosulphuric acid.**

See Dinitrososulphuric acid.

**Nitrosyl bromide,  $\text{NOBr}$ .**

Decomp. with cold  $\text{H}_2\text{O}$ . (Landolt, A. 116. 177.)

**Nitrosyl tribromide,  $\text{NOBr}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  or cold alcohol. Miscible with ether. (Landolt, A. 116. 177.) Mixture of  $\text{NOBr}$  and  $\text{Br}_3$ . (Fröhlich, A. 224. 270.)

**Nitrosyl platonic bromide,  $2\text{NOBr}$ ,  $\text{PtBr}_4$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Topsoe, J. B. 1863. 274.)

**Nitrosyl chloride,  $\text{NOCl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Absorbed by fuming  $\text{H}_2\text{SO}_4$  without decomp.

**Nitrosyl boron chloride,  $\text{NOCl}$ ,  $\text{BCl}_3$ .**

See Boron nitrosyl chloride.

**Nitrosyl platonic chloride,  $2\text{NOCl}$ ,  $\text{PtCl}_4$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NO}$ . (Rogers and Boye, Phil. Mag. J. 17. 397.)

**Nitrosyl thallium chloride,  $2\text{NOCl}$ ,  $\text{TlCl}$ ,  $\text{TlCl}_3$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with decomp. (Sudborough, Chem. Soc. 59. 657.)

**Nitrosyl stannic chloride,  $2\text{NOCl}$ ,  $\text{SnCl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ , chloroform, or benzene, not by carbon disulphide. (Jørgensen.)

**Nitrosyl titanium chloride,  $2\text{NOCl}$ ,  $\text{TiCl}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weber, Pogg. 118. 476.)

**Nitrosyl zinc chloride,  $\text{NOCl}$ ,  $\text{ZnCl}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NO}$ . (Sudborough, Chem. Soc. 59. 656.)

**Nitrosyl chloride sulphur trioxide,  $\text{NOCl}$ ,  $\text{SO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$  with evolution of  $\text{HCl}$ . (Weber, Pogg. 123. 233.)

**Nitrosyl fluoride,  $\text{NOF}$ .**

Sol. in  $\text{H}_2\text{O}$ . Solution decomp. on standing with formation of  $\text{NO}$  and  $\text{HNO}_3$ . (Ruff and Stäuber, Z. anorg. 1905, 47. 190.)

**Nitrosyl sulphate, acid,  $\text{H}(\text{NO})\text{SO}_4$ .**

See Nitrosulphonic acid.

**Nitrosyl sulphate, anhydro,  $(\text{NO})_2\text{S}_2\text{O}_7$ .**

See Nitrosulphonic anhydride.

**Nitrosyl selenic acid,  $\text{SeO}_2(\text{ONO})_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Lenher and Mathews, J. Am. Chem. Soc. 1906, 28. 516.)

**Nitrosyl sulphuric acid,  $\text{H}(\text{NO})\text{SO}_4$ .**

See Nitrosulphonic acid.

**Nitrous acid,  $\text{HNO}_2$ .**

Known only in aqueous solution.

See Nitrogen trioxide.

**Nitrites.**

Normal nitrites, except  $\text{AgNO}_2$ , are sol. in  $\text{H}_2\text{O}$  and alcohol; but, as a rule, they are less sol. than the corresponding nitrates.

**Ammonium nitrite,  $\text{NH}_4\text{NO}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

$\text{H}_2\text{O}$  solution decomp. at  $50^\circ$ . (Berzelius.) Very dil. solution can be evaporated on water bath without decomp. (Bohlig, A. 125. 25.) Solution containing  $\frac{1}{100,000}$  pt.  $\text{NH}_4\text{NO}_2$  can be evaporated to  $\frac{1}{2}$  its vol. without decomp. Solution containing  $\frac{1}{100}$  pt. gives a distillate containing 8.6% of  $\text{NH}_4\text{NO}_2$ , while residue contains 82% of original quantity, 9.4% being lost. (Schöyen.)

Very deliquescent, sol. in  $\text{H}_2\text{O}$ ; slowly but easily sol. in alcohol; insol. in ether. (Sörensen, Z. anorg. 1894, 7. 38.)

**Ammonium barium cupric nitrite,**

$(\text{NH}_4)_2\text{BaCu}(\text{NO}_2)_4$ .  
Ppt.; decomp. readily. (Präibylla, Z. anorg. 1897, 15. 424.)

**Ammonium bismuth silver nitrite,**

$(\text{NH}_4)_3\text{BiAg}(\text{NO}_2)_4$ .  
Moderately sol. in  $\text{H}_2\text{O}$ . Rapidly hydrolyzed by  $\text{H}_2\text{O}$ . (Ball and Abram, Chem. Soc. 1913, 103. 2120.)

**Ammonium bismuth sodium nitrite,**

$2\text{NH}_4\text{NO}_2$ ,  $\text{Bi}(\text{NO}_2)_3$ ,  $\text{NaNO}_2$ .  
Easily decomp. (Ball, Chem. Soc. 1905, 87. 761.)

**Ammonium cadmium nitrite ammonia, basic,**

$2\text{NH}_4\text{NO}_2$ ,  $\text{Cd}(\text{NO}_2)_2$ ,  $\text{Cd}(\text{OH})_2$ ,  $2\text{NH}_3$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Morin, C. R. 100. 1497.)

**Ammonium calcium cupric nitrite,**

$(\text{NH}_4)_2\text{CaCu}(\text{NO}_2)_4$ .  
Ppt.; decomp. easily. Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Präibylla, Z. anorg. 1897, 15. 423.)

**Ammonium cobaltic nitrite,  $3(\text{NH}_4)_2\text{O}$ ,  $\text{Co}_2\text{O}_3$ ,  $6\text{N}_2\text{O}_5 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ , decomp. in aq. solution on heating. (Rosenheim, Z. anorg. 1898, 17. 45.)  
 $+3\text{H}_2\text{O}$ .

Somewhat sol. in cold  $\text{H}_2\text{O}$ ; decomp. by boiling. Decomp. by conc.  $\text{H}_2\text{SO}_4$ , not by acetic or dil. mineral acids. (Erdmann, J. pr. 97. 405.)

**Ammonium cupric lead nitrite,**

$\text{CuPb}(\text{NH}_4)_2(\text{NO}_2)_4$ .  
Stable at ordinary temp.; sol. in  $\text{HNO}_3$  with decomp.  
2.575 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , or 2.51% salt in sat. solution at  $20^\circ$ . (Präibylla, Z. anorg. 1897, 15. 420.)

**Ammonium cupric strontium nitrite,**

$(\text{NH}_4)_2\text{CuSr}(\text{NO}_2)_4$ .  
Ppt.; sol. in  $\text{H}_2\text{O}$  with decomp. (Präibylla, l. c.)

**Ammonium iridium nitrite.**

See Iridonitrite, ammonium.

**Ammonium lead nickel nitrite,**

$(\text{NH}_4)_2\text{PbNi}(\text{NO}_2)_4(?)$ .  
Ppt. (Präibylla, Z. anorg. 1897, 15. 433.)

**Ammonium osmium nitrite.**

See Osminitrite, ammonium.

**Ammonium osmyl oxynitrite.**

See Osmyloxynitrite, ammonium.

**Ammonium platinum nitrite.**

See Platonitrite, ammonium.

**Ammonium rhodium nitrite.**

See Rhodenitrite, ammonium.

**Ammonium ruthenium hydrogen nitrite,**

$\text{Ru}_2\text{H}_3(\text{NO}_2)_4$ ,  $3\text{NH}_4\text{NO}_2 + 3\text{H}_2\text{O}$ .  
See Rutheninitrite, ammonium hydrogen.

**Barium nitrite,  $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Permanent. Very sol. in  $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. in 100 cc. $\text{Ba}(\text{NO}_2)_2$	Sp. gr.
0	58	1.40
20	63	1.45
25	71	1.50
30	82	1.52
35	97	1.61

(Vogel, Z. anorg. 1903, 35. 389.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
63.5	69.5	79.5	93 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$ ,
$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
113	136	170	202 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$ ,
$80^\circ$	$90^\circ$	$100^\circ$	$110^\circ$
254	331	461	765 pts. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .

The sat. solution at  $17^\circ$  contains 40%  $\text{Ba}(\text{NO}_2)_2$ , and has sp. gr.  $17^\circ/0^\circ = 1.4897$ . (Oswald, A. ch. 1914, (9) 1. 62.)

100 g.  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 64 g.  $\text{Ba}(\text{NO}_2)_2$ , +10.2 g.  $\text{AgNO}_3$ , with excess of  $\text{AgNO}_3$ , and 75.6 g.  $\text{Ba}(\text{NO}_2)_2$ , +9.5 g.  $\text{AgNO}_3$ , with excess of  $\text{AgNO}_3$ . (Oswald.)

Sol. in 64 pts. 94% alcohol; nearly insol. in absolute alcohol. (Lang, Pogg. 118. 285.)

Solubility in alcohol + Aq at  $t^\circ$ .

$t^\circ$	Solvent	100 ccm. of the sat. solution contain g. $\text{Ba}(\text{NO}_2)_2 + \text{H}_2\text{O}$
19.5	10% alcohol	49.30
21.0	20% "	29.30
20.5	30% "	18.41
20.5	40% "	13.33
20.5	50% "	9.11
20.0	60% "	4.84
19.0	70% "	2.66
19.5	80% "	0.98
20.0	90% "	0.00
20.0	absolute alcohol	0.00

(Vogel, Z. anorg. 1903, 35. 390.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Barium caesium nitrite,  $\text{CaBa}_2(\text{NO}_2)_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Jamieson, Am. Ch. J. 1907, 38. 616.)

$\text{Ca}_2\text{Ba}(\text{NO}_2)_4 + \text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Jamieson, Am. Ch. J. 1907, 38. 616.)

**Barium caesium silver nitrite,  $\text{Cs}_2\text{AgBa}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$ .**

Decomp. by cold  $\text{H}_2\text{O}$ . (Jamieson, Am. Ch. J. 1907, 38. 616.)

**Barium cobaltic nitrite,  $2\text{BaO}$ ,  $\text{Co}_2\text{O}_3$ ,  $4\text{N}_2\text{O}_5$  +  $10\text{H}_2\text{O}$ .**

Sol. in moderately warm  $\text{H}_2\text{O}$  without decomp. but not recryst. therefrom. (Rosenheim, Z. anorg. 1898, 17. 51-54.)

$3\text{BaO}$ ,  $\text{Co}_2\text{O}_3$ ,  $6\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Ppt.; very unstable. Nearly insol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1898, 17. 47.)

**Barium cobaltous potassium nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $\text{Co}(\text{NO}_2)_2$ ,  $2\text{KNO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Erdmann, J. pr. 97. 385.)

**Barium cupric nitrite,  $\text{Ba}[\text{Cu}(\text{OH})(\text{NO}_2)_2]_2$ .**

Ppt. Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Insol. in alcohol, but slowly decomp. by it. (Kurtenacker, Z. anorg. 1913, 82. 208.)

**Barium cupric potassium nitrite,  $\text{BaCuK}_2(\text{NO}_2)_6$ .**

Stable when dry, easily decomp. when moist; sol. in  $\text{H}_2\text{O}$  with decomp. 45.86 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , or 31.45% salt is contained in sat. solution at  $20^\circ$ . (Prašibylla, Z. anorg. 1897, 15. 424.)

**Barium cupric thallium nitrite,  $\text{BaCuTl}_2(\text{NO}_2)_6$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Prašibylla, Z. anorg. 1898, 18. 461.)

**Barium iridium nitrite.**

See Iridonitrite, barium.

**Barium mercuric nitrite,  $2\text{Ba}(\text{NO}_2)_2$ ,  $3\text{Hg}(\text{NO}_2)_2 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  and easily decomp. (Rây, Chem. Soc. 1910, 97. 327.)

**Barium nickel nitrite,  $2\text{Ba}(\text{NO}_2)_2$ ,  $\text{Ni}(\text{NO}_2)_2$ .**

Somewhat more easily sol. in  $\text{H}_2\text{O}$  than nickel potassium nitrite. (Lang.)

**Barium nickel potassium nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $\text{Ni}(\text{NO}_2)_2$ ,  $2\text{KNO}_3$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  without apparent decomp. (Lang.)

**Barium nickel thallium nitrite,  $\text{NiBaTl}_2(\text{NO}_2)_6$ .**

Ppt. (Prašibylla, Z. anorg. 1898, 18. 462.)

**Barium osmium nitrite.**

See Osminitrite, barium.

**Barium osmyl oxynitrite.**

See Osmyloxynitrite, barium.

**Barium potassium nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $2\text{KNO}_3 + \text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Lang, Pogg, 118. 293.)

**Barium rhodium nitrite,  $3\text{Ba}(\text{NO}_2)_2$ ,  $\text{Rh}_2(\text{NO}_2)_6$ .**

See Rhodonitrite, barium.

**Barium silver nitrite,  $\text{Ba}(\text{NO}_2)_2$ ,  $2\text{AgNO}_3 + \text{H}_2\text{O}$ .**

Resembles the potassium salt. (Fischer.) Less stable than the Na salt. (Oswald.)

**Bismuth nitrite, basic,  $(\text{BiO})\text{NO}_2 + \frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{HCl}$ . (Vanino, J. pr. 1906, (2) 74. 150.)

**Bismuth caesium silver nitrite,  $\text{Cs}_2\text{BiAg}(\text{NO}_2)_6$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (Ball and Abram, Chem. Soc. 1913, 103. 2122.)

**Bismuth potassium nitrite,  $\text{Bi}(\text{NO}_2)_3$ ,  $3\text{KNO}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Ball, Chem. Soc. 1905, 87. 762.)

**Bismuth potassium silver nitrite,  $\text{K}_2\text{BiAg}(\text{NO}_2)_6$ .**

Less sol. in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  salt. (Ball and Abram, Chem. Soc. 1913, 103. 2121.)

**Bismuth rubidium silver nitrite,  $\text{Rb}_2\text{BiAg}(\text{NO}_2)_6$ .**

Sl. sol. in  $\text{H}_2\text{O}$  with slow hydrolysis. (Ball and Abram.)

**Bismuth silver thallic nitrite,  $\text{BiAgTl}_3(\text{NO}_2)_9$ .**

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. (Ball and Abram.)

**Cadmium nitrite, basic,  $2\text{CdO}$ ,  $\text{N}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ . (Hampe, A. 125. 335.)

**Cadmium nitrite,  $\text{Cd}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Lang, J. B. 1862. 99.)

**Cadmium potassium nitrite,  $\text{Cd}(\text{NO}_2)_2$ ,  $\text{KNO}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Very difficultly sol. in absolute alcohol, and only sl. sol. in 90% alcohol. (Hampe, A. 125. 334.)

$\text{Cd}(\text{NO}_2)_2$ ,  $2\text{KNO}_3$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang, J. B. 1862. 99.)

$\text{Cd}(\text{NO}_2)_2$ ,  $4\text{KNO}_3$ . More sol. in  $\text{H}_2\text{O}$  than the above salt. (Lang.)

**Cæsium nitrite,  $\text{CsNO}_2$ .**

Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$ .  
(Ball, Chem. Soc. 1913, 103. 2130.)

**Cæsium calcium nitrite,  $\text{Cs}_2\text{Ca}(\text{NO}_2)_4 + \text{H}_2\text{O}$ .**

Ppt. (Jamieson, Am. Ch. J. 1907, 38. 617.)

**Cæsium cobaltic nitrite,  $\text{Cs}_2\text{Co}(\text{NO}_2)_6 + \text{H}_2\text{O}$ .**

Sol. in 20,100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . (Rosenblatt, B. 19. 2531.)

**Cæsium lead nitrite,  $\text{CsPb}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Sol. in cold  $\text{H}_2\text{O}$  without decomp. When solution is heated, some basic lead salt separates. (Jamieson, Am. Ch. J. 1907, 38. 618.)

**Cæsium lead silver nitrite,  $\text{Cs}_2\text{AgPb}(\text{NO}_2)_4 + 2\text{H}_2\text{O}$ .**

Ppt. (Jamieson.)

**Cæsium silver nitrite,  $\text{CsAg}(\text{NO}_2)_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Jamieson.)

**Cæsium silver strontium nitrite,  $\text{Cs}_2\text{AgSr}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$ .**

Partially decomp. by  $\text{H}_2\text{O}$ . (Jamieson.)

**Cæsium strontium nitrite,  $\text{CsSr}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Ppt. Sol. in  $\text{H}_2\text{O}$ . (Jamieson.)

**Calcium nitrite,  $\text{Ca}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .**

Very deliquescent. Insol. in dil. alcohol. (Fischer, Pogg. 74. 115.)

100 ccm. of the sat. solution contain 111.6 g.  $\text{Ca}(\text{NO}_2)_2 + \text{H}_2\text{O}$  at  $20.5^\circ$ . (Vogel, Z. anorg. 1903, 35. 395.)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	% $\text{Ca}(\text{NO}_2)_2$	Solid phase
0	38.3	$\text{Ca}(\text{NO}_2)_2, 4\text{H}_2\text{O}$
18.5	43	"
42	51.8	"
44	53.5	" + $\text{Ca}(\text{NO}_2)_2, \text{H}_2\text{O}$
54	55.2	$\text{Ca}(\text{NO}_2)_2, \text{H}_2\text{O}$
64	58.4	"
70	60.3	"
73	61.5	"
91	71.2	"

(Oswald, A. ch. 1914, (9) 1. 32.)

Sat. solution of  $\text{Ca}(\text{NO}_2)_2 + \text{AgNO}_2$  contains 92.4 g.  $\text{Ca}(\text{NO}_2)_2$  and 11.2 g.  $\text{AgNO}_2$  per 100 g.  $\text{H}_2\text{O}$  at  $14^\circ$ . (Oswald.)

Solubility in alcohol.

100 ccm. of sat. solution in 90% alcohol contain 39.0 g.  $\text{Ca}(\text{NO}_2)_2 + \text{H}_2\text{O}$  at  $20^\circ$ .

100 ccm. of sat. solution in absolute alcohol contain 1.1 g.  $\text{Ca}(\text{NO}_2)_2 + \text{H}_2\text{O}$  at  $20^\circ$ . (Vogel.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

+  $4\text{H}_2\text{O}$ . The sat. solution at  $16^\circ$  contains 42.3%  $\text{Ca}(\text{NO}_2)_2$  and has sp. gr. at  $16^\circ/0^\circ = 1.4205$ . (Oswald, A. ch. 1914, (9) 1. 66.)

**Calcium cobaltous potassium nitrite,**

$\text{Ca}(\text{NO}_2)_2, \text{Co}(\text{NO}_2)_2, 2\text{KNO}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Erdmann.)

**Calcium cupric potassium nitrite,**

$\text{CaCuK}_2(\text{NO}_2)_6$ .

Ppt., insol. in alcohol; sol. in  $\text{H}_2\text{O}$  with decomp.

14.97 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ , or 13.02 per cent of salt is contained in sat. solution. (Praisbylla, Z. anorg. 1897, 15. 422.)

**Calcium mercuric nitrite,  $\text{Ca}(\text{NO}_2)_2, \text{Hg}(\text{NO}_2)_2 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1910, 97. 327.)

**Calcium nickel potassium nitrite,  $\text{Ca}(\text{NO}_2)_2, \text{Ni}(\text{NO}_2)_2, 2\text{KNO}_2$ .**

Very al. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. Sl. sol. in dil.  $\text{HCl}$ . (Erdmann.)

**Calcium osmium nitrite.**

See Osminitrite, calcium.

**Calcium potassium nitrite,  $\text{CaK}(\text{NO}_2)_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoe, W. A. B. 73, 2. 112.) Deliquescent. (Lang.)

**Cobaltous nitrite.**

Known only in solution.

**Cobaltic lead nitrite,  $3\text{PbO}, \text{Co}_2\text{O}_3, 6\text{N}_2\text{O}_5 + 12\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1898, 17. 48.)

**Cobaltic lead potassium nitrite,  $3\text{K}_2\text{O}, 3\text{PbO}, 2\text{Co}_2\text{O}_3, 10\text{N}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

Sol. by boiling in much  $\text{H}_2\text{O}$ . Sol. in hot acids with evolution of  $\text{N}_2\text{O}_5$ . (Stromeyer, A. 96. 228.)

**Cobaltous potassium nitrite,  $2\text{Co}(\text{NO}_2)_2, 2\text{KNO}_2 + \text{H}_2\text{O}$ .**

Ppt. (Sadtler.)

$\text{Co}(\text{NO}_2)_2, 2\text{KNO}_2 + \text{H}_2\text{O}$ . Ppt. (Sadtler.)  $3\text{Co}(\text{NO}_2)_2, 6\text{KNO}_2 + \text{H}_2\text{O}$ . Insol. in cold, sol. in hot  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KCl}$ . (Erdmann, J. pr. 97. 397.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3602.)

**Cobaltic potassium nitrite (cobalt yellow),  $\text{Co}_2(\text{NO}_2)_6, 6\text{KNO}_2 + 3\text{H}_2\text{O}$ .**

Very al. sol. in cold  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. Sol. in traces in  $\text{CS}_2$ . (St. Evre,

C. R. 35. 552.) Insol. in boiling conc.  $K_2SO_4$ ,  $KCl$ ,  $KNO_3$ , or  $KC_2H_3O_2 + Aq$ .  
Sol. in 1120 pts.  $H_2O$  at  $17^\circ$ . (Rosenblatt, B. 1886, 19. 2535.)

Decomp. when heated in aq. solution. (Rosenheim, Z. anorg. 1898, 17. 42.)

More sol. in  $NH_4Cl$  or  $NaCl + Aq$  than in  $H_2O$ . (Stromeyer.)

Sl. decomp. by  $KOH + Aq$ , except when very conc.; easily decomp. by  $NaOH$  or  $Ba(OH)_2 + Aq$ .

Very sl. sol. in  $KC_2H_3O_2 + Aq$ , or  $KNO_3 + Aq$ . (Fresenius.) Sol. in  $HCl + Aq$ .

Sol. in  $HC_2H_3O_2$ , or  $H_2C_2O_4 + Aq$ . (Stromeyer.)

Small quantity of  $HC_2H_3O_2 + Aq$  does not dissolve. (Fresenius.)

**Cobaltic potassium silver nitrite**,  $KCoAg_2(NO_2)_6$ , and  $K_2CoAg(NO_2)_4$ .

Very sl. sol. in  $H_2O$ . Less sol. than  $Na$  comp. (Burgess and Karum, J. Am. Chem. Soc. 1912, 34. 653.)

**Cobaltous potassium strontium nitrite**,  $Co(NO_2)_2, 2KNO_3, Sr(NO_3)_2$ .

Decomp. by  $H_2O$ . (Erdmann, J. pr. 97. 385.)

**Cobaltic rubidium nitrite**,  $Rb_2Co(NO_2)_6 + H_2O$ .

Sol. in 19,800 pts.  $H_2O$ . (Rosenblatt, B. 19. 2531.)

**Cobaltic silver nitrite**,  $CoAg_2(NO_2)_6$ .

Fairly sol. in  $H_2O$ . (Cunningham and Perkin, Chem. Soc. 1909, 95. 1568.)

$2AgO, Co_2O_3, 3N_2O_5 + 3H_2O$ . Sl. sol. in  $H_2O$ ; decomp. by boiling  $H_2O$ . (Rosenheim, Z. anorg. 1898, 17. 56.)

**Cobaltic silver hydroxynitrite**,  $Co_2Ag_2(OH)_2(NO_2)_6$ .

Sl. sol. in  $H_2O$ . (Suzuki, Chem. Soc. 1910, 97. 729.)

**Cobaltic silver nitrite ammonia**,  $Co_2O_3, Ag_2O, 4N_2O_5, 4NH_3$ .

See Cobalt ammonium comps.

**Cobaltic sodium nitrite**,  $2Na_2O, Co_2O_3, 4N_2O_5$ .

Sol. in  $H_2O$  and alcohol. (Rosenheim, Z. anorg. 1898, 17. 50.)

$+H_2O$ . Ppt. (Sadler, Sill. Am. J. (2) 49. 196.)

$3Na_2O, Co_2O_3, 6N_2O_5 + xH_2O$ . Sol. in  $H_2O$ ; decomp. on heating; insol. in alcohol. (Rosenheim, Z. anorg. 1898, 17. 43.)

**Cobaltic strontium nitrite**,  $2SrO, Co_2O_3, 4N_2O_5 + 11H_2O$ .

Ppt. (Rosenheim, Z. anorg. 1898, 17. 54.)

**Cobaltic thallium nitrite**,  $Co_2(NO_2)_6, 6TlNO_2$ .

Sol. in 23,810 pts.  $H_2O$  at  $17^\circ$ . (Rosenblatt, B. 19. 2531.)

**Cobaltic zinc nitrite**,  $2ZnO, Co_2O_3, 3N_2O_5 + 11H_2O$ .

Sol. in dil. acetic acid. (Rosenheim, Z. anorg. 1898, 17. 56.)

**Cobalt nitrite nitrate**,  $2CoO, Co_2O_3, 3N_2O_5, Co(NO_3)_2 + 14H_2O$ .

Ppt. (Rosenheim, Z. anorg. 1898, 17. 58.)

**Cupric nitrite, basic**,  $2CuO, N_2O_5$ .

(Hampe, A. 125. 345.)

$Cu(NO_2)_2, 3Cu(OH)_2$ . Very sl. sol. in  $H_2O$  or alcohol. Easily sol. in dil. acids or ammonia. (van der Meulen, B. 12. 758.)

**Cupric nitrite**.

Known only in solution.

**Cupric lead potassium nitrite**,  $CuPbK_2(NO_2)_6$ .

(van Lessen, R. t. c. 10. 13.)

3.056 pts. are sol. in 100 pts.  $H_2O$  at  $20^\circ$ , or 2.51% salt is contained in sat. solution at  $20^\circ$  p. 429. (Präbilla, Z. anorg. 1897, 15. 429.)

**Cupric potassium strontium nitrite**,  $CuSrK_2(NO_2)_6$ .

Sol. in  $H_2O$  with decomp. 10.82 pts. are sol. in 100 pts.  $H_2O$  at  $20^\circ$ , or 9.77 per cent salt is contained in sat. solution at  $20^\circ$ . (Präbilla, Z. anorg. 1897, 15. 425.)

**Cupric rubidium nitrite**,  $Rb_2Cu(NO_2)_6$ .

Easily sol. in  $H_2O$ . Sol. in alcohol. (Kurténacker, Z. anorg. 1913, 82. 206.)

**Cupric nitrite ammonia**,  $Cu(NO_2)_2, 2NH_3 + 2H_2O$ .

Sol. in little  $H_2O$  with absorption of much heat. Decomp. by much  $H_2O$ . (Peligot, C. R. 53. 209.)

$3CuO, N_2O_5, 2NH_3 + H_2O$ . As above. (Peligot.)

**Iridium hydrogen nitrite**,  $Ir_2H_2(NO_2)_{11}$ .

See Iridonitrous acid.

**Iridium nitrite with  $MNO_2$** .

See Iridonitrite, M.

**Iron (ferrous) lead potassium nitrite**,  $FePbK_2(NO_2)_6$ .

Ppt.; insol. in cold  $H_2O$ ; stable at ordinary temp. (Präbilla, Z. anorg. 1897, 15. 439.)

**Iron (ferrous) lead thallos nitrite**,  $FePbTl_2(NO_2)_6$ .

Ppt. (Präbilla, Z. anorg. 1898, 18. 463.)



**Lead nitrite, basic**,  $4\text{PbO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O} = \text{Pb}(\text{OH})\text{NO}_2$ ,  $\text{PbO}$ .

Sol. in 143 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ , and 33 pts. at  $100^\circ$ . (Chevreul.)

Sol. in 1250 pts. cold  $\text{H}_2\text{O}$ , and 34.5 pts. at  $100^\circ$ . (Peligot.)

Sol. in cold  $\text{HNO}_3$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ .

Composition is  $3\text{PbO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . (Meissner, J. B. 1876. 194.)

Composition is as above. (v. Lorenz, W. A. B. 84, 2. 1133.)

$3\text{PbO}$ ,  $\text{N}_2\text{O}_5 = \text{Pb}(\text{NO}_2)_2$ ,  $2\text{PbO}$ . Sol. in  $\text{H}_2\text{O}$ . (Bromeis, A. 72. 38; v. Lorenz.)

$2\text{PbO}$ ,  $\text{N}_2\text{O}_5 + \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Bromeis.)

+  $3\text{H}_2\text{O}$ . (Meissner.)

$4\text{PbO}$ ,  $3\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Meissner, J. B. 1876. 195.)

**Lead nitrite**,  $\text{Pb}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Peligot, A. ch. 77. 87.)

**Lead nickel potassium nitrite**,  $\text{Pb}(\text{NO}_2)_2$ ,  $\text{KNO}_3$ ,  $\text{Ni}(\text{NO}_2)_2$ .

Insol. in  $\text{H}_2\text{O}$ . (Baubigny, A. ch. (6) 17. 111.)

Ppt. (Przibylla, Z. anorg. 1897, 15. 432.)

**Lead nickel thalious nitrite**,  $\text{NiPbTl}_3(\text{NO}_2)_4$ .

Ppt. (Przibylla, Z. anorg. 1898, 18. 462.)

**Lead potassium nitrite**,  $4\text{Pb}(\text{NO}_2)_2$ ,  $6\text{KNO}_3 + 3\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and in absolute alcohol. (Hampe, A. 125. 334.)

$\text{Pb}(\text{NO}_2)_2$ ,  $2\text{KNO}_3 + \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang, J. B. 1862. 102.)

**Lead potassium silver nitrite**,  $\text{K}_2\text{AgPb}(\text{NO}_2)_6 + 2\text{H}_2\text{O}$ .

Ppt. (Jamieson, Am. Ch. J. 1907, 38. 619.)

**Lead nitrite nitrate**.

See Nitrate nitrite, lead.

**Lithium nitrite**,  $\text{LiNO}_2 + \frac{1}{2}\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in alcohol and  $\text{H}_2\text{O}$ . (Vogel, Z. anorg. 1903, 35. 403.)

Sat. solution of  $\text{LiNO}_2 + \frac{1}{2}\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  contains at:

65°	81.5°	91°	96°	92.5°
63.8	68.7	72.4	91.8	94.3% $\text{LiNO}_2$ .

(Oswald.)

+  $\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ , readily forming supersat. solutions. Very sol. in abs. alcohol. (Ball, Chem. Soc. 1913, 103. 2133.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0°	10°	20°
125	156	189 pts. $\text{LiNO}_2 + \text{H}_2\text{O}$ .
30°	40°	50°
242	316	459 pts. $\text{LiNO}_2 + \text{H}_2\text{O}$ .

$\text{LiNO}_2$ ,  $\text{H}_2\text{O} + \text{Aq}$  sat. at  $19^\circ$  contains 48.9%  $\text{LiNO}_2$  and has sp. gr. = 1.3186. (Oswald, A. ch. 1914, (9) 1. 61.)

100 g.  $\text{H}_2\text{O}$  dissolve 78.5 g.  $\text{LiNO}_2 + 10.5$  g.  $\text{AgNO}_2$  at  $14^\circ$ . (Oswald.)

**Lithium mercuric nitrite**,  $\text{LiNO}_2$ ,  $\text{Hg}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .

(Ray, Chem. Soc. 1907, 91. 2033.)

$4\text{LiNO}_2$ ,  $\text{Hg}(\text{NO}_2)_2 + 4\text{H}_2\text{O}$ . Extremely deliquescent. (Ray.)

**Magnesium nitrite**,  $\text{Mg}(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . Solution decomp. by boiling. Easily sol. in absolute alcohol. (Hampe, A. 125. 334.)

Insol. in absolute alcohol. (Fischer.)

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and absolute alcohol. Very deliquescent. (Vogel, Z. anorg. 1903, 35. 397.)

**Magnesium osmium nitrite**.

See Osminitrite, magnesium.

**Magnesium potassium nitrite**.

Deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang.)

**Magnesium silver nitrite**.

Sol. in  $\text{H}_2\text{O}$  with decomp. (Spiegel, Ch. Z. 1895, 19. 1423.)

**Manganous nitrite**.

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Mitscherlich.) Not obtained in a solid state, as the solution decomp. on evaporation. (Lang, Pogg. 118. 290.)

**Mercurous nitrite**,  $\text{Hg}_2(\text{NO}_2)_2$ .

Sol. in  $\text{H}_2\text{O}$  with partial decomp. to  $\text{Hg}$  and  $\text{Hg}(\text{NO}_2)_2$ . (Ray, A. 1901, 316. 252.)

Sol. in cold conc.  $\text{HNO}_3$ . Very slowly sol. in cold dil.  $\text{HNO}_3$ . (Ray, Chem. Soc. 1897, 71. 339.)

Decomp. by boiling  $\text{H}_2\text{O}$  and by cold dil.  $\text{H}_2\text{SO}_4$ . (Ray, Z. anorg. 1896, 12. 366.)

+  $\text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1897, 71. 340.)

**Mercuric nitrite, basic**,  $\text{Hg}(\text{NO}_2)_2$ ,  $2\text{HgO} + \text{H}_2\text{O}$ .

Ppt. (Lang.)

$12\text{HgO}$ ,  $5\text{N}_2\text{O}_5 + 24\text{H}_2\text{O}$ . (Ray, Chem. Soc. 1897, 71. 341.)

**Mercuric nitrite**,  $\text{Hg}(\text{NO}_2)_2$ .

Deliquescent. Partly sol. in boiling  $\text{H}_2\text{O}$ , but the greater part is decomp. into  $\text{HgO} + \text{HNO}_3$ . (Ray, Proc. Chem. Soc. 1904, 20. 57.)

**Mercuriomercuric nitrite, basic**.

a.  $9\text{Hg}_2\text{O}$ ,  $4\text{HgO}$ ,  $5\text{N}_2\text{O}_5 + 8\text{H}_2\text{O}$ .

β.  $\text{Hg}_2\text{O}$ ,  $2\text{HgO}$ ,  $\text{N}_2\text{O}_5 + 2\text{H}_2\text{O}$ .

(Ray, Chem. Soc. 1897, 71. 341.)

**Mercuric potassium nitrite**,  $\text{Hg}(\text{NO}_2)_2 \cdot 2\text{KNO}_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lang, 1860.)

$\text{KHg}(\text{NO}_2)_2$ . Obtained from  $\text{K}_2\text{Hg}(\text{NO}_2)_4$ ,  $\text{H}_2\text{O} + \text{Aq}$  containing a small excess of  $\text{KNO}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 28. 173.)

$\text{K}_2\text{Hg}(\text{NO}_2)_4 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Formula of Lang is incorrect. (Rosenheim, Z. anorg. 1901, 28. 172.)

**Mercuric sodium nitrite**,  $\text{Na}_2\text{Hg}(\text{NO}_2)_4$ .

Very hygroscopic. Decomp. by hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 28. 173.)

$+2\text{H}_2\text{O}$ . Deliquescent. (R&y, Chem. Soc. 1907, 91. 2032.)

$2\text{Hg}(\text{NO}_2)_2 \cdot 3\text{NaNO}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (R&y, Chem. Soc. 1907, 91. 2032.)

**Mercuric strontium nitrite**,  $3\text{Hg}(\text{NO}_2)_2 \cdot 2\text{Sr}(\text{NO}_2)_2 + 5\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (R&y, Chem. Soc. 1910, 97. 327.)

**Mercuric nitrite hydrazine**,  $\text{Hg}(\text{NO}_2)_2 \cdot \text{N}_2\text{H}_4$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Hofmann and Marburg, A. 1899, 305. 215.)

**Nickel nitrite, basic**,  $2\text{NiO} \cdot \text{N}_2\text{O}_5$ .

Ppt. (Hampe, A. 125. 343.)

**Nickel nitrite**,  $\text{Ni}(\text{NO}_2)_2$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Lang, J. B. 1862. 100.)

**Nickel potassium nitrite**,  $\text{Ni}(\text{NO}_2)_2 \cdot 4\text{KNO}_2$ .

Moderately sol. in  $\text{H}_2\text{O}$ . (Fischer, Pogg. 74. 115.) Extremely sol. in  $\text{H}_2\text{O}$ . (Hampe, A. 125. 346.) Insol. in absolute alcohol.

**Nickel potassium strontium nitrite**,  $\text{Ni}(\text{NO}_2)_2 \cdot 2\text{KNO}_2 \cdot \text{Sr}(\text{NO}_2)_2$ .

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ .

**Nickel nitrite ammonia**,  $\text{Ni}(\text{NO}_2)_2 \cdot 4\text{NH}_3$ .

Sol. in cold  $\text{H}_2\text{O}$ . Decomp. on standing or by heating. Insol. in alcohol. Can be recrystallized by dissolving in  $\text{NH}_4\text{OH} + \text{Aq}$ , and adding much absolute alcohol. (Erdmann, J. pr. 97. 395.)

$\text{Ni}(\text{NO}_2)_2 \cdot 5\text{NH}_3$ . Decomp. in the air giving  $\text{Ni}(\text{NO}_2)_2 \cdot 4\text{NH}_3$ . (Ephraim, B. 1913, 46. 3110.)

**Osmium nitrite**,  $\text{Os}(\text{NO}_2)_2$ .

Ppt. (Wintrebert, C. R. 1905, 140. 587.)

**Osmium nitrite with  $\text{MNO}_2$** .

See Osminitrite, M.

**Osmyl nitrite with  $\text{MNO}_2$** .

See Osmynitrite, M.

**Osmyl oxynitrite with  $\text{MNO}_2$** .

See Osmyloxynitrite, M.

**Osmyl nitrite ammonia**,  $\text{OsO}_2(\text{NO}_2)_2 \cdot 4\text{NH}_3$ .

(Wintrebert, A. ch. 1903, (7) 28. 56.)

**Palladious nitrite with  $\text{MNO}_2$** .

See Palladonitrite, M.

**Platinous hydrogen nitrite**,  $\text{H}_2\text{Pt}(\text{NO}_2)_4$ .

See Platonitrous acid.

**Platinous nitrite with  $\text{MNO}_2$** .

See Platonitrite, M.

**Potassium nitrite**,  $\text{KNO}_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

Pure  $\text{KNO}_2$  is not deliquescent. (Oswald, A. ch. 1914, (9) 1. 32.)

Sol. in about  $\frac{1}{2}$  its wt. of  $\text{H}_2\text{O}$ . (Divers, Chem. Soc. 1899, 75. 86.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0°	10°	20°	30°	40°
281	291	302	313	325 pts. $\text{KNO}_2$ ,

50°	60°	70°	80°	90°
337.5	351	365	380	398 pts. $\text{KNO}_2$ ,

100°	110°	120°	130°
413	432	451	473 pts. $\text{KNO}_2$ .

Bpt. of sat.  $\text{KNO}_2 + \text{Aq}$  is  $132^\circ$  at 758.5 mm. pressure.

(Oswald, A. ch. 1914, (9) 1. 53.)

Sp. gr. of  $\text{KNO}_2 + \text{Aq}$  at  $17.5^\circ$  containing:

10	20	30	40% $\text{KNO}_2$ ,
1.049	1.126	1.208	1.295

50	60	70	74.5% $\text{KNO}_2$ .
1.377	1.491	1.599	1.646

(Oswald.)

100 g.  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 18 g.  $\text{KNO}_2 + 2.36$  g.  $\text{AgNO}_2$ ; at  $25^\circ$ , 23.1 g.  $\text{KNO}_2 + 5.3$  g.  $\text{AgNO}_2$ , with excess of  $\text{AgNO}_2$ .

100 g.  $\text{H}_2\text{O}$  at  $13.5^\circ$  dissolve 276 g.  $\text{KNO}_2 + 26.3$  g.  $\text{AgNO}_2$ ; at  $25^\circ$ , 279 g.  $\text{KNO}_2 + 39.3$  g.  $\text{AgNO}_2$ , with excess of  $\text{KNO}_2$ . (Oswald.)

See also under  $\text{AgNO}_2$ .

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Deliquesces in 90% alcohol; insol. in cold 94% alcohol. More sol. in  $\text{H}_2\text{O}$  than  $\text{KNO}_3$ , but less sol. in alcohol. (Fischer.)

Ppt. from its conc. aq. solution by the addition of methyl alcohol. Addition of ethyl alcohol to a conc. aq. solution of  $\text{KNO}_2$  causes separation into two layers, of which the lower aq. solution contains 71.9%  $\text{KNO}_2$ , while the upper alcoholic layer contains 6.9%  $\text{KNO}_2$ . (Donath, Ch. Z. 1911, 35. 773.)

Very sl. sol. in acetone. (Krug and Meyer, J. Anal. Ch. 6. 184.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

**Potassium rhodium nitrite**,  $6\text{KNO}_3$ ,  $\text{Rh}_2(\text{NO}_2)_6$ .

See Rhodonitrite, potassium.

**Potassium ruthenium nitrite.**

See Ruthenonitrite, potassium.

**Potassium silver nitrite**,  $\text{KNO}_3$ ,  $\text{AgNO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . Sol. in  $\text{KNO}_3 + \text{Aq}$  without decomp. Insol. in alcohol. (Lang.)

**Potassium strontium nitrite**,  $2\text{KNO}_3$ ,  $\text{Sr}(\text{NO}_2)_2$ .

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Lang, Pogg. 118. 293.)

**Potassium zinc nitrite**,  $2\text{KNO}_3$ ,  $\text{Zn}(\text{NO}_2)_2 + \text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Lang, J. B. 1862. 101.)

$\text{K}_2\text{Zn}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ . Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 23. 174.)

**Rhodium nitrite with  $\text{MNO}_3$ .**

See Rhodonitrite, M.

**Rubidium nitrite**,  $\text{RbNO}_2$ .

Deliquescent; very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in hot alcohol, almost insol. in acetone. (Ball, Chem. Soc. 1913, 103. 2131.)

**Ruthenium nitrite with  $\text{MNO}_3$ .**

See Ruthenonitrite, M.

**Silver nitrite**,  $\text{AgNO}_2$ .

Sol. in 120 pts. cold  $\text{H}_2\text{O}$  (Mitscherlich), in 300 pts. (Fischer), and more abundantly in hot  $\text{H}_2\text{O}$ .

1 l.  $\text{H}_2\text{O}$  dissolves 3.1823 g. or 0.02067 g. mols. at  $18^\circ$ . (Naumann and Rücker, B. 1905, 38. 2294.)

1 litre  $\text{H}_2\text{O}$  dissolves at—

$0^\circ$	0.0113 mol. $\text{AgNO}_2$
$8^\circ$	0.0159 " "
$14^\circ$	0.0189 " "
$16^\circ$	0.0203 " "
$18^\circ$	0.0216 " "
$25^\circ$	0.0260 " "
$33^\circ$	0.0370 " "

(Pick and Abegg, Z. anorg. 1906, 51. 3.)

1 l.  $\text{H}_2\text{O}$  dissolves 3.609 g.  $\text{AgNO}_2$  at  $21^\circ$ . (Oswald, A. ch. 1914, (9) 1. 33.)

### Solubility in $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	% $\text{AgNO}_2$
1	0.1589
15	0.2752
25	0.4125
35	0.6016
51	1.0240
60	1.3625

(Creighton and Ward, J. Am. Chem. Soc. 1915, 37. 2335.)

### Solubility in $\text{AgNO}_3 + \text{Aq}$ at $18^\circ$ .

Mols. $\text{AgNO}_3$ per l. of the solution	Mols. $\text{AgNO}_2$ dissolved per l.
0.	0.0207
0.0026	0.0198
0.0052	0.0190
0.0103	0.0169
0.0207	0.0144
0.0413	0.0117
0.0827	0.0096

(Abegg and Pick, B. 1905, 38. 2573.)

1 l. 0.2-N  $\text{NaNO}_3 + \text{Aq}$  dissolves 4.956 g.  $\text{AgNO}_2$  at  $25^\circ$ . (Ley and Schaefer, B. 1906, 39. 1263.)

1 l. sat.  $\text{KNO}_3 + \text{Aq}$  dissolves 26%  $\text{AgNO}_2$  at  $13.5^\circ$ . (Oswald, A. ch. 1914, (9) 1. 33.)

### Solubility in salts + $\text{Aq}$ at $25^\circ$ .

Salt	Conc. of the salt mols. per l.	G. $\text{AgNO}_2$ in 100 g. of solution
		0.4135
$\text{AgNO}_3$	0.00258	0.3991
	0.00588	0.3735
	0.01177	0.3432
	0.02355	0.2943
	0.04710	0.2498
$\text{KNO}_3$	0.00258	0.3974
	0.00588	0.3820
	0.01177	0.3560
	0.02355	0.3119
	0.04710	0.2765

(Creighton and Ward, J. Am. Chem. Soc. 1915, 37. 2336.)

See also under  $\text{KNO}_3$ .

$\text{AgNO}_2 + \text{NaNO}_3$ .

1 l. 0.02 N- $\text{NaNO}_3 + \text{Aq}$  dissolves 3.185 g.  $\text{AgNO}_2$  at  $25^\circ$ , 0.2-N  $\text{NaNO}_3$ , 3.016 g.  $\text{AgNO}_2$ . (Ley and Schaefer, B. 1906, 39. 1263.)

100 g.  $\text{H}_2\text{O}$  sat. with  $\text{AgNO}_2$  and  $\text{Sr}(\text{NO}_2)_2$  contain 10.9 g.  $\text{AgNO}_2$  and 78.3 g.  $\text{Sr}(\text{NO}_2)_2$  at  $14^\circ$ . (Oswald.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 829.)

Insol. in alcohol.

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37, 4328.)

100 pts. acetonitrile dissolve 23 pts. at ord. temp.; 40 pts. at  $81.6^\circ$ . (Scholl and Steinkopf, B. 1906, 39, 4393.)

Sl. sol. in methyl acetate. (Bezold, Dissert. 1906.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43, 314.)

**Silver sodium nitrite,  $\text{AgNO}_2, \text{NaNO}_2$ .**

Completely sol. in a little  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . (Fischer.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . (Oswald, A. ch. 1914, (9) 1, 75.)

**Silver nitrite ammonia,  $\text{AgNO}_2, \text{NH}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; less sol. in alcohol; nearly insol. in ether. (Reychler, B. 16, 2425.)

$\text{AgNO}_2, 2\text{NH}_3$ . (Reychler.)

$\text{AgNO}_2, 3\text{NH}_3$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Reychler.)

**Sodium nitrite,  $\text{NaNO}_2$ .**

Not deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{NaNO}_3$ , but less in alcohol.

6 pts.  $\text{H}_2\text{O}$  dissolve 5 pts.  $\text{NaNO}_2$  at  $15^\circ$ . (Divers, Chem. Soc. 1899, 75, 86.)

100 g.  $\text{H}_2\text{O}$  dissolve 83.25 g.  $\text{NaNO}_2$  at  $15^\circ$ . (Niementowski and Roszkowski, J. phys. Ch. 1897, 22, 146.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$   $10^\circ$   $20^\circ$   $30^\circ$   $40^\circ$   
73 78 84 91.5 98.5 pts.  $\text{NaNO}_2$ ,

$50^\circ$   $60^\circ$   $70^\circ$   $80^\circ$   
107 116 125.5 136 pts.  $\text{NaNO}_2$ ,

$90^\circ$   $100^\circ$   $110^\circ$   $120^\circ$   
147 160.5 178 198.5 pts.  $\text{NaNO}_2$ .

B-pt. of sat.  $\text{NaNO}_2 + \text{Aq} = 128^\circ$  at 761.5 mm. pressure. Sat. solution at  $20^\circ$  has a sp. gr. = 1.3585. (Oswald, A. ch. 1914, (9) 1, 59.)

**Solubility in  $\text{NaNO}_2 + \text{Aq}$  at  $t^\circ$ .**

$t^\circ$	100 pts. $\text{H}_2\text{O}$ dissolve	
	$\text{NaNO}_2$	$\text{NaNO}_3$
0	73	0
	68.5	19
	67.1	36.3
	64.9	41.7*
	50.3	46.8
	30.2	55.4
	0	74.2

**Solubility in  $\text{NaNO}_2 + \text{Aq}$  at  $t^\circ$ .—Continued.**

$t^\circ$	100 pts. $\text{H}_2\text{O}$ dissolve	
	$\text{NaNO}_2$	$\text{NaNO}_3$
21	84.75 81.1 79.7 73.8 73.1 64.2 46.8 21.6 0	0 9.6 23.5 50.8 54.5* 56.7 62.8 74.7 89.3
52	108.8 107.9 104.3 101.8 99.5 98.0 97.8 65.2 44.2 27.2 14.7 0	0 6.7 20.6 34.5 43.2 62.6* 82.0 88.0 92.9 101.4 109 118
65	120.7 111.5 108.5 107.8 78.3 49.5 28.4 14.7 0	0 34.8 62.8 90.6* 96 104.1 113.4 121.4 131
81	137.1 125.7 122.7 122.6 79.1 50.0 27.2 0	0 38.8 69.8 101.0* 111.5 121.0 131.7 150
92	149.7 141.2 134.6 132.3 60.2 30.3 0	0 23.6 57.6 107.8* 130.6 145.0 163.5
103	166 153.3 148.8 142.4 100.0 60.1 0	0 33.2 58.8 116.0* 126.8 142.9 181.2

\* Both salts in solid phase.

(Oswald, A. ch. 1914, (9) 1, 71.)

Solubility in  $H_2O$  is decreased by presence of  $Na_2SO_4$ . 100 pts.  $H_2O$  dissolve 11.8 pts.  $Na_2SO_4$  + 53.9 pts.  $NaNO_2$ . (Oswald.)

Very sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Neither dissolved nor attacked by liquid  $NO_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol. in warm 90% alcohol. (Hampe, A. 125. 336.)

100 pts. absolute methyl alcohol dissolve 4.43 pts. at  $19.5^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 0.31 pt. at  $19.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

### Strontium nitrite, $Sr(NO_2)_2$ .

Very sol. in  $H_2O$ , and very sl. sol. in boiling alcohol. (Lang, Pogg. 118. 287.)

Easily sol. in 90% alcohol. (Hampe, A. 125. 340.)

+ $H_2O$ . Hydrosopic. 100 ccm. of the sat. solution contain 62.83 g.  $Sr(NO_2)_2 + H_2O$  at  $19.5^\circ$ . (Vogel, Z. anorg. 1903, 35. 393.)

100 pts.  $H_2O$  dissolve at:

0°	10°	20°	30°
58.9	67.6	75.5	84 pts. $Sr(NO_2)_2 + H_2O$ ,
40°	50°	60°	70°
94	105	116	130 pts. $Sr(NO_2)_2 + H_2O$ ,
80°	90°	100°	
145	162	182	pts. $Sr(NO_2)_2 + H_2O$ .

Bpt. of sat. solution is  $112.5^\circ$  at 763 mm. pressure. The sat. solution at  $19^\circ$  contains 39.3%  $Sr(NO_2)_2$  and has sp. gr. at  $19^\circ/0^\circ = 1.4461$ . (Oswald, A. ch. 1914, (9) 1. 64.)

Solubility in alcohol. 100 ccm. of the solution in 90% alcohol contain 0.42 g.  $Sr(NO_2)_2 + H_2O$  at  $20^\circ$ . 100 ccm. of the solution in absolute alcohol contain 0.04 g.  $Sr(NO_2)_2 + H_2O$  at  $20^\circ$ . (Vogel, Z. anorg. 1903, 35. 393.)

### Thallous nitrite, $TlNO_2$ .

Sol. in  $H_2O$ . Ppt. from solution in  $H_2O$  by absolute alcohol. (Vogel, Z. anorg. 1903, 35. 404.)

Very sol. in  $H_2O$ ; insol. in alcohol. (Ball, Chem. Soc. 1913, 103. 2131.)

### Zinc nitrite, basic, $2ZnO, N_2O_3$ .

(Hampe, A. 125. 334.)

### Zinc nitrite, $Zn(NO_2)_2 + 3H_2O$ .

Deliquescent. Sol. in  $H_2O$  and alcohol. (Lang, J. B. 1862. 99.)

### Nitrous oxide, $N_2O$ .

See Nitrogen monoxide.

### Nitroxyl bromide, $NO_2Br$ .

Decomp. spontaneously or with  $H_2O$ . (Hasenbach, J. pr. (2) 4. 1.)

Does not exist. (Fröhlich, A. 224. 270.)

### Nitroxyl chloride, $NO_2Cl$ .

Decomp. by  $H_2O$  without evolution of gas. Probably does not exist. (Geuther, A. 245. 98.)

### Nitroxyl fluoride, $NO_2F$ .

Absorbed by  $H_2O$  with formation of  $HNO_3$  and  $HF$ . Decomp. by  $H_2O$ , alcohol, and ether. (Moissan and Lebeau, C. R. 1905, 140. 1624.)

### Nitroxypyrosulphuric acid,

$(HO)_2S_2O_7(NO_2)_2, H_2O$ .

Very deliquescent. Sol. in  $H_2O$  with decomp. (Weber, Pogg. 142. 602.)

### Nitryl chloride, $NO_2Cl$ .

See Nitroxyl chloride.

### Octamine cobaltic compounds.

The formulae of the following octamine cobaltic compounds should be reduced one-half, and they should be classed with the tetramine cobaltic compounds. (Jørgensen, Z. anorg. 2. 279.)

### Octamine cobaltic carbonate,

$Co_2(NH_3)_4(CO_3)_4 + 3H_2O$ .

Easily sol. in  $H_2O$ . (Vortmann and Blasberg, B. 22. 2654.)

See Carbonatotetramine carbonate.

$Co_2(NH_3)_4O_2(CO_3)_4 + 3H_2O$ . Rather difficultly sol. in  $H_2O$ .

— — — chloride (?),  $Co_2(NH_3)_4(OH)_2Cl_4 + 2H_2O$ .

Ppt.

$Co_2(NH_3)_4(OH)_2Cl_4, 2HgCl_2$ .

$Co_2(NH_3)_4(OH)_2Cl_4, PtCl_4 + H_2O$ . (Vortmann and Blasberg, B. 22. 2654.)

— — — mercuric chloride,  $Co_2(NH_3)_4Cl_4, 3HgCl_2 + H_2O$ .

$Co_2(NH_3)_4Cl_4, HgCl_2$ . Difficultly sol. in cold  $H_2O$ , decomp. on warming. (Vortmann.)

— — — chlorosulphite,  $Co_2(NH_3)_4(SO_3)_2Cl_2 + 4H_2O$ .

Sol. in  $H_2O$ . (Vortmann and Magdeburg, B. 22. 2635.)

— — — chromate,

$Co_2(NH_3)_4(CrO_4)_2(H_2O)_2 + 2H_2O$ .

Sol. in  $H_2O$  or acetic acid.

+ $8H_2O$ . Sol. in warm  $H_2O$  or acetic acid.

$Co_2(NH_3)_4(CrO_4)_2Cr_2O_7(H_2O)_2 + H_2O$ . Easily sol. in  $H_2O$ , from which it is precipitated by dil.  $HNO_3 + Aq$ . (Vortmann, B. 15. 5895.)

**Octamine cobaltic nitrate**,  $\text{Co}_2(\text{NH}_3)_8(\text{NO}_3)_6 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; precipitated by conc.  $\text{HNO}_3$  + Aq. (Vortmann.)

—— **nitratocarbonate**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{NO}_3)_2(\text{CO}_3)_2 + \text{H}_2\text{O}$ .

Less sol. than other octamine carbonates. (Vortmann and Blasberg, B. 22. 2650.)

See Carbonatotetramine cobaltic nitrate.

—— **purpureochloride**,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ ; partly precipitated from aqueous solution by conc.  $\text{HCl}$  + Aq. (Vortmann, B. 10. 1451.)

= Chlorotetramine cobaltic chloride,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{Cl}_2$ , *wich see*. (Jørgensen, J. pr. (2) 42. 211.)

—— **purpureomercuric chloride**,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2, 6\text{HgCl}_2$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Vortmann.)

= Chlorotetramine cobaltic mercuric chloride. (Jørgensen, J. pr. (2) 42. 211.)

—— **purpureomercuric hydroxychloride**,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgCl})_4(\text{HgOH})_4\text{Cl}_4$ .

Ppt. (Vortmann and Morgulis, B. 22. 2647.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_4$ . (V. and M.)  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_4(\text{OH})_2$ . (V. and M.)

—— **purpureomercuriodide, basic**,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{I}_4$ .

(Vortmann and Borsbach, B. 23. 2805.)

—— **purpureochloroplatinate**.

Very sl. sol. in  $\text{H}_2\text{O}$ . (Vortmann.)

= Chlorotetramine cobaltic chloroplatinate,  $\text{ClCo}(\text{NH}_3)_4(\text{OH}_2)\text{PtCl}_6 + 2\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) 42. 215.)

—— **roseochloride**,  $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2 + 2\text{H}_2\text{O}$ , or  $4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1891.)

See Roseotetramine cobaltic chloride.

—— **roseomercuric chloride**,  
 $\text{Co}_2(\text{NH}_3)_8\text{Cl}_6(\text{H}_2\text{O})_2, 6\text{HgCl}_2 + 3\text{H}_2\text{O}$ .

Ppt. (Vortmann.)

—— **roseomercuric hydroxychloride**,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgCl})_6(\text{HgOH})_2\text{Cl}_4$ .

(Vortmann and Morgulis, B. 22. 2647.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_4$ . (V. and M.)

$\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgOH})_8\text{Cl}_4(\text{OH})_2$ . (V. and M.)

—— **roseomercuric iodide**,  
 $\text{Co}_2\text{N}_8\text{H}_{16}(\text{HgI})_4\text{I}_4$ .

Ppt. Sol. in  $\text{HCl}$  or  $\text{HNO}_3$ . (Vortmann and Borsbach, B. 23. 2806.)

$\text{Co}_2\text{N}_8\text{H}_{20}(\text{HgI})_4\text{I}_4$ . Ppt. (V. and B.)

$\text{Co}_2\text{N}_8\text{H}_{20}(\text{HgI})_4\text{I}_4(\text{OH})_2$ . Ppt. (V. and B.)

**Octamine cobaltic sulphate**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{OH})_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ . (?)

Sol. in  $\text{H}_2\text{O}$  or dil.  $\text{H}_2\text{SO}_4$  + Aq. Sol. in moderately conc.  $\text{HCl}$  + Aq. (Vortmann and Blasberg, B. 22. 2653.)

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Vortmann.)

+  $4\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .

See Roseotetramine cobaltic sulphate.

—— **sulphatocarbonate**,  
 $\text{Co}_2(\text{NH}_3)_8\text{SO}_4(\text{CO}_3)_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann, B. 10. 1458.)

See Carbonatotetramine cobaltic sulphate.

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_4)_2\text{CO}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Blasberg, B. 22. 2650.)

—— **ammonium sulphite**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_2\text{NH}_4)_2 + 10\text{H}_2\text{O}$ .

See Octamine cobaltisulphite, ammonium.

**Octamine cobaltisulphurous acid**.

**Ammonium octamine cobaltisulphite**,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_2\text{NH}_4)_2 + 10\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Magdeburg, B. 22. 2632.)

$\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2(\text{SO}_2\text{NH}_4)_2 + 4\text{H}_2\text{O}$ .

**Ammonium barium** ————,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2\text{Ba}_2(\text{NH}_4)_2 + 7\text{H}_2\text{O}$ .

Ppt. (V. and M.)

**Barium** ————,  $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2\text{Ba}_2 + 7\text{H}_2\text{O}$ .

Ppt. (V. and M.)

**Cobaltic** ————,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2\text{Co}_2 + 36\text{H}_2\text{O}$ , and  $24\text{H}_2\text{O}$ .

**Luteocobaltic** ————,  
 $\text{Co}_2(\text{NH}_3)_8(\text{SO}_3)_2(\text{NH}_3)_{12}\text{Co}_2 + 8\text{H}_2\text{O}$ .

Ppt. (V. and M.)

**Octamine iridium chloride**,

$\text{Ir}_2(\text{NH}_3)_8\text{Cl}_6$ .

Very sol. in  $\text{H}_2\text{O}$ . (Palmaer, B. 22. 16.)

**Octamine iridium chlorosulphate**,

$\text{Ir}_2(\text{NH}_3)_8\text{Cl}_6\text{SO}_4 + 4\text{H}_2\text{O}$ .

(Palmaer.)

**Osmiamic acid**,  $\text{H}_2\text{N}_2\text{O}_8\text{O}_6$ , or  $\text{H}_2\text{N}_2\text{O}_8\text{O}_6(?)$ .

Known only in aqueous solution, which is unstable.

**Ammonium osmiamate.**

Easily sol. in  $H_2O$  or alcohol. (Fritzsche and Struve, J. pr. 41. 97.)

**Barium osmiamate,  $BaN_2Os_2O_4$ .**

Moderately sol. in  $H_2O$ .

**Lead osmiamate.**

Ppt. Sol. in acids without decomp.

**Lead osmiamate chloride.**

Ppt.

**Mercurous osmiamate.**

Ppt.

**Mercuric osmiamate.**

Ppt.

**Potassium osmiamate,  $K_2N_2Os_2O_4$ , or  $K_2N_2Os_2O_4$ .**

Sl. sol. in cold, much more easily in hot  $H_2O$ . Sl. sol. in alcohol. Insol. in ether.

**Silver osmiamate,  $Ag_2N_2Os_2O_4$ .**

Extremely sl. sol. in  $H_2O$  or cold  $HNO_3$  + Aq. Sol. in  $NH_4OH$  + Aq.

**Sodium osmiamate.**

Easily sol. in  $H_2O$  or alcohol.

**Zinc osmiamate,  $ZnN_2Os_2O_4$ .**

Decomp. by  $H_2O$ . Nearly insol. in  $NH_4OH$  + Aq.

**Osmic acid,  $H_2OsO_4$ .**

Stable in  $H_2O$  containing alcohol. Sol. in  $HNO_3$  or  $HCl$  + Aq. Not attacked by  $H_2SO_4$  + Aq. (Moraht and Wischin, Z. anorg. 3. 153.)

100 g.  $H_2O$  dissolve 5.88 g.  $H_2OsO_4$  at  $15^\circ$ . (Squire and Cains, Pharm. J. 1905, 74. 720.)

Attacked by liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

**Barium osmate,  $BaOsO_4 + H_2O$ .**

Insol. in  $H_2O$ . (Claus, Pogg. 65. 205.)

**Calcium osmate,  $CaOsO_4$ .**

Insol. in  $H_2O$ . (Fremy, J. pr. 33. 411.)

**Lead osmate.**

Insol. in  $H_2O$ . (Fremy.)

**Potassium osmate,  $K_2OsO_4 + 2H_2O$ .**

Sl. sol. in cold, much more sol. in hot  $H_2O$ , but is decomp. thereby. Sl. sol. in  $KNO_3$  + Aq. Insol. in dil. or conc. alcohol and ether. Fremy, A. ch. (3) 12. 516.)

Insol. in conc. saline solutions. (Gibbs, Am. J. Sci. (2) 31. 70.)

**Sodium osmate,  $Na_2OsO_4$ .**

Sol. in  $H_2O$ ; insol. in alcohol and ether. (Fremy, l. c.)

**Peroosmic acid.**

See Peroosmic acid.

**Osminitrous acid.****Ammonium osminitrite,  $(NH_4)_2Os(NO_2)_3 + 2H_2O$ .**

Sol. in  $H_2O$ . Decomp. when solution is warmed. (Wintrebert, C. R. 1905, 140. 586.)

**Barium osminitrite,  $BaOs(NO_2)_3$ .**

+  $H_2O$ ; +  $4H_2O$ . (Wintrebert.)

**Calcium osminitrite,  $CaOs(NO_2)_3 + 4H_2O$ .**

(Wintrebert.)

**Magnesium osminitrite,  $MgOs(NO_2)_3 + 4H_2O$ .**

(Wintrebert.)

**Potassium osminitrite,  $K_2Os(NO_2)_3$ .**

Very hygroscopic. Very sol. in  $H_2O$ . Decomp. by  $HCl$ ,  $HBr$  and  $HI$ . (Wintrebert, A. ch. 1903, (7) 23. 135.)

**Silver osminitrite,  $Ag_2Os(NO_2)_3 + 2H_2O$ .**

Sl. sol. in  $H_2O$  with partial decomp. (Wintrebert, C. R. 1905, 140. 586.)

**Sodium osminitrite,  $Na_2Os(NO_2)_3 + 2H_2O$ .**

Sol. in  $H_2O$ . (Wintrebert.)

**Strontium osminitrite,  $SrOs(NO_2)_3 + 2H_2O$ .**

(Wintrebert.)

**Zinc osminitrite,  $ZnOs(NO_2)_3 + \frac{1}{2}H_2O$ .**

(Wintrebert.)

**Osmyloxynitrous acid.****Ammonium osmyloxynitrite,**

$(NH_4)_2OsO_3(NO_2)_3$ .

Decomp. by boiling conc.  $HCl$  and by  $KOH$  + Aq. (Wintrebert, A. ch. 1903, (7) 23. 107.)

**Barium osmyloxynitrite,  $BaOsO_3(NO_2)_3 + 4H_2O$ .**

(Wintrebert.)

**Potassium osmyloxynitrite,  $K_2OsO_3(NO_2)_3 + 3H_2O$ .**

Sl. sol. in cold  $H_2O$ . Aqueous solution decomp. slowly. Sol. with decomp. in dil.  $KOH$  + Aq. (Wintrebert.)

**Silver osmyloxynitrite,  $Ag_2OsO_3(NO_2)_3 + H_2O$ .**

(Wintrebert.)

**Strontium osmyloxynitrite**,  $\text{SrOsO}_2(\text{NO}_2)_2 + 3\text{H}_2\text{O}$ . (Wintrebert.)

### Osmynitrous acid.

**Potassium osmynitrite**,  $\text{K}_2\text{OsO}_2(\text{NO}_2)_4$ .

Decomp. by  $\text{H}_2\text{O}$  and by excess of  $\text{KOH} + \text{Aq}$ . (Weinland, A. ch. 1903, (7) 28. 54.)

### Osmisulphurous acid.

**Potassium osmisulphite**,  $[\text{Os}(\text{H}_2\text{O})(\text{SO}_2)_2]\text{K}_4 + 4\text{H}_2\text{O}$ .

Ppt. (Rosenheim, Z. anorg. 1899, 21. 144.)

**Potassium hydrogen osmisulphite**,  $[\text{Os}_2(\text{H}_2\text{O})(\text{SO}_2)_3]\text{K}_{11}\text{H}_2 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Rosenheim.)  
 $[\text{Os}(\text{SO}_2)_2]\text{K}_2\text{H}_2 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Rosenheim.)

**Sodium osmisulphite**,  $[\text{Os}(\text{SO}_2)_2]\text{Na}_2 + 8\text{H}_2\text{O}$ .

Only sl. sol. in  $\text{H}_2\text{O}$ .

$[\text{Os}_2(\text{H}_2\text{O})(\text{SO}_2)_3]\text{Na}_4 + 4\text{H}_2\text{O}$ . Ppt.  
 $[\text{Os}(\text{SO}_2)_2]\text{Na}_2 + 3\text{H}_2\text{O}$ . Ppt. (Rosenheim.)

### Osmium, Os.

When finely divided and not ignited to a very high temperature, Os is sol. in  $\text{HNO}_3 + \text{Aq}$  or aqua regia. When ignited it is not attacked by any acid.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. ch. J. 1898, 30.. 828)

### Osmium ammonium compa.

See—

**Oxyosmiumamine compa.**,  $\text{OsO}(\text{NH}_3)_2\text{X}$ .

**Oxyosmiumdiamine compa.**,  $\text{OsO}_2(\text{NH}_3)_2\text{X}_2$ .

### Osmium bromide with MBr.

See Bromosmate, M.

### Osmium dichloride, $\text{OsCl}_2$ .

Deliquescent. Sol. in little, but decomp. by more  $\text{H}_2\text{O}$ , with pptn. of Os. Sol. in conc. alkali chlorides + Aq with combination and partial decomp. (Berselius.)

Sol. in alcohol and ether.

Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . Sl. sol. in  $\text{HNO}_3$  and aqua regia. Slowly sol. in strong alkali. Insol. in liquid  $\text{Cl}_2$ . Insol. in alcohol and formaldehyde. (Ruff, Z. anorg. 1910, 65. 455.)

### Osmium trichloride, $\text{OsCl}_3$ .

Hydroscopic. Sol. in conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and conc.  $\text{HNO}_3$ . Sol. in alkali and in  $\text{NH}_4\text{OH}$ . Insol. in liquid  $\text{Cl}_2$ . Easily sol. in alcohol. Sl. sol. in ether. (Ruff, Z. anorg. 1910, 65. 453.)

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Moraht and Wischin, Z. anorg. 3. 153.)

### Osmium tetrachloride, $\text{OsCl}_4$ .

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by further addition of that solvent. Sol. in conc.  $\text{HCl} + \text{Aq}$ .

### Osmium trichloride with MCl.

See Chlorosmate, M.

### Osmium tetrachloride with MCl.

See Chlorosmate, M.

### Osmium sodium chloride, $\text{Na}_2\text{OsCl}_4 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1899, 21. 133.)

### Osmium tetrafluoride, $\text{OsF}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Ruff, B. 1913, 46. 948.)

### Osmium hexafluoride, $\text{OsF}_6$ .

Decomp. by  $\text{H}_2\text{O}$  and conc.  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{NaOH} + \text{Aq}$ . (Ruff, B. 1913, 46. 945.)

### Osmium octofluoride, $\text{OsF}_8$ .

Sol. in  $\text{H}_2\text{O}$ , but is somewhat hydrolyzed. Sol. in conc.  $\text{H}_2\text{SO}_4$  with decomp. Sol. in  $\text{NaOH} + \text{Aq}$ . (Ruff, B. 1913, 46. 944.)

### Osmium monohydroxide, $\text{OsO}$ , $x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{KOH} + \text{Aq}$ . Slowly but completely sol. in acids. (Berselius.)

### Osmium dihydroxide, $\text{OsO}_2$ , $\text{H}_2\text{O}$ .

Sol. in  $\text{HCl} + \text{Aq}$  while still moist. Insol. in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . +  $2\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$  while still moist. (Claus and Jacoby.)

### Osmium sesquihydroxide, $\text{Os}_2\text{O}_3\text{H}_4$ .

Sol. in acids, and partly sol. in  $\text{KOH} + \text{Aq}$ . (Claus and Jacoby.)

### Osmium iodide, $\text{OsI}_4$ .

Extremely deliquescent. Sol. in  $\text{H}_2\text{O}$  of alcohol, but solution is unstable. (Moraht and Wischin, Z. anorg. 3. 153.)

### Osmium potassium nitroschloride, $\text{K}_2\text{Os}(\text{NO})\text{Cl}_4$ .

Stable in aqueous solution. Only sl. attacked by hot  $\text{HNO}_3$ . (Wintrebert, A. ch. 1903, (7) 28. 132.)

### Osmium monoxide, $\text{OsO}$ .

Insol. in  $\text{H}_2\text{O}$  or acids. (Claus and Jacoby.)

### Osmium dioxide, $\text{OsO}_2$ .

Insol. in  $\text{H}_2\text{O}$  or acids.

### Osmium sesquioxide, $\text{Os}_2\text{O}_3$ .

Insol. in acids. (Claus and Jacoby.)



**Osmium trioxide, "Osmic acid,"**  $\text{OsO}_3$ .

See Osmic acid.

**Osmium tetroxide, "Perosmic acid,"**  $\text{OsO}_4$ .

Slowly but abundantly sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol and ether with gradual decomposition. Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  the solution undergoing decomposition on heating.

**Osmium oxide ammonia,**  $\text{OsO}_2 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$ .

See Oxyosmiumamine hydroxide.

**Osmium oxysulphide,**  $\text{Os}_2\text{S}_7\text{O}_8 + 2\text{H}_2\text{O}$ .

Unstable.

$\text{OsSO}_2 + 1\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (v. Meyer, J. pr. (2) 16. 77.)

$\text{Os}_2\text{O}_5\text{S}_2 + \text{H}_2\text{O}$ . Decomp. and dissolved by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Moraht and Wischin, Z. anorg. 3. 153.)

**Osmium sulphide,**  $\text{Os}_2\text{S}_3$  (?).

(Berzelius.)

Min. *Laurite*. Insol. in all acids, even in aqua regia.

**Osmium disulphide,**  $\text{OsS}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; not more sol. in alkali hydrates or carbonates +  $\text{Aq.}$  Insol. in alkalies after drying. (Fremy, A. ch. (3) 12. 521.)

**Osmium tetrasulphide,**  $\text{OsS}_4 + x\text{H}_2\text{O}$ .

Insol. in alkali sulphides, carbonates, or hydroxides +  $\text{Aq.}$  Sol. in cold dil.  $\text{HNO}_3 + \text{Aq.}$  (Claus.)

**Osmocyanhydric acid,**  $\text{H}_4\text{Os}(\text{CN})_6$ .

Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in ether. (Martius, A. 117. 361.)

**Barium osmocyanide,**  $\text{Ba}_2\text{Os}(\text{CN})_6 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and dil. alcohol. (M.)

**Barium potassium osmocyanide,**

$\text{BaK}_2\text{Os}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

**Ferric osmocyanide,**  $\text{Fe}_4\text{Os}(\text{CN})_{12} + x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .

**Potassium osmocyanide,**  $\text{K}_2\text{Os}(\text{CN})_6 + 3\text{H}_2\text{O}$ .

Moderately sol. in boiling, less in cold  $\text{H}_2\text{O}$ . Insol. in alcohol and ether.

**Osmosyl ammonium comps.**

See Oxyosmium amine comps.

**Osmyl potassium bromide,**  $\text{K}_2\text{OsO}_2\text{Br}_4 + 2\text{H}_2\text{O}$ .

Same properties as the chloride. (Wintrebert, A. ch. 1903, (7) 28. 94.)

**Osmyl potassium chloride,**  $\text{K}_2\text{OsO}_2\text{Cl}_4$ .

Very sol. in  $\text{H}_2\text{O}$ . Solution is stable only in the presence of a small amt. of  $\text{HCl}$ . Decomp. by hot conc.  $\text{HCl}$ .

+  $2\text{H}_2\text{O}$ . As the anhydrous salt. (Wintrebert, A. ch. 1903, (7) 28. 86.)

**Osmyl ditetramine comps.**

See Oxyosmium diamine comps.

**Oxamidodisulphonic acid.**

See Hydroxylamine monosulphonic acid.

**Oximidosulphonic acid.**

See Hydroxylamine disulphonic acid.

**Oxyamidodisulphonic acid.**

See Hydroxylamine sulphonic acid.

**Oxyammonium salts.**

See Hydroxylamine salts.

**Oxycobaltamines, acid comps.**

(Maquenne, C. R. 96. 344.)

Are anhydrooxycobaltamine comps., which see. (Vortmann, M. ch. 6. 404.)

**Oxycobaltamine chloride,**

$\text{Co}_2(\text{NH}_3)_{10} \left( \begin{smallmatrix} \text{OH} \\ \text{OH} \end{smallmatrix} \right) \text{Cl}_4$ .

(Vortmann, M. ch. 6. 404.)

$\text{Co}_2(\text{NH}_3)_{10}\text{O}_2\text{Cl}_4$ ,  $\text{HCl} + 3\text{H}_2\text{O}$ . Is anhydrooxycobaltamine chloride, which see.

— chloronitrate hydrochloride,

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{NO}_2)_2\text{Cl}_2$ ,  $4\text{HCl} + 3\text{H}_2\text{O}$ .

Is anhydrooxycobaltamine chloronitrate, which see.

— chlorosulphate,

$\text{Co}_2(\text{NH}_3)_{10} \left( \begin{smallmatrix} \text{OH} \\ \text{O(OH)} \end{smallmatrix} \right) (\text{SO}_4)_2\text{Cl}_2$ ,  $4\text{HCl}$ .

Easily decomp.

— iodide,  $\text{Co}_2(\text{NH}_3)_{10} \left( \begin{smallmatrix} \text{OH} \\ \text{O(OH)} \end{smallmatrix} \right) \text{I}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Vortmann.)

— nitrate,  $\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{NO}_2)_4 + \text{H}_2\text{O}$ .

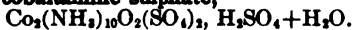
Decomp. by  $\text{H}_2\text{O}$ .

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{NO}_2)_4$ ,  $\text{HNO}_3 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ .

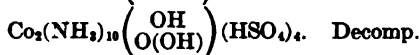
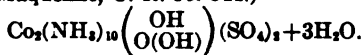
— nitratodisulphate,

$\text{Co}_2(\text{NH}_3)_{10}(\text{OH})(\text{O.OH})(\text{SO}_4)(\text{NO}_2)_3$ ,  $4\text{HNO}_3$ .

Decomp. at once by  $\text{H}_2\text{O}$ .

**Oxycobaltamine sulphate,**

Very sl. sol. in  $\text{H}_2\text{O}$  with decomp.; more easily sol. in acidified  $\text{H}_2\text{O}$ . Sol. in acids. (Maquenne, C. R. 96, 344.)



violently by  $\text{H}_2\text{O}$ .

**Oxygen,  $\text{O}_2$ .**

100 vols.  $\text{H}_2\text{O}$  absorb 4.6 vols. O gas at ord. temp. (Otto-Graham.)

Sol. in 27 pts.  $\text{H}_2\text{O}$  at ord. temp. (Pelouze and Fremy.)

100 vols.  $\text{H}_2\text{O}$  dissolve 0.925 vol. O. (Gay-Lussac.)

1 vol.  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm. absorbs V vols. O gas, reduced to  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	0.04114	7	0.03465	14	0.03034
1	0.04007	8	0.03389	15	0.02989
2	0.03907	9	0.03317	16	0.02949
3	0.03810	10	0.03250	17	0.02914
4	0.03717	11	0.03189	18	0.02884
5	0.03628	12	0.03133	19	0.02858
6	0.03544	13	0.03082	20	0.02838

(Bunsen's Gasometry.)

Coefficient of absorption of O by  $\text{H}_2\text{O}$  =  $0.04115 - 0.0010899t + 0.000022563t^2$ . (Bunsen and Pauli, A. 93, 21.)

Coefficient of absorption of O in  $\text{H}_2\text{O}$  at  $6.4^\circ = 0.041408$ ; at  $12.6^\circ = 0.036011$ . (Timofejew, Z. phys. Ch. 6, 148.)

Absorption of O by  $\text{H}_2\text{O}$ .  $\beta_1$  = "solubility," i. e., the amount of gas (reduced to  $0^\circ$  and 760 mm.) which is absorbed by 1 vol. of the liquid when the barometer indicates 760 mm. pressure;  $\beta$  = coefficient of absorption, i. e., amount absorbed by the liquid when the pressure of the gas itself without the tension of the liquid amounts to 760 mm.;  $\beta_1 = \beta \frac{760-f}{760}$ , when  $f$  = vapor tension of solvent at  $t^\circ$ .

$t^\circ$	$\beta$	$\beta_1$
0	0.04890	0.04860
1	4759	4728
2	4633	4601
3	4512	4479
4	4397	4362
5	4286	4250
6	4181	4142
7	4080	4040
8	3983	3941
9	3891	3847
10	3802	3756
11	3718	3670
12	3637	3587
13	3560	3507

**Absorption of O by  $\text{H}_2\text{O}$ .—Continued**

$t^\circ$	$\beta$	$\beta_1$
14	0.3486	0.3431
15	3415	3358
16	3347	3288
17	3283	3220
18	3220	3155
19	3161	3093
20	3102	3031
21	3044	2970
22	2988	2911
23	2934	2853
24	2881	2797
25	2831	2743
26	2783	2691
27	2736	2641
28	2691	2592
29	2649	2545
30	2608	2500
31	2572	2459
32	2537	2419
33	2503	2380
34	2471	2342
35	2440	2306
36	2410	2270
37	2382	2236
38	2355	2203
39	2330	2171
40	2306	2140
41	2280	2107
42	2256	2075
43	2232	2043
44	2209	2012
45	2187	1981
46	2166	1952
47	2145	1922
48	2126	1894
49	2108	1865
50	2090	1837
52	2057	1782
54	2026	1728
56	1998	1674
58	1971	1619
60	1946	1565
62	1921	1508
64	1897	1450
66	1874	1392
68	1853	1332
70	1833	1270
72	1815	1208
74	1799	1144
76	1785	1078
78	1772	1010
80	1761	9939
82	1752	0865
84	1743	0788
86	1736	0707
88	1729	0622
90	1723	0532
92	1717	0437
94	1712	0337
96	1708	0231
98	1704	0119
100	7001	0000

(Winkler, B. 24, 3800.)

Absorption of O by H<sub>2</sub>O at t° and 760 mm. $\beta$  = coefficient of absorption.

t°	$\beta$	t°	$\beta$	t°	$\beta$
0	0.04961	23	0.03006	46	0.02163
1	4838	24	2956	47	2139
2	4720	25	2904	48	2115
3	4606	26	2855	49	2092
4	4496	27	2808	50	2070
5	4389	28	2762	51	2049
6	4286	29	2718	52	2029
7	4186	30	2676	53	2009
8	4089	31	2635	54	1990
9	3994	32	2596	55	1972
10	3903	33	2558	56	1955
11	3816	34	2521	57	1938
12	3732	35	2486	58	1922
13	3651	36	2452	59	1907
14	3573	37	2419	60	1893
15	3497	38	2387	65	1832
16	3425	39	2356	70	1787
17	3357	40	2326	75	1752
18	3292	41	2297	80	1726
19	3230	42	2269	85	1707
20	3171	43	2241	90	1693
21	3114	44	2214	95	1684
22	3059	45	2188	100	1679

(Bohr and Bock, W. Ann. (2) 44. 318.)

Coefficient of absorption of O by H<sub>2</sub>O between 0° and 30° = 0.04890—0.0013413t + 0.0000283t<sup>2</sup>—0.00000029534t<sup>3</sup>. (Winkler, l. c.)Solubility in H<sub>2</sub>O at 25° = 0.03080; at 15° = 0.03630. (Geffcken, Z. phys. Ch. 1904, 49. 269.)Absorption of O<sub>2</sub> by distilled H<sub>2</sub>O at t°.a = ccm. of O<sub>2</sub> absorbed by 1 l. of H<sub>2</sub>O at t° and 760 mm.

t°	a	t°	a	t°	a
0	49.24	17	33.21	34	25.19
1	47.94	18	32.58	35	24.85
2	46.65	19	32.01	36	24.52
3	45.45	20	31.44	37	24.20
4	44.31	21	30.91	38	23.89
5	43.21	22	30.38	39	23.59
6	42.15	23	29.86	40	23.30
7	41.15	24	29.38	41	23.02
8	40.19	25	28.90	42	22.75
9	39.28	26	28.42	43	22.49
10	38.37	27	27.94	44	22.24
11	37.51	28	27.51	45	22.00
12	36.75	29	27.08	46	21.77
13	35.98	30	26.65	47	21.55
14	35.26	31	26.27	48	21.34
15	34.55	32	25.90	49	21.14
16	33.88	33	25.54	50	20.95

(Fox, Trans. Faraday Soc. 1909, 5. 74.)

Solubility in H<sub>2</sub>O at various pressures.

V = volume of the absorbing liquid.

P = Hg-pressure in metres.

 $\lambda$  = coefficient of solubility.

V	t°	P	$\lambda$
33.320 ccm.	23°	0.9595	0.02937
		1.0941	0.02939
		1.2883	0.02938
		1.4976	0.02935
		1.7638	0.02939
		2.0838	0.02931
		2.5011	0.02928
		3.0402	0.02909
		3.8675	0.02886
		4.2504	0.02872
		4.6301	0.02855
32.003 ccm.	25.9°	5.1360	0.02832
		5.6973	0.02818
		6.1857	0.02797
		6.7343	0.02772
		7.3051	0.02741
		7.7138	0.02729
		8.1406	0.02706
		0.8611	0.02848
		0.9808	0.02849
		1.0833	0.02846
		1.2039	0.02842
		1.4112	0.02845
		1.6602	0.02847
		2.3854	0.02831
		2.6482	0.02826
		2.8995	0.02816
		3.2883	0.02803
		3.9133	0.02798
		4.2720	0.02785
		4.6905	0.02776
		5.0559	0.02762
		5.6141	0.02749
		6.0120	0.02734
		6.5637	0.02719
		7.1056	0.02687
		7.4729	0.02676
		8.1889	0.02645

(Cassuto, Phys. Zeit. 1904, 5. 236.)

Solubility of O in H<sub>2</sub>O at 25° = 0.0294. (Findlay and Creighton, Bioch. J. 1911, 5. 294.)Coefficient of absorption for H<sub>2</sub>O = 0.03398 at 15°; 0.03375 at 15.3°; 0.03330 at 16.2°. (Müller, Z. phys. Ch. 1912, 81. 494.)

Solubility in  $H_2O$  at  $t^\circ$ .

$l_{760}$  = solubility of atmospheric  $O_2$  in  $H_2O$  at 760 mm. and  $t^\circ$ .

$t^\circ$	$l_{760}$	$t^\circ$	$l_{760}$
0	10.26	13	7.51
1	9.99	14	7.36
2	9.73	15	7.21
3	9.48	16	7.07
4	9.25	17	6.93
5	9.02	18	6.80
6	8.80	19	6.67
7	8.59	20	6.55
8	8.39	21	6.43
9	8.20	22	6.32
10	8.02	23	6.21
11	7.84	24	6.10
12	7.67	25	6.00

(Carlson, Zeit. angew. Ch. 1913, 26. 714.)

Solubility of atmospheric  $O_2$  in mixtures of distilled  $H_2O$  with sea water diminishes regularly with the proportion of sea water present. (Clowes, J. Soc. Chem. Ind. 1904, 23. 359.)

No. of ccm. of  $O_2$  absorbed by 1 l. of sea water from a free dry atmosphere of 760 mm. pressure.

Cl per 1000	$t=0^\circ$	$4^\circ$	$8^\circ$	$12^\circ$	$16^\circ$	$20^\circ$	$24^\circ$	$28^\circ$
0	10.29	9.26	8.40	7.68	7.08	6.57	6.14	5.75
4	9.83	8.85	8.04	7.36	6.80	6.33	5.91	5.53
8	9.36	8.45	7.68	7.04	6.52	6.07	5.67	5.31
12	8.90	8.04	7.33	6.74	6.24	5.82	5.44	5.08
16	8.43	7.64	6.97	6.43	5.96	5.56	5.20	4.86
20	7.97	7.23	6.62	6.11	5.69	5.31	4.95	4.62

(Fox, Trans. Faraday Soc. 1909, 5. 77.)

For  $O$  absorbed from the air, see also air, atmospheric, p. 1.

Absorption of  $O_2$  by acids + Aq.

M = content in gram-equivalents per litre.  
S = solubility.

 $HNO_3$  + Aq.

M	S $25^\circ$	S $15^\circ$
0.492	0.03021	0.03478
0.494	0.03016	0.03490
1.00	0.02954	0.03354
1.008	0.02963	0.03365
1.88	0.02853	0.03175
1.901	...	0.03166

Absorption of  $O_2$  by acids + Aq.—Continued. $HCl$  + Aq.

M	S $25^\circ$	S $15^\circ$
0.578	0.02963	0.03431
0.579	0.02960	0.03410
1.170	0.02817	0.03217
1.176	0.02833	0.03109
1.736	0.02733	0.03069
1.982	0.02674	0.02988

 $\frac{H_2SO_4}{2}$  + Aq.

M	S $25^\circ$	S $15^\circ$
0.489	0.02887	0.03366
0.527	0.02875	0.03375
0.977	0.02757	0.03210
1.017	0.02745	0.03217
1.896	0.02545	0.02886
1.829	0.02577	0.02930
2.947	0.02285	0.02584
3.512	0.02198	0.02399
4.951	...	0.02174
5.293	0.01918	0.02067

(Geffcken, Z. phys. Ch. 1904, 49. 269.)

Absorption of  $O_2$  by  $H_2SO_4$  + Aq at  $t^\circ$ .

$\alpha$  = coefficient of absorption.

Normality of the acid	$t^\circ$	$\alpha$
0	20.9	0.0310
4.9	20.9	0.0195
8.9	20.9	0.0155
10.7	21.2	0.0143
20.3	21.1	0.0119
24.8	21.5	0.0103
29.6	20.8	0.0117
34.3	20.9	0.0201
35.8	21.2	0.0275

(Bohr, Z. phys. Ch. 1910, 71. 49.)

Absorption of  $O_2$  by  $NaOH$  + Aq.

M = content in gram-equivalents per litre.  
S = solubility.

M	S $25^\circ$	S $15^\circ$
0.559	0.02434	0.02777
0.601	0.02424	0.02784
1.033	0.02020	0.02291
1.059	0.01991	0.02262
2.077	0.01295	0.01479
2.089	0.01272	0.01456

Absorption of O<sub>2</sub> by KOH+Aq.

M	S 25°	S 15°
0.577	0.02447	0.02791
0.579	0.02435	0.02791
1.157	0.01920	0.02191
1.170	0.01914	0.02181

(Geffcken, Z. phys. Ch. 1904, 49. 270.)

NaCl+Aq with a chlorine content of 1,930 per 100,000 dissolved 82.9% of the amount of O<sub>2</sub> dissolved by distilled H<sub>2</sub>O alone. (Clowes, J. Soc. Chem. Ind. 1904, 23. 359.)

Absorption of O<sub>2</sub> by salts+Aq.

M = content in gram-equivalents per litre.

S = solubility.

Absorption of O = by  $\frac{K_2SO_4}{2}$  +Aq.

M	S 25°	S 15°
0.499	0.02528	0.02944
0.506	0.02530	0.02922
0.968	...	0.02395
0.970	0.02096	0.02377

Absorption of O<sub>2</sub> by NaCl+Aq.

M	S 25°	S 15°
0.530	0.02598	0.03045
0.535	0.02604	0.03052
1.020	0.02226	0.02601
1.034	0.02202	0.02557
1.880	...	0.01898
1.890	0.01663	0.01904
1.921	0.01654	0.01869

(Geffcken, Z. phys. Ch. 1904, 49. 270.)

Solubility of O<sub>2</sub> in NaCl+Aq.Data indicate cc. O<sub>2</sub> dissolved per l. at 760 mm. and 0°.

t°	NaCl+Aq 1 g. mol. per l.	NaCl+Aq 2 g. mol. per l.	NaCl+Aq sat. at 20°
0	6.50	3.14	1.27
5	5.80	2.84	1.22
10	5.25	2.59	1.17
15	4.77	2.41	1.12
20	4.39	2.25	1.07
25	4.06	2.13	1.02
30	3.76	2.01	0.97

(Winkler, Z. anorg. 1911, 24. 342.)

Solubility of O<sub>2</sub> in KCN+Aq at 20°.

% KCN      1      10      20      30      50  
Coeff. of abs. 0.029 0.018 0.013 0.008 0.003  
(McLaurin, J. S. C. I. 1893, 63. 737.)

1 vol. alcohol absorbs 0.28397 vol. O at all temperatures between 0° and 24°. (Bunsen.)

## Absorption by alcohol (99.7%) at t°.

 $\beta$  = coefficient of absorption; $\beta_1$  = solubility. (See p. 635.)

t°	$\beta$	$\beta_1$
0	0.23370	0.22978
1	0.23296	0.22878
2	0.23222	0.22777
3	0.23149	0.22675
4	0.23077	0.22572
5	0.23005	0.22469
6	0.22934	0.22365
7	0.22863	0.22260
8	0.22793	0.22155
9	0.22724	0.22047
10	0.22656	0.21937
11	0.22588	0.21827
12	0.22521	0.21715
13	0.22455	0.21601
14	0.22389	0.21484
15	0.22324	0.21365
16	0.22259	0.21245
17	0.22195	0.21122
18	0.22132	0.20994
19	0.22069	0.20862
20	0.22007	0.20733
21	0.21946	0.20600
22	0.21886	0.20459
23	0.21826	0.20317
24	0.21767	0.20172

(Timofejew, Z. phys. Ch. 6. 151.)

Solubility of O<sub>2</sub> in alcohol at 20° and 760 mm.

Wt. % alcohol	Vol. % abs. O <sub>2</sub>	Wt. % alcohol	Vol. % abs. O <sub>2</sub>
0.0	2.98	33.33	2.67
9.09	2.78	50.0	3.50
16.67	2.63	66.67	4.95
23.08	2.52	80.0	5.66
28.57	2.49		

(Lubarsch, W. Ann. 1889, (2) 37. 525.)

Solubility of O<sub>2</sub> in methyl alcohol at t°.

t°	l.	t°	l.
0	0.31864	25	0.23642
5	0.30506	30	0.21569
10	0.29005	40	0.16990
15	0.27361	50	0.11840
20	0.25574		

(Levi, Gazz. ch. it. 1901, 31. II, 513.)

Solubility of O<sub>2</sub> in ether at 0° = 0.4235; at 10° = 0.4215. (Christoff, Z. phys. Ch. 1912, 79. 459.)

Solubility of  $O_2$  in acetone at  $t^\circ$ .

$t^\circ$	l.	$t^\circ$	l.
0	0.2997	25	0.2127
5	0.2835	30	0.1935
10	0.2667	40	0.1533
15	0.2493	50	0.1057
20	0.2313		

(Levi, Gazz. ch. it. 1901, 31. II, 513.)

Absorption of  $O_2$  by chloralhydrate + Aq. $t^\circ$  = temp. of the solution.

P = % chloralhydrate in the solution.

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ . $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ . $\beta 20^\circ$  = coefficient of absorption at  $20^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
18.3	22.9	0.02759	0.02940
16.9	28.0	0.02690	0.02800
15.4	36.6	0.02590	0.02560
16.6	38.6	0.02402	0.02477
12.8	51.3	0.02439	0.02339
16.2	58.44	0.02350	0.02407
15.9	70.0	0.02659	0.02710
17.2	80.85	0.03200	0.03300
16.9	80.9	0.03140	0.03250

			$\beta 20^\circ$
20.0	16.9	0.02795	0.02795
21.0	32.0	0.02443	0.02495
21.0	52.9	0.02375	0.02325
20.4	61.08	0.02390	0.02410
21.8	65.5	0.02500	0.02580
21.0	71.4	0.02680	0.02730
22.2	78.0	0.03090	0.03280

(Müller, Z. phys. Ch. 1912, 81. 499.)

Absorption of  $O_2$  by glycerine + Aq. $t^\circ$  = temp. of the solution.

P = % glycerine in the solution.

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ . $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
12.2	20.5	0.02904	0.02742
12.5	25.0	0.02654	0.02521
14.6	37.3	0.02038	0.02022
13.5	45.0	0.01800	0.01744
12.4	52.0	0.01623	0.01570
12.1	71.5	0.01010	0.00950
13.3	88.5	0.00908	0.00886

(Müller.)

Absorption of  $O_2$  by glucose + Aq. $t^\circ$  = temp. of the solution.

P = % glucose in the solution.

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ . $\beta 20^\circ$  = coefficient of absorption at  $20^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 20^\circ$
21.2	10.84	0.02650	0.02690
21.5	20.7	0.02202	0.02250
19.9	33.8	0.01814	0.01815
20.5	51.9	0.01378	0.01390
21.7	58.84	0.01221	0.01250

(Müller.)

Absorption of  $O_2$  by sucrose + Aq. $t^\circ$  = temp. of the solution.

P = % sucrose in the solution.

 $\beta t^\circ$  = coefficient of absorption at  $t^\circ$ . $\beta 15^\circ$  = coefficient of absorption at  $15^\circ$ .

$t^\circ$	P	$\beta t^\circ$	$\beta 15^\circ$
15.3		0.03375	0.03400
16.2		0.03330	0.03397
16.0	12.1	0.02911	0.02969
15.6	24.38	0.02367	0.02396
16.6	28.44	0.02113	0.02181
15.6	42.96	0.01582	0.01600
16.2	49.25	0.01348	0.01380
17.2	50.0	0.01302	0.01359

(Müller.)

Abundantly absorbed by oil of turpentine. Oil of turpentine absorbs its own vol. O when exposed two weeks to the air, but does not give it off on boiling. (Brandes.)

Absorbed by other oils, but this is decomposition rather than absorption, as the oils are oxidised. (See Storer's Dict.)

100 vols. arterial blood dissolve 10-13 vols. O. (Magnus.)

Coefficient of absorption for petroleum = 0.202 at  $20^\circ$ ; 0.229 at  $10^\circ$ . (Gniewasz and Walfisz, Z. phys. Ch. 1. 70.)

The author examined the solubility of  $O_2$  and  $N_2$  at low temp. in alcohols, ethers, acetone,  $CHCl_3$ , petroleum, benzene and various inorganic liquids; at low temp. the solubility of the  $N_2$  increases at the same rate as that of the  $O_2$ . (Claude, C. R. 1900, 131. 448.)

## Oxydimercuri ammonium bromate,

 $(NH_2OH)_2BrO_3$ .

(Rammelsberg, Pogg. 55. 82.)

— carbonate,  $(NH_2OH)_2CO_3 + \frac{1}{2}H_2O$ .

Insol. in  $H_2O$ . Decomp. by  $HCl$  + Aq only when conc. Not decomp. by boiling  $KOH$  + Aq. Decomp. by  $KI$  or  $K_2S$  + Aq. (Hirzel.) +  $H_2O$ . As above. (Hirzel.)

**Oxydimercuri ammonium chloride,**  
( $\text{NH}_2\text{OH}_2$ )Cl.

Is dimercuri ammonium chloride,  $\text{NH}_2\text{Cl} + \text{H}_2\text{O}$ , which see.

— **oxytrimercuriammonium chloride,**  
( $\text{NH}_2\text{OH}_2$ )Cl, ( $\text{NH}_2\text{O}_2\text{H}_2$ )Cl (?).

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . More difficultly sol. in very dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . Insol. in conc.  $\text{H}_2\text{SO}_4$ . Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ , or ( $\text{NH}_4$ ) $_2\text{SO}_4 + \text{Aq}$ . Decomp. by  $\text{KOH} + \text{Aq}$ . (Schmieder.)

— **chromate,** ( $\text{NH}_2\text{OH}_2$ ) $_2\text{CrO}_4$ .

Not decomp. by  $\text{KOH} + \text{Aq}$ . (Hirzel, J. B. 1852. 421.)

— **mercuric chromate,** ( $\text{NH}_2\text{OH}_2$ ) $_2\text{CrO}_4$ ,  
 $4\text{HgO}$ ,  $3\text{CrO}_3$ .

Decomp. by  $\text{HNO}_3$  without going into solution. Easily sol. in  $\text{HCl}$ . (Hirzel.)

Composition is ( $\text{NH}_2\text{OH}_2$ ) $_2\text{O}$ ,  $2\text{CrO}_3$ ,  $3[(\text{NH}_4)_2\text{O}$ ,  $2\text{Cr}_2\text{O}_3]$  = ( $\text{NH}_2\text{OH}_2$ ) $_2\text{Cr}_2\text{O}_7$ ,  $3(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ . (Hensgen, R. t. c. 6. 187.)

Probably ( $\text{NH}_2$ ) $_2\text{Cr}_2\text{O}_7$ ,  $3(\text{NH}_4)_2\text{Cr}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

— **fluoride, acid,** ( $\text{NH}_2\text{OH}_2$ )F, HF.

(Finkener, Pogg. 110. 632.)

Probably  $\text{NH}_2\text{F}$ ,  $\text{HF} + \text{H}_2\text{O}$ .

— **hydroxide,** ( $\text{NH}_2\text{OH}_2$ )OH =  $\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

(Millon's base.) Sl. sol. in  $\text{H}_2\text{O}$ , especially if warm. Sol. in 13,000 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , and 1700 pts. at  $80^\circ$ . Insol. in alcohol or ether. (Gerresheim, A. 195. 373.)

+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in traces in  $\text{NH}_4\text{OH} + \text{Aq}$ . Not decomp. by cold  $\text{KOH} + \text{Aq}$ ; sl. decomp. if hot. (Millon.)

— **ammonium iodate,** ( $\text{NH}_2\text{OH}_2$ )IO $_3$ ,  
 $2\text{NH}_4\text{IO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Millon, A. ch. (3) 18. 410.)

— **iodide,** ( $\text{NH}_2\text{OH}_2$ )I.

Sol. in warm  $\text{HCl} + \text{Aq}$ . Not decomp. by boiling  $\text{KOH} + \text{Aq}$ . Sol. in warm  $\text{KI} + \text{Aq}$ . (Rammelsberg, Pogg. 48. 170.)

Correct formula is  $\text{NH}_2\text{I} + \text{H}_2\text{O}$ . (Rammelsberg.)

— **nitrate,** ( $\text{NH}_2\text{OH}_2$ )NO $_3$ .

Insol. in  $\text{H}_2\text{O}$ ; not decomp. by boiling  $\text{KOH} + \text{Aq}$ . Sol. in cold  $\text{HCl} + \text{Aq}$ , from which it is precipitated by  $\text{H}_2\text{O}$ . Sl. sol. without decomp. in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Soubeiran.)

Is dimercuri ammonium nitrate,  $\text{NH}_2\text{NO}_3$ . (Pesci, Gazz. ch. it. 20. 485.)

— **ammonium nitrate,**  $\text{NH}_2\text{OH}_2$ )NO $_3$ ,  
 $2\text{NH}_4\text{NO}_3 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Kane, A. ch. 72. 242.)

Is dimercuri ammonium ammonium nitrate,  $\text{NH}_2\text{NO}_3$ ,  $2\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ . (Pesci.)

**Oxydimercuri ammonium oxide,**  
( $\text{NH}_2\text{OH}_2$ ) $_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol; not attacked by boiling conc.  $\text{KOH} + \text{Aq}$ . Sol. in hot  $\text{NH}_4\text{NO}_3 + \text{Aq}$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$ , ( $\text{NH}_4$ ) $_2\text{SO}_4 + \text{Aq}$ ,  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , ( $\text{NH}_4$ ) $_2\text{C}_2\text{O}_4 + \text{Aq}$ . (Millon, A. ch. (3) 18. 397.)

— **mercuric phosphate,**  $\text{Hg}(\text{NH}_2\text{OH}_2)\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in hot  $\text{HNO}_3 + \text{Aq}$ ; not decomp. by boiling with  $\text{KOH} + \text{Aq}$ , but by  $\text{KI}$  or  $\text{K}_2\text{S} + \text{Aq}$ . Sol. in  $\text{HCl} + \text{Aq}$  or much hot ( $\text{NH}_4$ ) $_2\text{HPO}_4 + \text{Aq}$ . (Hirzel.)

— **mercuric sulphite,** ( $\text{NH}_2\text{OH}_2$ ) $_2\text{SO}_3$ ,  
 $\text{HgSO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in much ( $\text{NH}_4$ ) $_2\text{SO}_3 + \text{Aq}$ . Sol. in  $\text{HCl} + \text{Aq}$  with decomposition. Insol. in boiling  $\text{KOH} + \text{Aq}$ . (Hirzel.)

— **sulphate,** ( $\text{NH}_2\text{OH}_2$ ) $_2\text{SO}_4$ .

Sol. in traces in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Kane.)

Insol. in  $\text{HNO}_3 + \text{Aq}$ . (Hirzel.)

Slowly sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . (Hirzel.)

Insol. in conc., easily sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Schmieder, J. pr. 75. 147.)

Moderately sol. in much ( $\text{NH}_4$ ) $_2\text{SO}_4$  or boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Not decomp. by boiling  $\text{KOH} + \text{Aq}$ . (Hirzel.)

Easily decomp. by boiling with dil.  $\text{KOH} + \text{Aq}$ . (Schmieder.)

Does not exist. (Pesci.)

$2\text{NH}_3$ ,  $2\text{HgO}$ ,  $\text{SO}_3$ .

See Dimercuri ammonium sulphate.

**Oxytrimercuriammonium chloride,**  
( $\text{NH}_2\text{O}_2\text{H}_2$ )Cl (?).

Insol. in  $\text{H}_2\text{O}$ .

— **nitrate,** ( $\text{NH}_2\text{O}_2\text{H}_2$ )NO $_3$ .

Sol. in cold  $\text{HCl} + \text{Aq}$ , from which it is precipitated by  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. Not decomp. by  $\text{H}_2\text{SO}_4$  or warm  $\text{KOH} + \text{Aq}$ . (Pagenstecher.)

Does not exist. (Pesci, Gazz. ch. it. 20. 485.)

**Oxytrimercuridiammonium sulphate,**  
 $2\text{NH}_3$ ,  $3\text{HgO}$ ,  $\text{SO}_3$ .

See Trimercuriammonium sulphate.

**Oxytrimercurioxydimercuri ammonium**  
**sulphate,**  $\text{NH}_2\text{Hg}_2\text{O}_2 > \text{SO}_3$ .

Completely sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , or ( $\text{NH}_4$ ) $_2\text{SO}_4 + \text{Aq}$ . Sol. in dil. or conc.  $\text{HCl} + \text{Aq}$ , and very dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in  $\text{HNO}_3 + \text{Aq}$  or conc.  $\text{H}_2\text{SO}_4$ . (Schmieder.)

Does not exist. (Pesci.)

**Oxytetramercuriammonium mercuric nitrate** (?),  $2(\text{NHg}_2\text{O}_2)\text{NO}_3$ ,  $\text{HgNO}_3$  (?).

Completely insol. in  $\text{HNO}_3 + \text{Aq.}$  Sol. in warm  $\text{HCl} + \text{Aq.}$  Slowly decomp. by boiling  $\text{KOH} + \text{Aq.}$  Gradually sol. in hot conc.  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Hirzel.)

Does not exist. (Pesci, Gazz. ch. it. 20. 485.)

**Oxynitrosulphonic anhydride,**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weber, Pogg. 123. 339.)

**Oxyosmiumamine hydroxide (Osmosyldiamine hydroxide),**

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in acids. Sol. in  $\text{KOH} + \text{Aq.}$  When moist, sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

**Oxyosmiumdiamine chloride (Osmyltetramine chloride),**  $\text{OsO}_2(\text{N}_2\text{H}_4\text{Cl})_2$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Gibbs, Am. Ch. J. 3. 233.)

— chloroplatinate,  $\text{OsO}_2(\text{N}_2\text{H}_4\text{Cl})_2$ ,  $\text{PtCl}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— hydroxide,  $\text{OsO}_2(\text{N}_2\text{H}_4\text{OH})_2$ .

Known only in solution.

— nitrate,  $\text{OsO}_2(\text{N}_2\text{H}_4\text{NO}_2)_2$ .

— sulphate,  $\text{OsO}_2(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

(Gibbs, Am. Ch. J. 3. 233.)

**Oxyphosphuretted hydrogen** (?),  $\text{P}_4\text{H}(\text{OH})$ .

$\text{P}_4\text{O}$  of Leverrier, and Goldschmidt has this formula according to Franke (J. pr. (2) 35. 341). Decomp. slowly by  $\text{H}_2\text{O}$  or alkalis. Forms potassium salt,  $\text{P}_4\text{H}(\text{OK})$ , sol. in  $\text{H}_2\text{O}$ .

— hydriodide,  $\text{P}_4\text{H}(\text{OH})$ ,  $\text{HI}$ .

Decomp. at  $80^\circ$ .

**Sesquioxypyplatissulphuric acid,**  $\text{Pt}_2\text{O}_3$ ,  $3\text{SO}_3$ ,  $8\text{O}_2\text{H}_2 + 11\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Blondel, A. ch. 1905, (8) 6. 113.)

**Barium sesquioxypyplatissulphate,**  $\text{Pt}_2\text{O}_3$ ,  $3\text{SO}_3$ ,  $8\text{O}_2\text{Ba} + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Blondel.)

**Potassium sesquioxypyplatissulphate,**  $\text{Pt}_2\text{O}_3$ ,  $3\text{SO}_3$ ,  $8\text{O}_2\text{K}_2 + 2\text{H}_2\text{O}$ .

(Blondel.)

**Sodium sesquioxypyplatissulphate,**  $\text{Pt}_2\text{O}_3$ ,  $3\text{SO}_3$ ,  $\text{Na}_2 + 8\text{H}_2\text{O}$ .

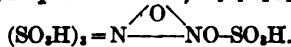
Very sol. in  $\text{H}_2\text{O}$ . (Blondel.)

**Oxysulphantimonic acid.**

See Sulphoxyantimonic acid.

**Oxysulpharsenic acid.**

See Sulphoxyarsenic acid.

**Oxysulphazotic acid,**  $\text{H}_2\text{S}_4\text{N}_2\text{O}_{14} =$ 

Known only in its salts. (Claus, A. 158. 52, 194.)

Has formula  $(\text{SO}_2\text{H})_2\text{N} \begin{array}{c} \diagup \text{O} \diagdown \\ \text{---} \end{array} \text{N}(\text{SO}_2\text{H})_2$ .

(Raschig, A. 241. 161.)

**Potassium oxysulphazotate,**  $\text{NO}(\text{SO}_2\text{K})_2$ .

Insol. in alcohol. (Freymy, A. ch. (3) 15. 451.)

According to Raschig the formula is



Very sol. in water, with rapid decomposition. (Raschig.)

See also Peroxylaminesulphonate, potassium.

**Oxysulphotungstic acid.**

See Sulphotungstic acid.

**Oxysulphovanadic acid.**

See Sulphoxyvanadic acid.

**Ozone,  $\text{O}_3$ .**

Not appreciably sol. in  $\text{H}_2\text{O}$ . (Schönbein.) Imparts its taste and properties to  $\text{H}_2\text{O}$ . (Williamson.)

Later, Carius (B. 5. 520) found that 1000 vols.  $\text{H}_2\text{O}$  at  $1-2.5^\circ$  absorb 5.11 vols.  $\text{O}_3$  (red. to  $0^\circ$  and 760 mm.). He also still later (A. 174. 1) found, by conducting the gas for 9-12 hours through  $\text{H}_2\text{O}$ , that 1000 vols.  $\text{H}_2\text{O}$  absorb a maximum of 28.160 vols.  $\text{O}_3$ . The ozonized oxygen used contained 3.44 vols.  $\text{O}_3$  in 100 vols.  $\text{O}_2$ . Since gases are absorbed in proportion to their partial pressure, which is very small for the  $\text{O}_3$ , the amount of absorption of water for the gas is very considerable. Carius calculated the coefficient of absorption at  $+1^\circ$  to be 0.834.

Ozone is *not at all* absorbed by  $\text{H}_2\text{O}$ ; the  $\text{H}_2\text{O}$  through which ozone had been passed gave no reactions for ozone. (Rammelsberg, B. 6. 603.)

Schöne (B. 6. 1224) corroborates Carius, and finds 8.81 vols. to 1000 vols.  $\text{H}_2\text{O}$  as a maximum amount absorbed.

Sol. in  $\text{H}_2\text{O}$ . (Leeds, B. 12. 1831.)



H<sub>2</sub>O takes up  $\frac{1}{2}$  of its vol. of O<sub>2</sub> at 0° and 760 mm. pressure and  $\frac{1}{2}$  of its vol. at 12°, or about 15 times that of oxygen at the same pressure and temp. (Mailfert, C. R. 1894, 119. 951.)

Solubility in H<sub>2</sub>O at t°.

Temp.	Wt. O <sub>2</sub> dissolved in 1 l. H <sub>2</sub> O	Wt. O <sub>2</sub> in gaseous mixture above the solution	Coefficient of solubility of O <sub>2</sub>
0	39.4 mgr.	61.5 mgr.	0.641
6	34.3	61	0.562
11.8	29.9	59.6	0.500
13	28	58.1	0.482
15	25.9	56.8	0.456
19	21	55.2	0.381
27	13.9	51.4	0.270
32	7.7	39.5	0.195
40	4.2	37.6	0.112
47	2.4	31.2	0.077
55	0.6	19.2	0.031
60	0.0	12.3	0.000

(Mailfert, C. R. 1894, 119. 952.)

Solubility of ozone in acidulated H<sub>2</sub>O.

Temp.	Coefficient of solubility of ozone	Composition of solution
30°	0.240	} 1 l. H <sub>2</sub> O + 0.7 cc. H <sub>2</sub> SO <sub>4</sub>
33	0.224	
42.7	0.174	
49	0.156	1 l. H <sub>2</sub> O + 0.9 cc. "
57	0.096	1 l. " + 0.3 cc. "

(Mailfert.)

0.00002 pt. by weight is sol. in 1 pt. by weight H<sub>2</sub>O at ordinary temp. and pressure. Ladenburg, B. 1898, 31. 2510.)

The solution of O<sub>3</sub> in H<sub>2</sub>O cannot be brought into equilibrium, because when the gas is blown through the liquid, a portion is continually decomposed, although the concentration remains constant. (Ingles, Chem. Soc. 1903, 83. 1012.)

About 10 mg. ozone are sol. in 1 l. H<sub>2</sub>O at +2°; 1.5 mg. ozone are sol. at +28°. (Moufang, C. C. 1911, II. 1674.)

Solubility in 0.1-N H<sub>2</sub>SO<sub>4</sub>.

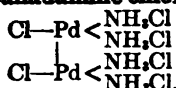
C solution: C gas = 0.23 at 20°; 0.44 at 0°. (Luther, Z. Elektrochem. 1905, 11. 833.)

The absorption coefficient of the gas in 0.1 N H<sub>2</sub>SO<sub>4</sub> solution is 0.487. (Rothmund, C. C. 1912, I. 1261.)

Sol. in H<sub>2</sub>C<sub>2</sub>O<sub>4</sub> + Aq. (Jeremin, B. 11. 988.)

Completely absorbed by oil of turpentine and oil of cinnamon. (Soret, A. ch. (4) 17. 113.)

**Dipalladamine chloride**, Cl<sub>2</sub>Pd<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>Cl<sub>4</sub> =



Sl. sol. in H<sub>2</sub>O. (Deville and Debray, C. R. 86. 296.)

**Palladium, Pd.**

Not attacked by H<sub>2</sub>O. Sl. attacked by HC + Aq, but Pd sponge or filings are easily dissolved in warm HCl + Aq, with access of air. HNO<sub>3</sub> + Aq of 1.2 sp. gr. dissolves Pd slightly, but it is easily sol. in HNO<sub>3</sub> + Aq of 1.35 sp. gr. (Rose.)

Easily sol. in aqua regia. Sl. sol. in conc., but insol. in dil. HI + Aq. Sol. in conc. boiling H<sub>2</sub>SO<sub>4</sub>. Sol. in boiling FeCl<sub>3</sub> + Aq. Sol. in HBr + Aq with a little HNO<sub>3</sub>.

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 828.)

**Palladium ammonium compounds.**

See—

**Dipalladamine comps.**, Cl<sub>2</sub>Pd<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>Cl<sub>4</sub>.

**Palladodiamine** " Pd(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>.

**Palladosamine** " Pd(NH<sub>3</sub>)<sub>2</sub>Cl<sub>2</sub>.

**Palladium dibromide.**

Not known in pure state.

**Palladium bromide with MBr.**

See Bromopalladite, M.

**Palladium tetrabromide with MBr.**

See Bromopalladate, M.

**Palladous phosphorus bromide**, Pd<sub>2</sub>P<sub>2</sub>Br<sub>12</sub>.

Properties as the corresponding chloride. (Strecker, B. 1909, 42. 1776.)

**Palladium subchloride**, Pd<sub>2</sub>Cl<sub>3</sub>.

Deliquescent. Decomp. by H<sub>2</sub>O, NH<sub>4</sub>Cl, KI, or NH<sub>4</sub>OH + Aq. Kane.)

Sol. in acetone. Naumann, B. 1904, 37. 4328.)

**Palladium dichloride**, PdCl<sub>2</sub>.

Slowly but completely sol. in H<sub>2</sub>O.

+ 2H<sub>2</sub>O. Not deliquescent when pure.

Slowly sol. in H<sub>2</sub>O. Much more sol. in H<sub>2</sub>O containing HCl.

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Sol. in ethyl acetate. Naumann, B. 1904, 37. 3601.)

**Palladium dichloride with MCl.**

See Chloropalladite, M.

**Palladium tetrachloride with MCl.**

See Chloropalladate, M.

**Palladous phosphorus chloride**, PdCl<sub>2</sub>, PCl<sub>3</sub>.

Decomp. by H<sub>2</sub>O into deliquescent P(OH)<sub>3</sub>, PdCl<sub>2</sub>. Decomp. by alcohol. (Fink, C. R. 115. 176.)

Decomp. by H<sub>2</sub>O. Sol. in CHCl<sub>3</sub> and C<sub>2</sub>H<sub>5</sub>. Insol. in ligroin and CCl<sub>4</sub>. (Strecker, B. 1909, 42. 1775.)

PdCl<sub>2</sub>, 2PCl<sub>3</sub>. Sol. in C<sub>2</sub>H<sub>5</sub>, and decomp. by H<sub>2</sub>O. (Fink.)

**Palladous chloride carbon monoxide**,  $\text{PdCl}_2 \cdot 2\text{CO}$ .

Decomp. by heat. (Fink, C. R. 1898, 126. 648.)

$2\text{PdCl}_2 \cdot 3\text{CO}$ . Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{CCl}_4$ . (Fink.)

**Palladium difluoride**,  $\text{PdF}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$  or  $\text{HF} + \text{Aq}$ . Sl. sol. while moist, in  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. after drying, in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in boiling  $\text{NaF}$  or  $\text{NaHF}_2 + \text{Aq}$ . (Berzelius.)

**Palladium hydride**,  $\text{Pd}_2\text{H}$  (?).

**Palladous hydroxide**,  $\text{PdO}$ ,  $x\text{H}_2\text{O}$  (?).

Easily sol. in acids or excess of alkali hydrates, and carbonates +  $\text{Aq}$ . Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Rose.)

Insol. in  $\text{Na}_2\text{B}_4\text{O}_7$ , and  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Claus.)

**Palladic hydroxide**,  $\text{PdO}_2$ ,  $x\text{H}_2\text{O}$ .

Slowly sol. in acids. Sol. in conc.  $\text{HCl} + \text{Aq}$  without decomp. With dil.  $\text{HCl} + \text{Aq}$ ,  $\text{Cl}_2$  is evolved. (Berzelius.)

**Palladous hydroxide hydroxylamine**,

$\text{Pd}(\text{NH}_2\text{O})_4(\text{OH})_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and in dil.  $\text{H}_2\text{SO}_4$ . (Zeisel, A. 1907, 351. 445.)

**Palladous iodide**,  $\text{PdI}_2$ .

Insol. in  $\text{H}_2\text{O}$ . Can be detected as a brown coloration in presence of 400,000 pts.  $\text{H}_2\text{O}$ . (Lassaigne.)

Sl. sol. in  $\text{HI} + \text{Aq}$ . Easily sol. in  $\text{KI} + \text{Aq}$ . (Lassaigne, J. ch. méd. 11. 57.)

Insol. in dil.  $\text{HCl} + \text{Aq}$ , but slightly sol. in saline solutions. (Fresenius.)

Sl. sol. in hot conc.  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{Cl}_2 + \text{Aq}$ ,  $\text{Br}_2 + \text{Aq}$ ,  $\text{I}_2 + \text{Aq}$ , and  $\text{CN} + \text{Aq}$ ; also in  $\text{HCN}$ , and  $\text{MCN} + \text{Aq}$ . Insol. in dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HNO}_3$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in the  $\text{K}$ ,  $\text{Na}$ , or  $\text{NH}_4$  salts of those acids. Insol. in  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ , or  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . Insol. in  $\text{KBr} + \text{Aq}$  except in presence of a free mineral acid, but not  $\text{HC}_2\text{H}_3\text{O}_2$ . Insol. in sugar or starch +  $\text{Aq}$ , uric acid, alcohol, ether, or oil of lemon. Somewhat sol. in urine. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , even when dil., with evolution of heat and decomposition. (Kersten, A. 87. 28.)

Insol. in alcohol or ether.

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Palladous potassium iodide**.

See Iodopalladite, potassium.

**Palladium suboxide**,  $\text{Pd}_2\text{O}$ .

Decomp. by acids into palladous salt and  $\text{Pd}$ . (Kane, Phil. Trans. 1842, 1. 276.)

Insol. in acids, even boiling aqua regia. (Wilm. B. 25. 220.)

**Palladous oxide**,  $\text{PdO}$ .

Slowly sol. in acids by boiling. (Wöhler, A. 174. 160.)

**Palladic oxide**,  $\text{PdO}_2$ .

Very sl. attacked by acids.

**Palladopalladic oxide**,  $4\text{PdO}$ ,  $\text{PdO}_2$ .

Not attacked by aqua regia. (Schneider, Pogg. 141. 528.)

**Palladous oxychloride**,  $3\text{PdO}$ ,  $\text{PdCl}_2 + 4\text{H}_2\text{O}$  (?).

Sol. in dil. acids. (Kane.)

**Palladous oxychloride ammonia**,  $\text{PdO}$ ,  $\text{PdCl}_2$ ,  $6\text{NH}_3$  (?).

Sol. in  $\text{HCl} + \text{Aq}$ .

$3\text{PdO}$ ,  $\text{PdCl}_2$ ,  $2\text{NH}_3 + 3\text{H}_2\text{O}$  (?). Ppt. (Kane.)

**Palladium selenide**,  $\text{PdSe}$ .

Insol. in  $\text{HNO}_3$ , and aqua regia. (Rössler, A. 180. 240.)

**Palladium subsulphide**,  $\text{Pd}_2\text{S}$ .

Not attacked by acids except aqua regia, which attacks slightly. (Schneider, Pogg. 141. 530.)

**Palladium monosulphide**,  $\text{PdS}$ .

Insol. in  $\text{H}_2\text{O}$  or  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Pptd. in presence of 10,000 pts.  $\text{H}_2\text{O}$ . (Fellenberg, Pogg. 50. 65.)

Sol. in potassium thiocarbonate +  $\text{Aq}$ . (Rosenblatt, Z. anal. 26. 15.)

A sol. colloidal form was obtained in very dilute solution. (Winnsinger, Bull. Soc. (2) 49. 452.)

Does not exist. (Kritschenko, Z. anorg. 4. 247.)

**Palladium disulphide**,  $\text{PdS}_2$ .

$\text{HNO}_3$  dissolves out part of the  $\text{S}$ . Easily sol. in aqua regia without separation of  $\text{S}$ . (Schneider.)

**Palladium sulphide with  $\text{M}_2\text{S}$** .

See Sulphopalladate,  $\text{M}$ .

**Palladodiamine bromide**,  $\text{Pd}(\text{N}_2\text{H}_4\text{Br})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

— bromopalladite,  $\text{Pd}(\text{N}_2\text{H}_4\text{Br})_2$ ,  $\text{PdBr}_2$ .

Properties as the corresponding chloropalladite.

— carbonate.

Sol. in  $\text{H}_2\text{O}$ .

— chloride,  $\text{Pd}(\text{N}_2\text{H}_4\text{Cl})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

**Palladodiamine chloropalladite**,  $\text{Pd}(\text{N}_2\text{H}_4\text{Cl})_2$ ,  
 $\text{PdCl}_2$ .

"Vauquelin's red salt." Insol. in cold  $\text{H}_2\text{O}$ .  
(Fischer.)

Sol. in boiling  $\text{H}_2\text{O}$  with decomp. Sol. in  
 $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ .

— **fluoride**.

Easily sol. in  $\text{H}_2\text{O}$ . (Müller.)

— **fluosilicate**.

Sl. sol. in cold, easily in warm  $\text{H}_2\text{O}$ . Insol.  
in alcohol.

— **hydroxide**,  $\text{Pd}(\text{N}_2\text{H}_4\text{OH})_2$ .

Sol. in  $\text{H}_2\text{O}$ .

— **iodide**,  $\text{Pd}(\text{N}_2\text{H}_4\text{I})_2$ .

Sol. in  $\text{H}_2\text{O}$ .

— **nitrate**,  $\text{Pd}(\text{N}_2\text{H}_4\text{NO}_3)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Insol. in alcohol.

— **palladous nitrite**,  $\text{Pd}(\text{N}_2\text{H}_4\text{NO}_2)_2$ ,  
 $\text{Pd}(\text{NO}_2)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ .

— **sulphate**,  $\text{Pd}(\text{N}_2\text{H}_4)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

— **sulphite**,  $\text{Pd}(\text{N}_2\text{H}_4)_2\text{SO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

**Palladochloronitrous acid**.

**Potassium palladochloronitrite**,  
 $\text{Pd}(\text{NO}_2)_2\text{Cl}_2\text{K}_2$ .

Sol. in 2 pts. hot, and 3 pts. cold  $\text{H}_2\text{O}$ .  
(Vézes, C. R. 115. 111.)

**Palladocyanhydric acid**.

**Ammonium palladocyanide**,  
 $(\text{NH}_4)_2\text{Pd}(\text{CN})_4$  (?).

Sol. in hot  $\text{H}_2\text{O}$ . (Rössler, Z. ch. 1866. 175.)

**Barium** —,  $\text{BaPd}(\text{CN})_4 + 4\text{H}_2\text{O}$ .

Not efflorescent. Sol. in  $\text{H}_2\text{O}$ .

**Calcium** —,  $\text{CaPd}(\text{CN})_4 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Cupric** —,  $\text{CuPd}(\text{CN})_4$ .

Ppt.

**Lead** —,  $\text{PbPd}(\text{CN})_4$ .

Ppt.

**Magnesium** —,  $\text{MgPd}(\text{CN})_4$ .

Very sol. in  $\text{H}_2\text{O}$ .

**Magnesium** — **platimocyanide**,  $\text{MgPd}(\text{CN})_4$ ,  
 $\text{MgPt}(\text{CN})_4 + 14\text{H}_2\text{O}$ .

Extremely sol. in  $\text{H}_2\text{O}$ .

**Potassium** —,  $\text{K}_2\text{Pd}(\text{CN})_4 + 3\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$ .

+  $\text{H}_2\text{O}$ . Not efflorescent.

**Silver** —,  $\text{Ag}_2\text{Pd}(\text{CN})_4$ .

Ppt.

**Sodium** —,  $\text{Na}_2\text{Pd}(\text{CN})_4$ .

Not efflorescent. Sol. in  $\text{H}_2\text{O}$ .

+  $\text{H}_2\text{O}$ .

**Palladoiodonitrous acid**.

**Potassium palladoiodonitrite**,  
 $\text{Pd}(\text{NO}_2)_2\text{I}_2\text{K}_2 + 3\text{H}_2\text{O}$ .

Effloresces in the air.

Decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Rosen-  
heim, Z. anorg. 1900, 23. 28.)

**Palladonitrous acid**.

**Potassium palladonitrite**,  $\text{K}_2\text{Pd}(\text{NO}_2)_4 +$   
 $2\text{H}_2\text{O}$ .

Efflorescent; sol. in  $\text{H}_2\text{O}$ . (Lang, J. pr. 83.  
415.)

**Silver palladonitrite**,  $\text{Ag}_2\text{Pd}(\text{NO}_2)_4$ .

Easily sol. in hot  $\text{H}_2\text{O}$ . (Lang.)

**Sodium** —,  $\text{Na}_2\text{Pd}(\text{NO}_2)_4$ .

(Fischer.)

**Palladosamine bromide**,  $\text{Pd}(\text{NH}_2\text{Br})_2$ .

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . Easily  
sol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{KOH}$ ,  $\text{NH}_4\text{OH}$ , or  
alkali carbonates +  $\text{Aq}$ . (Müller, A. 86. 341.)

— **carbonate**,  $\text{Pd}(\text{NH}_2)_2\text{CO}_3$ .

Moderately sol. in  $\text{H}_2\text{O}$ .

— **chloride**,  $\text{Pd}(\text{NH}_2\text{Cl})_2$ .

Insol. in  $\text{H}_2\text{O}$ , but very gradually decomp.  
by boiling therewith.

Sol. in warm  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Sol. in  
cold  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in  $\text{KOH} + \text{Aq}$  with-  
out evolution of  $\text{NH}_3$ .

+  $2\text{H}_2\text{O}$ . Efflorescent. Insol. in  $\text{H}_2\text{O}$ .  
(Baubigny, A. Suppl. 4. 253.)

— **cyanide**,  $\text{Pd}(\text{NH}_2\text{CN})_2$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

— **fluoride**.

Known only in solution.

— **hydroxide**,  $\text{Pd}(\text{NH}_2\text{OH})_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . Slowly decomp. by  
boiling with  $\text{H}_2\text{O}$ . (Müller, A. 86. 341.)

**Palladosamine iodide,  $\text{Pd}(\text{NH}_4\text{I})_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in boiling  $\text{HNO}_3$  with evolution of  $\text{I}_2$ . (Fehling, A. **39**. 106.)

**— nitrate.**

Known only in solution, which decomp. on evaporation.

**— nitrite,  $\text{Pd}(\text{NH}_4\text{NO}_2)_2$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . (Lang.)

**— palladous nitrite,  $\text{Pd}(\text{NH}_4\text{NO}_2)_2$ ,  $\text{Pd}(\text{NO}_2)_2$ .**

Slowly sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Lang.)

**— sulphate,  $\text{Pd}(\text{NH}_4)_2\text{SO}_4$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . (Müller.)

**— sulphite,  $\text{Pd}(\text{NH}_4)_2\text{SO}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Müller.)

**Pentamine chromium compounds.**

See—

Bromopurpureochromium compounds.

Chloropurpureochromium compounds.

Iodopurpureochromium compounds.

Xanthochromium compounds.

Roseochromium compounds.

**Pentamine cobaltic compounds.**

See—

Bromopurpureocobaltic compounds.

Chloropurpureocobaltic compounds.

Nitratopurpureocobaltic compounds.

Nitrocobaltic compounds.

Purpureocobaltic compounds.

Rosecobaltic compounds.

Sulphatopurpureocobaltic compounds.

Xanthocobaltic compounds.

**Pentamine dicobaltic sulphite.**

See Rosecobaltic cobaltic sulphite.

**Pentamine iridium compounds.**

See Iridopentamine, and Irido-aquopentamine compounds.

**Pentamine rhodium compounds.**

See—

Bromopurpureorhodium compounds.

Chloropurpureorhodium compounds.

Iodopurpureorhodium compounds.

Nitratopurpureorhodium compounds.

Roseorhodium compounds.

Xanthorhodium compounds.

**Pentathionic acid,  $\text{H}_2\text{S}_5\text{O}_6$ .**

Known only in aqueous solution.

Conc. solution is decomp. by boiling, but made stable by addition of acids.

Sp. gr. of aqueous solution of pentathionic acid at  $22^\circ$ :

Sp. gr.	1.233	1.320	1.474	1.506
% $\text{H}_2\text{S}_5\text{O}_6$	32.1	41.7	56	59.7

(Kessler, Pogg. **74**. 279.)

Does not exist. (Spring, Bull. Acad. roy. Belg.)

Existence proven by Smith (Chem. Soc. **43**. 355.)

**Barium pentathionate,  $\text{BaS}_5\text{O}_6 + 2\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution is precipitated by alcohol.

Contains  $3\text{H}_2\text{O}$ . (Lewes, C. N. **43**. 41.)

**Barium pentathionate tetrathionate,  $\text{BaS}_4\text{O}_6$ ,  $\text{BaS}_5\text{O}_6 + 6\text{N}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Not precipitated from aqueous solution by two vols. alcohol. (Ludwig, Arch. Pharm. (2) **51**. 264.)

**Cupric pentathionate,  $\text{CuS}_5\text{O}_6 + 4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Debus, Chem. Soc. **53**. 360.)

**Lead pentathionate,  $\text{PbS}_5\text{O}_6 + 4\text{H}_2\text{O}$ .**

Ppt.

**Potassium pentathionate,  $\text{K}_2\text{S}_5\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, J. B. **1857**. 136.)

Solution decomposes very quickly when neutral, but is more stable in presence of salts or acids.

Sol. in about 2 pts.  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Debus, Chem. Soc. **53**. 295.)

+  $\text{H}_2\text{O}$ . (Shaw, Chem. Soc. **43**. 351.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . (Debus, A. **244**. 76.)

+  $2\text{H}_2\text{O}$ . (Lewes, C. N. **43**. 41.)

**Perarsenic acid.****Sodium perarsenate,  $\text{NaAsO}_4$ .**

(Alvarez, C. N. **1906**, **94**. 270.)

**Perboric acid.****Ammonium perborate,  $\text{NH}_4\text{BO}_3$ .**

(Constam and Bennett, Z. anorg. **1900**, **25**. 265.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Stable in dry air. 100 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 1.55 g. anhydrous salt.

Decomp. in aqueous solution at ord. temp.

Decomp. by dil. and conc.  $\text{H}_2\text{SO}_4$  and by  $\text{HCl}$ . (Melikoff, B. **1898**, **31**. 953.)

+  $\text{H}_2\text{O}$ . (Bruhat, C. R. **1905**, **140**. 508.)

Much more sol. in  $\text{H}_2\text{O}$  than the Na salt. (Tanatar, Z. phys. Ch. **1898**, **26**. 133.)

+  $3\text{H}_2\text{O}$ . (Melikoff, B. **1898**, **31**. 954.)

$\text{NH}_4\text{BO}_3$ ,  $\text{NH}_4\text{BO}_4 + \text{H}_2\text{O}$ . (Petrenko, C. C. **1902**, I. 1192.)

**Barium perborate,  $\text{Ba}(\text{BO}_3)_2 \cdot 7\text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Melikoff, B. 1898, 31. 954.)

**Cæsium perborate,  $\text{CsBO}_3 + \text{H}_2\text{O}$ .**

As  $\text{NH}_4$  salt. (Christensen.)

**Calcium perborate.**

Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. in water much more rapidly than the Ba salt. (Melikoff, B. 1898, 31. 954.)

**Copper perborate.**

Very unstable. Insol. in  $\text{H}_2\text{O}$ . (Melikoff, B. 1898, 31. 954.)

**Nickel perborate.**

Very unstable. Insol. in  $\text{H}_2\text{O}$ . (Melikoff.)

**Potassium perborate,  $2\text{KBO}_3 + \text{H}_2\text{O}$ .**

1.25 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ ; 2.5 pts., at  $15^\circ$ .

Insol. in alcohol and ether. (Girrewald, B. 1909, 42. 867.)

**Potassium perborate hydrogen peroxide,  $2\text{KBO}_3, \text{H}_2\text{O}_2$ .**

0.70 pt. is sol. in 100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Girrewald, B. 1909, 42. 868.)

**Potassium perdisborate,  $\text{KB}_2\text{O}_5 + 2\text{H}_2\text{O}$ .**

Ppt. (Bruhat, C. R. 1905, 140. 508.)

**Rubidium perborate,  $\text{RbBO}_3 + \text{H}_2\text{O}$ .**

As Na salt. (Christensen.)

**Sodium perborate,  $\text{Na}_2\text{B}_2\text{O}_5 + 10\text{H}_2\text{O}$ .**

100 g.  $\text{H}_2\text{O}$  dissolve 4.2 g. at  $11^\circ$ ; 7.1 g. at  $22^\circ$ ; 13.8 g. at  $32^\circ$ . (Jaubert, C. R. 1904, 134. 796.)

+  $4\text{H}_2\text{O}$ . Slowly decomp. in cold solution, rapidly when boiled. (Tanatar, Z. phys. Ch. 1898, 26. 132.)

Sol. in  $\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve 1.17 g. Aq. solution decomp. on warming. (Melikoff, B. 1898, 31. 679.)

100 g.  $\text{H}_2\text{O}$  dissolve 2.55 g. at  $15^\circ$ ; 2.69 g. at  $21^\circ$ ; 2.85 g. at  $26^\circ$ ; 3.78 g. at  $32^\circ$ . (Jaubert and Lion, Rev. gén. Chim. 1905, (7) 8. 163.)

**Uranyl perborate,  $\text{UBO}_4$ .**

(Bruhat, C. R. 1905, 140. 508.)

**Perbromic acid,  $\text{HBrO}_4$ .**

Known only in aqueous solution, which can be concentrated to a thick liquid on water bath. Not decomp. by  $\text{HCl}$ ,  $\text{SO}_3$ , or  $\text{H}_2\text{S}$ . (Kämmerer, J. pr. 86. 452; 90. 190.)

Does not exist. (Muir, C. N. 33. 256; MacIvor, C. N. 33. 35.)

**Barium perbromate,  $\text{Ba}(\text{BrO}_4)_2$ .**

Very sl. sol. in boiling  $\text{H}_2\text{O}$ . (Kämmerer, J. pr. 90. 190.)

Does not exist. (Wolfram, A. 198. 95.)

**Potassium perbromate,  $\text{KBrO}_4$ .**

Less sol. in  $\text{H}_2\text{O}$  than  $\text{KBrO}_3$ , but more sol. than  $\text{KClO}_4$ . (Kämmerer, J. pr. 90. 190.)

Does not exist. (Wolfram, A. 198. 95.)

**Silver perbromate,  $\text{AgBrO}_4$ .**

Sl. sol. in cold, more abundantly in hot  $\text{H}_2\text{O}$ . (Kämmerer, J. pr. 90. 190.)

Does not exist. (Wolfram, A. 198. 95.)

**Perbromoplatinocyanhydric acid,  $\text{H}_2\text{Pt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Holst, Bull. Soc. (2) 22. 347.)

**Aluminum perbromoplatinocyanide,  $\text{Al}_2[\text{Pt}(\text{CN})_4\text{Br}_2]_3 + 22\text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

**Ammonium —,  $(\text{NH}_4)_2\text{Pt}(\text{CN})_4\text{Br}_2$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Barium —,  $\text{BaPt}(\text{CN})_4\text{Br}_2 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  or alcohol.

**Cadmium —,  $\text{CdPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ .

**Calcium —,  $\text{CaPt}(\text{CN})_4\text{Br}_2 + 7\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Cobaltous —,  $\text{CoPt}(\text{CN})_4\text{Br}_2 + 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol.

**Glucinum —,  $\text{GIPt}(\text{CN})_4\text{Br}_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Ferrous —.**

Very sl. sol. in  $\text{H}_2\text{O}$ .

**Lead —,  $\text{PbPt}(\text{CN})_4\text{Br}_2 + 2\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ .

**Lithium —,  $\text{Li}_2\text{Pt}(\text{CN})_4\text{Br}_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Magnesium —,  $\text{MgPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Nickel —,  $\text{NiPt}(\text{CN})_4\text{Br}_2 + x\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Potassium —,  $\text{K}_2\text{Pt}(\text{CN})_4\text{Br}_2$ .**

Sol. in  $\text{H}_2\text{O}$ .  
+  $2\text{H}_2\text{O}$ . Efflorescent.

Silver perbromoplatinocyanide,  
 $\text{Ag}_2\text{PtBr}_2(\text{CN})_4$ .

Ppt. (Miolati, Gazz. ch. it. 1900, 30. 588.)

Sodium —,  $\text{Na}_2\text{Pt}(\text{CN})_4\text{Br}_2$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

Strontium —,  $\text{SrPt}(\text{CN})_4\text{Br}_2 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

Zinc —,  $\text{ZnPt}(\text{CN})_4\text{Br}_2 + 5\text{H}_2\text{O}$ .

Not very sol. in  $\text{H}_2\text{O}$ .

### Percarbonic acid.

Ammonium percarbonate,  $(\text{NH}_4)_2\text{CO}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ . Insol. in alcohol and ether. (Kasanevsky, C. C. 1902, I. 1263.)

Barium percarbonate,  $\text{BaCO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Merck, C. C. 1906, II. 1743.)

Decomp. slowly in the air. Not rapidly decomp. by  $\text{H}_2\text{O}$ . Rapidly decomp. by acids. (Wolfenstein, B. 1908, 41. 280.)

Potassium percarbonate,  $\text{K}_2\text{CO}_4$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Sl. sol. in alcohol. (v. Hansen, Z. Elektrochem. 1897, 3. 448.)

$\text{K}_2\text{C}_2\text{O}_8$ . Sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  with only slight decomp. but is decomp. at ord. temp. Sl. sol. in alcohol. (Treadwell, Ch. Z. 1901, 25. 1008.)

Rubidium percarbonate,  $\text{Rb}_2\text{CO}_4, 2\text{H}_2\text{O}_2 + \text{H}_2\text{O}$ .

Hydroscopic; decomp. by  $\text{H}_2\text{O}$ ; pptd. by alcohol.

$\text{Rb}_2\text{CO}_4, \text{H}_2\text{O}_2 + 2\text{H}_2\text{O}$ . Hydroscopic; decomp. by  $\text{H}_2\text{O}$ ; pptd. by alcohol.

$\text{Rb}_2\text{CO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ . Hydroscopic; decomp. by  $\text{H}_2\text{O}$ ; pptd. by alcohol. (Peltner, B. 1909, 42. 1782.)

$\text{Rb}_2\text{C}_2\text{O}_8$ . Very deliquescent. (Constam and Hansen, Z. Elektrochem. 1897, 3. 144.)

Sodium percarbonate,  $\text{Na}_2\text{CO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with gradual decomp. (Tansar, B. 1899, 32. 1544.)

Sodium hydrogen percarbonate,  $4\text{Na}_2\text{CO}_4, \text{H}_2\text{CO}_3$ .

Ppt. (Merck, Chem. Soc. 1908, 94. (2) 180.)

### Perchloric acid, $\text{HClO}_4$ .

Combines with  $\text{H}_2\text{O}$  with a hissing sound and evolution of much heat.

Solution in  $\text{H}_2\text{O}$  is very stable.

When dil.  $\text{HClO}_4 + \text{Aq}$  is distilled,  $\text{H}_2\text{O}$  and  $\text{HClO}_4$  distil off until a temp. of  $203^\circ$  is reached, when an acid of constant composition containing 71.6–72.2%  $\text{HClO}_4$  ( $= \text{HClO}_4 + 2\text{H}_2\text{O}$ ) is obtained. Forms hydrate  $\text{HClO}_4 + \text{H}_2\text{O}$ , which is deliquescent, and dissolves in  $\text{H}_2\text{O}$  with evolution of much heat.  $\text{HClO}_4$  is very unstable,  $\text{HClO}_4 + \text{H}_2\text{O}$  more stable, and  $\text{HClO}_4 + 2\text{H}_2\text{O}$  is very stable. (Roscoe, A. 121. 346.)

Sp. gr. of  $\text{HClO}_4 + \text{Aq}$ . at  $15^\circ/4^\circ$ .

Sp. gr.	$\text{HClO}_4$	Sp. gr.	$\text{HClO}_4$	Sp. gr.	$\text{HClO}_4$
1.005	1.00	1.235	33.29	1.465	54.50
1.010	1.90	1.240	33.85	1.470	54.89
1.015	2.77	1.245	34.40	1.475	55.18
1.020	3.61	1.250	34.95	1.480	55.56
1.025	4.43	1.255	35.49	1.485	55.95
1.030	5.25	1.260	36.03	1.490	56.32
1.035	6.07	1.265	36.56	1.495	56.69
1.040	6.88	1.270	37.08	1.500	57.06
1.045	9.68	1.275	37.60	1.505	57.44
1.050	8.48	1.280	38.10	1.510	57.81
1.055	9.28	1.285	38.60	1.515	58.17
1.060	10.06	1.290	39.10	1.520	58.54
1.065	10.83	1.295	39.60	1.525	58.91
1.070	11.58	1.300	40.10	1.530	59.28
1.075	12.33	1.305	40.59	1.535	59.66
1.080	13.08	1.310	41.08	1.540	60.04
1.085	13.83	1.315	41.56	1.545	60.41
1.090	14.56	1.320	42.03	1.550	60.78
1.095	15.28	1.325	42.49	1.555	61.15
1.100	16.00	1.330	42.97	1.560	61.52
1.105	16.72	1.335	43.43	1.565	61.89
1.110	17.45	1.340	43.89	1.570	62.26
1.115	18.16	1.345	44.35	1.575	62.63
1.120	18.88	1.350	44.81	1.580	63.00
1.125	19.57	1.355	45.26	1.585	63.37
1.130	20.26	1.360	45.71	1.590	63.74
1.135	20.95	1.365	46.16	1.595	64.12
1.140	21.64	1.370	46.61	1.600	64.50
1.145	22.32	1.375	47.05	1.605	64.88
1.150	22.99	1.380	47.49	1.610	65.26
1.155	23.65	1.385	47.93	1.615	65.63
1.160	24.30	1.390	48.37	1.620	66.01
1.165	24.94	1.395	48.80	1.625	66.39
1.170	25.57	1.400	49.23	1.630	66.76
1.175	26.20	1.405	49.68	1.635	67.13
1.180	26.82	1.410	50.10	1.640	67.51
1.185	27.44	1.415	50.51	1.645	67.89
1.190	28.05	1.420	50.91	1.650	68.26
1.195	28.66	1.425	51.31	1.655	68.64
1.200	29.26	1.430	51.71	1.660	69.02
1.205	29.86	1.435	52.11	1.655	69.40
1.210	30.45	1.440	52.51	1.670	69.77
1.215	31.04	1.445	52.91	1.675	70.15
1.220	31.61	1.450	53.31		
1.225	32.18	1.455	53.71		
1.230	32.74	1.460	54.11		

Sp. gr. of  $\text{HClO}_4 + \text{Aq.}$ 

% $\text{HClO}_4$	Sp. gr. at 15°/4°	Sp. gr. at 30°/4°	Sp. gr. at 50°/4°
11.14	1.0670	.....	1.0507
35.63	1.2569	1.2451	1.2292
55.63	1.4807	1.4637	1.4421
69.81	1.6708	.....	1.6284

(Emster, Z. anorg. 1907, 52. 279.)

Sp. gr. of  $\text{HClO}_4 + \text{Aq.}$ 

Sp. gr.				% by wt. HClO <sub>4</sub> in the liquid
corrected		uncorrected		
20°	50°	20°	50°	
1.7676	1.7098	1.7716	1.7312	100
1.7817	1.7259	1.7858	1.7475	98.62
1.8059	1.7531	1.8100	1.7751	94.67
...	1.7690	...	1.7912	90.80
...	1.7756	...	1.7979	84.81
...	1.7619	...	1.7840	81.07
1.7386	1.7023	1.7425	1.7237	75.59
1.6471	1.6110	1.6508	1.6311	68.42
1.5353	1.5007	1.5386	1.5194	60.38
1.4078	1.3779	1.4108	1.3949	50.51
1.2901	1.2649	1.2927	1.2804	39.73
1.1778	1.1574	1.1800	1.1715	27.07

(v. Wyk, Z. anorg. 1905, 48. 45.)

Bpt. of  $\text{HClO}_4 + \text{Aq.}$  at atmospheric pressure.

% by wt. $\text{HClO}_4$ in the liquid	% by wt. $\text{HClO}_4$ in the vapor	Initial bpt.
72.4	72.4	203°
70.06	40.11	198.7
65.2	6.06	181.2
61.2	0.9	162.3
56.65	...	148.0
50.67	...	132.4
38.90	...	114.8
24.23	...	105.8
0.0	0.0	100

(v. Wyk, Z. anorg. 1905, 48. 33.)

Bpt. of  $\text{HClO}_4 + \text{Aq.}$  at 18 mm. pressure.

% by wt. $\text{HClO}_4$ in the liquid	Bpt.
100	16.0°
94.8	24.8
92.0	35
84.8	70
79.8	92
70.5	107

(v. Wyk, Z. anorg. 1905, 48. 36.)

+ $\text{H}_2\text{O}$ . Deliquescent. (Roscoe, A. 121. 346.)  
 + $2\text{H}_2\text{O}$ .  $\text{HClO}_4 + 2\text{H}_2\text{O}$  has 1.65 sp. gr.

and boils at 200° (Serullas); has 1.72–1.82 sp. gr. and boils at 200° (Nativelle, J. pr. 26. 405).

Sol. in alcohol with decomp.; often explosive.

+ $2\frac{1}{2}\text{H}_2\text{O}$ . (v. Wyck.)

+ $3\text{H}_2\text{O}$ . (v. Wyck.)

+ $3\frac{1}{2}\text{H}_2\text{O}$ . (v. Wyck.)

## Perchlorates.

All perchlorates are sol. in  $\text{H}_2\text{O}$ ,  $\text{KClO}_4$ ,  $\text{RbClO}_4$ , and  $\text{CsClO}_4$ , somewhat difficultly. They are all deliquescent, and sol. in alcohol, excepting  $\text{NH}_4\text{ClO}_4$ ,  $\text{KClO}_4$ ,  $\text{Pb}(\text{ClO}_4)_2$ , and  $\text{Hg}_2(\text{ClO}_4)_2$ . (Serullas, A. ch. (2) 46. 296.)

Aluminum perchlorate,  $\text{Al}(\text{ClO}_4)_3 + 6\text{H}_2\text{O}$ .

Very deliquescent. (Weinland, Z. anorg. 1913, 84. 370.)

Aluminum sodium perchlorate,  $\text{AlNa}(\text{ClO}_4)_4 + 12\text{H}_2\text{O}$ .

Sl. hygroscopic. (Weinland, Z. anorg. 1913, 84. 370.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Ammonium perchlorate,  $\text{NH}_4\text{ClO}_4$ .

Permanent. Sol. in 5 pts.  $\text{H}_2\text{O}$ ; somewhat sol. in alcohol. (Mitscherlich, Pogg. 25. 300.)

Solubility of  $\text{NH}_4\text{ClO}_4$  in  $\text{H}_2\text{O}$  at t°.

t°	G. per l. solution	Sp. gr.
0	115.63	1.059
20	208.45	1.098
40	305.77	1.128
60	390.50	1.158
80	481.86	1.193
100	570.06	1.216
107	591.15	1.221

(Carlson, Festak. Stockholm. 1911. 262.)

100 g.  $\text{H}_2\text{O}$  dissolve 18.5 g.  $\text{NH}_4\text{ClO}_4$ . (Hofmann, Höbald and Quocq, A. 1912, 386. 304.)

100 g. sat. solution in  $\text{H}_2\text{O}$  contain 1.735 (17.35?) g.  $\text{NH}_4\text{ClO}_4$  at 14.2°. (Thin and Cumming, Chem. Soc. 1915, 107. 361.)

Insol. in conc.  $\text{HClO}_4 + \text{Aq.}$   
 100 g. sat. solution in 98.8% ethyl alcohol contain 1.96 g.  $\text{NH}_4\text{ClO}_4$  at 25.2°. (Thin and Cumming.)

Sol. in acetone. Eidmann, C. C. 1899, II. 1014.)

Barium perchlorate,  $\text{Ba}(\text{ClO}_4)_2 + 4\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

+3H<sub>2</sub>O. Solubility of Ba(ClO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O in H<sub>2</sub>O at t°.

t°	G. per 100 g. H <sub>2</sub> O	Sp. gr.
0	206	1.782
20	289	1.912
40	358	2.009
60	432	2.070
80	497	2.114
100	564	2.155
120	645	2.195
140	758	2.230

(Carlson, Festsch. Stockholm, 1911. 262.)

**Bismuth perchlorate**, (BiO)ClO<sub>4</sub>.

Insol. in H<sub>2</sub>O. Easily sol. in HCl or HNO<sub>3</sub>, +Aq. less easily in H<sub>2</sub>SO<sub>4</sub>+Aq. (Muir, C. N. 33. 15.)

**Cadmium perchlorate**, Cd(ClO<sub>4</sub>)<sub>2</sub>.

Very deliquescent. Sol. in H<sub>2</sub>O and alcohol. (Serullas, A. ch. 46. 305.)

+4H<sub>2</sub>O. (Salvadori, C. C. 1912, II. 414.)  
+6H<sub>2</sub>O. (S.)

**Cadmium perchlorate ammonia**, Cd(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>.

Cd(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>. (Salvadori, C. C. 1912, II. 414.)

**Cæsium perchlorate**, CsClO<sub>4</sub>.

Very sl. sol. in H<sub>2</sub>O. (Retgers, Z. phys. Ch. 8. 17.)

Solubility in H<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve at:  
8.5° 14° 33.7° 42° 50°  
0.91 1.19 2.99 4.09 5.47 g. CsClO<sub>4</sub>,

60° 70° 84° 99°  
7.30 9.79 16.51 28.57 g. CsClO<sub>4</sub>.  
(Calzolari, Acc. Sc. Med. Ferrara, 1911, 85. 150.)

Solubility in H<sub>2</sub>O at t°.

t°	G. per 100 g. H <sub>2</sub> O	Sp. gr.
5	0.97	1.007
25	2.05	1.010
80	17.05	1.084

(Carlson, Festsch. Stockholm, 1911. 262.)

**Calcium perchlorate**, Ca(ClO<sub>4</sub>)<sub>2</sub>.

Very deliquescent. Very sol. in H<sub>2</sub>O and alcohol. (Serullas, A. ch. 46. 304.)

**Cerous perchlorate**, Ce(ClO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.

Very deliquescent. (Jolin.)

**Chromic perchlorate**, Cr(ClO<sub>4</sub>)<sub>3</sub>+6H<sub>2</sub>O.

Very hygroscopic. (Weinland, Z. anorg. 1913, 84. 371.)

+9H<sub>2</sub>O. Can be cryst. from H<sub>2</sub>O. (Weinland.)

**Cobaltous perchlorate**, Co(ClO<sub>4</sub>)<sub>2</sub>+9H<sub>2</sub>O.

Solubility in H<sub>2</sub>O at t°.

t°	G. anhydrous salt in 100 ccm.	Sp. gr. of sat. solution at t°/4°
-30.7	83.14	...
-21.3	90.57	...
0	100.13	1.5639
+7.5	101.92	1.5658
18	103.80	1.5670
26	113.45	1.5811
45	115.10	1.5878

(Golblum and Terlikowsky, Bull. Soc. 1912, (4) 11. 146.)

+6H<sub>2</sub>O. (Salvadori, Gazz. ch. it. 1912, 42. (1) 458.)

**Cobalt perchlorate ammonia**, Co(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>.

Co(ClO<sub>4</sub>)<sub>2</sub>, 5NH<sub>3</sub>.

Co(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>, and +2H<sub>2</sub>O.

Co(ClO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub>, and +3H<sub>2</sub>O.

Co(ClO<sub>4</sub>)<sub>2</sub>, 3NH<sub>3</sub>+2H<sub>2</sub>O.

(Salvadori, Gazz. ch. it. 1912, 42. (1) 458.)

**Cupric perchlorate, basic**, Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>.

Ppt. (Salvadori, C. C. 1912, II. 414.)

**Cupric perchlorate**, Cu(ClO<sub>4</sub>)<sub>2</sub>.

Deliquescent. Sol. in H<sub>2</sub>O and alcohol. (Serullas, A. ch. 46. 306.)

+4H<sub>2</sub>O. (Salvadori, C. C. 1912, II. 414.)

**Cupric perchlorate ammonia**, Cu(ClO<sub>4</sub>)<sub>2</sub>, 4NH<sub>3</sub>+2H<sub>2</sub>O.

Not deliquescent. Sol. in NH<sub>4</sub>OH+Aq. (Roscoe, A. 121. 346.)

Cu(ClO<sub>4</sub>)<sub>2</sub>, NH<sub>3</sub>+H<sub>2</sub>O.

Cu(ClO<sub>4</sub>)<sub>2</sub>, 2CuO+2H<sub>2</sub>O, NH<sub>3</sub>.

Cu(ClO<sub>4</sub>)<sub>2</sub>, 2CuO+2H<sub>2</sub>O, 2NH<sub>3</sub>.

Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>+2H<sub>2</sub>O, 6NH<sub>3</sub>.

Cu(ClO<sub>4</sub>)<sub>2</sub>, Cu(OH)<sub>2</sub>+2H<sub>2</sub>O, 4NH<sub>3</sub>.

(Salvadori, C. C. 1912, II. 414.)

**Didymium perchlorate**, Di(ClO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O.

Very deliquescent. Very sol. in H<sub>2</sub>O and alcohol. (Cleve.)

**Erbium perchlorate**, Er(ClO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.

Very deliquescent.

**Glucinum perchlorate**, Gl(ClO<sub>4</sub>)<sub>3</sub>+4H<sub>2</sub>O.

Very deliquescent, and sol. in H<sub>2</sub>O. (Atterberg.)

**Hydrazine perchlorate**, (N<sub>2</sub>H<sub>4</sub>)(HClO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O.

1 l. of sat. solution in H<sub>2</sub>O contains 417.2 g. at 18°, sp. gr. = 1.264; 669 g. at 35°, sp. gr. = 1.391. (Carlson, Festsch. Stockholm, 1911. 262.)



**Indium perchlorate,  $\text{In}(\text{ClO}_4)_3 + 8\text{H}_2\text{O}$ .**

Deliquescent.  $\text{H}_2\text{O}$  solution decomp. at  $40^\circ$  with separation of basic salt. Sol. in  $\text{H}_2\text{O}$  and easily forms sat. solutions. Sol. in abs. alcohol, but much less sol. in ether. (Mathers, J. Am. Chem. Soc. 1908, 30. 212.)

**Iodine perchlorate,  $\text{I}(\text{ClO}_4)_3 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Indifferent toward organic solvents. (Fichter, Z. anorg. 1915, 91. 135.)

**Iron (ferrous) perchlorate,  $\text{Fe}(\text{ClO}_4)_2$ .**

Tolerably permanent; sol. in  $\text{H}_2\text{O}$ . (Serullas, A. ch. 46. 335.)

**Iron (ferric) perchlorate,  $\text{Fe}(\text{ClO}_4)_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Serullas.)

**Iron (ferric) sodium perchlorate,  $[\text{Fe}(\text{ClO}_4)_4]\text{Na} + 6\text{H}_2\text{O}$ .**

Hygroscopic. Can be cryst. from  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84. 366.)

**Lanthanum perchlorate,  $\text{La}(\text{ClO}_4)_3 + 9\text{H}_2\text{O}$ .**

Extremely deliquescent. Sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Cleve.)

**Lead perchlorate, basic,  $2\text{PbO}$ ,  $\text{Cl}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  into an insol. more basic salt, and sol.  $\text{Pb}(\text{ClO}_4)_2$ . (Marignac.)

**Lead perchlorate,  $\text{Pb}(\text{ClO}_4)_2 + 3\text{H}_2\text{O}$ .**

Permanent; extremely easily sol. in  $\text{H}_2\text{O}$ . (Roscoe, A. 121. 356.)

Sol. in about 1 pt.  $\text{H}_2\text{O}$ . (Serullas.)

**Lithium perchlorate,  $\text{LiClO}_4$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas.)

+  $3\text{H}_2\text{O}$ . (Wyrouboff, Zeit. Kryst. 10. 626.)

**Magnesium perchlorate,  $\text{Mg}(\text{ClO}_4)_2$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas.)

+  $6\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84. 372.)

**Manganous perchlorate,  $\text{Mn}(\text{ClO}_4)_2$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas, A. ch. 46. 335.)

+  $6\text{H}_2\text{O}$ . Sol. in 0.342 pts.  $\text{H}_2\text{O}$ . (Salvadori, C. C. 1912, II. 414.)

**Manganous perchlorate ammonia,  $\text{Mn}(\text{ClO}_4)_2 \cdot 5\text{NH}_3 + \text{H}_2\text{O}$ .**

Sol. in  $\text{HCl}$ ; insol. in  $\text{HNO}_3$ . (Salvadori, C. C. 1912, II. 414.)

**Mercurous perchlorate,  $(\text{HgClO}_4)_2 + 4\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . Gradually decomp. by

$\text{H}_2\text{O}$ . Decomp. by alcohol. (Chikashigé, Chem. Soc. 1895, 67. 1016.)

+  $6\text{H}_2\text{O}$ . Very deliquescent. (Roscoe, A. 121. 356.)

Permanent. (Serullas.)

**Mercuric perchlorate, basic,  $\text{HgO}$ ,  $2\text{Hg}(\text{ClO}_4)_2$ .**

Anhydrous. Ppt. Insol. in either  $\text{HCl}$  or  $\text{HNO}_3$ . Decomp. and dissolved by a mixture of the two. (Chikashigé, Chem. Soc. 1905, 87. 824.)

+  $12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Chikashigé.)

$2\text{HgO}$ ,  $\text{Hg}(\text{ClO}_4)_2$ .

$\alpha$ -salt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in acids. (Chikashigé, Chem. Soc. 1895, 67. 1015.)

$\beta$ -salt. Insol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HCl}$  or  $\text{HNO}_3$ . (Chikashigé, Chem. Soc. 1905, 87. 825.)

**Mercuric perchlorate,  $\text{Hg}(\text{ClO}_4)_2$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$ ; sl. sol. with decomp. in alcohol. (Serullas, A. ch. 34. 243.)

+  $6\text{H}_2\text{O}$ . Very hygroscopic. Very sol. in  $\text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ , more easily by alcohol. (Chikashigé, Chem. Soc. 1895, 67. 1014.)

**Mercuric perchlorate bromide,  $\text{HgClO}_4\text{Br}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Borelli, Gazz. ch. it. 1908, 38. (2) 421.)

**Mercuric perchlorate cyanide,  $\text{Hg}(\text{ClO}_4)_2 \cdot \text{Hg}(\text{CN})_2$ .**

Very sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Borelli.)

**Mercuric perchlorate iodide,  $\text{Hg}(\text{ClO}_4)_2\text{I}$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Sol. in much alcohol. Decomp. by  $\text{HNO}_3$ . Completely sol. in  $\text{KI}$  or  $\text{KCN} + \text{Aq}$ . (Borelli.)

**Mercuric perchlorate sulphocyanide,  $\text{Hg}(\text{ClO}_4)_2 \cdot \text{Hg}(\text{SCN})_2$ .**

Insol. in  $\text{H}_2\text{O}$  and conc. acids. Sol. in aqua regia. (Borelli.)

+  $6\text{H}_2\text{O}$ . (Salvadori, C. C. 1912, II. 414.)

**Nickel perchlorate,  $\text{Ni}(\text{ClO}_4)_2$ .**

Deliquescent; easily sol. in alcohol and  $\text{H}_2\text{O}$ . (Groth, Pogg. 133. 226.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. anhydrous salt in 100 cem.	Sp. gr. of the sat. solution
-30.7	89.98	...
-21.3	92.48	...
0	104.55	1.5726
+7.5	106.76	1.5755
18	110.05	1.5760
26	112.15	1.5841
45	118.60	1.5936

(Golblum and Terlikowsky, Bull. Soc. 1912, (4) 11. 147.)

+5H<sub>2</sub>O. (Golblum and Terlikowsky.)  
 +6H<sub>2</sub>O. (Salvadori, C. C. 1912, II. 414.)  
 +9H<sub>2</sub>O. (Golblum and Terlikowsky.)

**Nickel perchlorate, ammonia, Ni(ClO<sub>4</sub>)<sub>2</sub>, 6NH<sub>3</sub>.**

Ppt. (Salvadori.)

**Nitrosyl perchlorate, NO.O.ClO<sub>3</sub>+H<sub>2</sub>O.**

Ppt.; sl. hygroscopic; decomp. by H<sub>2</sub>O. (Hofmann, B. 1909, 42. 2032.)

**Platinum perchlorate, Pt<sub>2</sub>ClO<sub>6</sub>+15H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O. (Prost, Bull. Soc. (2) 46. 156.)

**Potassium perchlorate, KClO<sub>4</sub>.**

Sol. in 57.9 pts. H<sub>2</sub>O at 21.3° (Longuinine, A. 121. 123); in 65 pts. H<sub>2</sub>O at 15° (Serullas, A. ch. (2) 46. 297); in 88 pts. H<sub>2</sub>O at 10°; in 55 pts. H<sub>2</sub>O at 100° (Hutstein, J. B. 1851. 331.)

**Solubility in H<sub>2</sub>O.**

1 pt. KClO<sub>4</sub> dissolves in 142.9 pts. H<sub>2</sub>O at 6°, and solution has sp. gr. = 1.0005; in 52.5 pts. H<sub>2</sub>O at 25°, and solution has sp. gr. = 1.0123; in 15.5 pts. H<sub>2</sub>O at 50°, and solution has sp. gr. = 1.0181; in 5.04 pts. H<sub>2</sub>O at 100°, and solution has sp. gr. = 1.0660. (Muir, C. N. 33. 15.)

1 l. H<sub>2</sub>O dissolves 78.07 millimols. KClO<sub>4</sub> at 10°; 120.4 millimols. at 20°; 179.9 millimols. at 30°. (Noyes and Sammet, Z. phys. Ch. 1903, 43. 538.)

1 l. H<sub>2</sub>O dissolves 0.1475 mol. KClO<sub>4</sub> at 25°. (Rothmund, Z. phys. Ch. 1909, 69. 539.)

**Solubility in H<sub>2</sub>O at t°.**

t°	G. KClO <sub>4</sub> in 100 g. H <sub>2</sub> O	t°	G. KClO <sub>4</sub> in 100 g. H <sub>2</sub> O
0	0.70	50	6.45
10	1.14	70	12.3
15	1.54	99	22.2
20.5	1.90	..	...

(Calsolari, Acc. Sci. Med. Ferrara, 1911, 85. 150.)

t°	G. per 100 g. H <sub>2</sub> O	Sp. gr.
0	0.79	1.007
20	1.80	1.011
40	4.81	1.022
60	8.71	1.033
80	14.78	1.053
100	20.98	1.067

(Carlson, Festak. Stockholm, 1911. 262.)

1 l. H<sub>2</sub>O dissolves 0.1481 equivalents KClO<sub>4</sub> at 25°. (Noyes and Boggs, J. Am. Chem. Soc. 1911, 33. 1652.)

100 cc. of sat. solution of KClO<sub>4</sub> in H<sub>2</sub>O con-

tains 2.085 g. KClO<sub>4</sub> at 25.2°. (Thin and Cumming, Chem. Soc. 1915, 107. 361.)

KClO<sub>4</sub> is sol. in 22.6 pts. H<sub>2</sub>O at ord. temp., and 4.00 pts. at 100°; in 29.6 pts. NH<sub>4</sub>OH + Aq (conc.) at ord. temp.; in 30.4 pts. NH<sub>4</sub>OH + Aq (1 vol. conc. + 3 vols. H<sub>2</sub>O) at ord. temp.; in 22.4 pts. HNO<sub>3</sub> + Aq (1 vol. conc. + 5 vols. H<sub>2</sub>O) at ord. temp., and 5.00 pts. at 100°; in 30.4 pts. HCl + Aq. (1 vol. conc. + 4 vols. H<sub>2</sub>O) at ord. temp.; 45.2 pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (1 vol. commercial acid + 1 vol. H<sub>2</sub>O) at ord. temp.; in 24.4 pts. NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (dil. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + dil. NH<sub>4</sub>OH + Aq) at ord. temp., and 6.00 pts. at 100°; in 25.6 pts. NH<sub>4</sub>Cl + Aq (1 pt. NH<sub>4</sub>Cl + 10 pts. H<sub>2</sub>O) at ord. temp., and 6.00 pts. at 100°; in 16.0 pts. NH<sub>4</sub>NO<sub>3</sub> + Aq (1 pt. NH<sub>4</sub>NO<sub>3</sub> + 10 pts. H<sub>2</sub>O) at ord. temp., and 4.00 pts. at 100°; in 25.6 pts. NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq (conc. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Na<sub>2</sub>CO<sub>3</sub> + 4 vols. H<sub>2</sub>O) at ord. temp., and 7.00 pts. at 100°; in 29.2 pts. Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub> + Aq (Stolba, Z. anal. 2. 390) at ord. temp., and 7.00 pts. at 100°; in 27.2 pts. cane sugar (1 pt. + 10 pts. H<sub>2</sub>O) at ord. temp.; in 36.8 pts. grape sugar (1 pt. + 10 pts. H<sub>2</sub>O) at ord. temp. (Approximate.) (Pearson, Zeit. Chem. 1869. 662.)

**Solubility of KClO<sub>4</sub> in HClO<sub>4</sub> at 25.2°.**

Normality of HClO <sub>4</sub>	% KClO <sub>4</sub>
0.01	1.999
0.10	1.485
1.00	0.527

(Thin and Cumming, Chem. Soc. 1915, 107. 361.)

**Solubility in KCl + Aq at 25°.**

Concentration of KCl Equivalents per litre	Solubility of KClO <sub>4</sub> Equivalents per litre
0.04973	0.1282
0.09933	0.1123

(Noyes and Boggs, J. Am. Chem. Soc. 1911, 33. 1652.)

**Solubility in K<sub>2</sub>SO<sub>4</sub> + Aq at 25°.**

Concentration of K <sub>2</sub> SO <sub>4</sub> Equivalents per litre	Solubility of KClO <sub>4</sub> Equivalents per litre
0.04970	0.1315
0.09922	0.1181

(Noyes and Boggs.)

Very sl. sol. in abs. alcohol, and insol. if alcohol contains trace of an acetate. (Roscoe.) Insol. in alcohol of 0.835 sp. gr. (Schlössing, C. R. 73. 1269.)

Sol. in 6400 pts. 97.2% alcohol; in 5000 pts. 95.8% alcohol; in 2500-3000 pts. 90% alcohol; in 25,000 pts. alcohol-ether (2 pts. 97% alcohol : 1 pt. ether). Practically insol.

in an alcoholic solution of  $\text{HClO}_4$ . (Wenze' Z. angew. Ch. 1891. 691.)

Solubility of  $\text{KClO}_4$  in ethyl alcohol + Aq at  $25.2^\circ$ .

Vol. % alcohol	G. $\text{KClO}_4$ sol. in 100 g. alcohol
51.2	0.754
93.5	0.051
98.8	0.019

(Thin and Cumming, Chem. Soc. 1915, 107. 361.)

Solubility in organic compds. + Aq. at  $25^\circ$ .

Solvent	Mol. $\text{KClO}_4$ sol. in 1 litre
0.5-N methyl alcohol	0.1402
" ethyl alcohol	0.1356
" propyl alcohol	0.1343
" tert. amyl alcohol	0.1279
" acetone	0.1451
" ether	0.1336
" glycol	0.1416
" glycerine	0.1404
" urea	0.1510
" ammonia	0.1474
" diethylamine	0.1342
" pyridine	0.1410
" urethane	0.1400
" formamide	0.1539
" acetamide	0.1447
" acetic acid	0.1462
" phenol	0.1362
" methylal	0.1400
" methyl acetate	0.1429

(Rothmund, Z. phys. Ch. 1909, 69. 539.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Potassium rubidium perchlorate,  
 $\text{KRb}_2(\text{ClO}_4)_3$ .

15.5 g. are contained in 1 l. solution sat. at  $20^\circ$ ; sp. gr. = 1.013. (Carlson.)

Rubidium perchlorate,  $\text{RbClO}_4$ .

Sol. in 92.1 pts.  $\text{H}_2\text{O}$  at  $21.3^\circ$ . (Longuine, A. 121. 123.)

1 pt. sol. in 92.1 pts.  $\text{H}_2\text{O}$  at  $21^\circ$  as compared with 1 pt.  $\text{KClO}_4$  sol. in 57.9 pts.  $\text{H}_2\text{O}$  at  $21^\circ$ . (Erdmann, Arch. Pharm. 1894, 232. 23.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{RbClO}_4$ in 100 g. $\text{H}_2\text{O}$	$t^\circ$	G. $\text{RbClO}_4$ in 100 g. $\text{H}_2\text{O}$
0	2.46	42.2	14.94
8	3.50	50	19.40
19.8	6.28	77	41.65
30	9.53	99	76.5

(Calzolari, Acc. Sci. Med. Ferrara, 1911, 85. 150.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. in 100 g. $\text{H}_2\text{O}$	Sp. gr.
0	1.10	1.007
20	1.56	1.010
40	3.26	1.017
60	6.27	1.028
80	11.04	1.050
100	15.75	1.070

(Carlson, Festsk. Stockholm, 1911. 262.)

Scandium perchlorate.

(Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

Silver perchlorate,  $\text{AgClO}_4$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas, A. ch. 46. 307.)

Sodium perchlorate,  $\text{NaClO}_4$ .

Deliquescent, and very sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas.)

Not deliquescent. (Potilitsin, J. russ. Soc. 1889, 1. 258.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. in 1 l. of solution	Sp. gr.
15	1076	1.666
50	1234	1.731
143	1414	1.789

(Carlson, Festsk. Stockholm, 1911. 262.)

+  $\text{H}_2\text{O}$ . Not deliquescent. (Potilitsin.)

Strontium perchlorate,  $\text{Sr}(\text{ClO}_4)_2$ .

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas, A. ch. 46. 304.)

Terbium perchlorate.

Very sol. in  $\text{H}_2\text{O}$  and in alcohol. (Potratz, C. N. 1905, 92. 3.)

Thallous perchlorate,  $\text{TlClO}_4$ .

1 pt. salt dissolves in 10 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 0.6 pt. at  $100^\circ$ . (Roscoe, Chem. Soc. (2) 4. 504.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. per 100 g. $\text{H}_2\text{O}$	Sp. gr.
0	6.00	1.060
10	8.04	1.075
30	19.72	1.146
50	39.62	1.251
70	65.32	1.430
80	81.49	1.520

(Carlson, Festsk. Stockholm, 1911. 262.)

Sl. sol. in alcohol. (Roscoe.)

**Thallic perchlorate,  $\text{Ti}(\text{ClO}_4)_3 + 6\text{H}_2\text{O}$ .**

Very hygroscopic, sol. in  $\text{H}_2\text{O}$ . Decomp. in moist air. (Gewecke, Z. anorg. 1912, **75**, 274.)

**Uranyl perchlorate,  $(\text{UO}_2)(\text{ClO}_4)_2 + 4\text{H}_2\text{O}$ .**

(Salvadori, Ch. Z. 1912, **36**, 513.)  
 $+ 6\text{H}_2\text{O}$ . (Salvadori.)

**Yttrium perchlorate,  $\text{Y}(\text{ClO}_4)_3 + 8\text{H}_2\text{O}$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Cleve.)

**Zinc perchlorate,  $\text{Zn}(\text{ClO}_4)_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Serullas, A. ch. **46**, 302.)

$+ 4\text{H}_2\text{O}$ , and  $6\text{H}_2\text{O}$ . (Salvadori, C. C. 1912, II, 414.)

**Zinc perchlorate, ammonia,  $\text{Zn}(\text{ClO}_4)_2, 4\text{NH}_3$ .**

Ppt. (Salvadori, C. C. 1912, II, 414.)  
 $\text{Zn}(\text{ClO}_4)_2, 6\text{NH}_3$ . (Ephraim, B. 1915, **48**, 643.)

**Perchromic acid.**

Sol. in ethyl acetate and valerate; in amyl chloride, formate, acetate, butyrate, and valerate. (All give blue solutions.)

Insol. in  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_5\text{NH}_2$ ,  $\text{C}_6\text{H}_5\text{NO}_2$ , and toluene. (Grosvenor, J. Am. Chem. Soc. 1895, **17**, 41-43.)

$\text{H}_2\text{CrO}_5 + 2\text{H}_2\text{O}$ . Decomp. above  $-30^\circ$ . (Riesenfeld, B. 1914, **47**, 552.)

**Ammonium perchromate,  $(\text{NH}_4)_2\text{CrO}_5$ .**

Very unstable. Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Insol. in pure alcohol and pure ether. Decomp. by boiling alcohol containing more than 50%  $\text{H}_2\text{O}$ . (Wohlers, B. 1905, **38**, 1888.)

$\text{CrO}_4, 3\text{NH}_3$ . Sol. in 10%  $\text{NH}_4\text{OH} + \text{Aq}$ ; sol. in  $\text{H}_2\text{O}$  with decomp., insol. in other solvents. (Wiede, B. 1897, **30**, 2181.)

$\text{NH}_4\text{CrO}_5, \text{H}_2\text{O}_2$ . Decomp. in the air. Sol. in ice cold  $\text{H}_2\text{O}$ , decomp. when warmed. Insol. in alcohol, ether, ligroin and  $\text{CHCl}_3$ . (Wiede, B. 1898, **31**, 518.)

**Ammonium hydrogen perchromate,**

$\text{CrO}_2(\text{O.O.NH}_4)(\text{O.OH})$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Difficultly sol. in cold abs. alcohol. (Hofmann, B. 1904, **37**, 3406.)

**Barium perchromate,  $\text{BaCr}_2\text{O}_8$ .**

(Byers and Reid, Am. Ch. J. 1904, **32**, 513.)

**Calcium perchromate,  $\text{CaCr}_2\text{O}_8$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Mylius, B. 1900, **33**, 3689; Byers and Reid, Am. Ch. J. 1904, **32**, 513.)

**Lithium perchromate,  $\text{Li}_2\text{Cr}_2\text{O}_8$ .**

(Byers and Reid, Am. Ch. J. 1904, **32**, 511.)

**Magnesium perchromate,  $\text{MgCr}_2\text{O}_8$ .**

(Byers and Reid.)

**Potassium perchromate,  $\text{K}_2\text{Cr}_2\text{O}_8$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Insol. in pure alcohol and pure ether. Decomp. by boiling alcohol containing more than 50%  $\text{H}_2\text{O}$ . (Wohlers, B. 1905, **38**, 1888.)

$+ x\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  without decomp. (Riesenfeld and Kutsch, B. 1908, **41**, 3948.)

$\text{K}_2\text{Cr}_2\text{O}_8$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. in the air. (Byers and Reid, Am. Ch. J. 1904, **32**, 505.)

$\text{KCrO}_5, \text{H}_2\text{O}_2$  or  $\text{KH}_2\text{CrO}_7$ . Sol. in ice cold  $\text{H}_2\text{O}$ , decomp. when warmed; explosive. (Wiede, B. 1898, **31**, 520.)

**Sodium perchromate,  $\text{Na}_2\text{Cr}_2\text{O}_8$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . Insol. in pure alcohol and pure ether. Decomp. by boiling with alc. containing more than 50%  $\text{H}_2\text{O}$ . (Wohlers, B. 1905, **38**, 1888.)

$\text{Na}_2\text{Cr}_2\text{O}_8 + 28\text{H}_2\text{O}$ . Efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ , with decomp. Not decomp. by  $\text{NaOH} + \text{Aq}$ . (Häussermann, J. pr. (2) **48**, 70.)

$\text{Na}_2\text{Cr}_2\text{O}_8$ . (Byers and Reid, Am. Ch. J. 1904, **32**, 511.)

**Perchloroplatinocyanhydric acid,**

$\text{H}_2\text{Pt}(\text{CN})_4\text{Cl}_2 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  and alcohol.

**Ammonium perchloroplatinocyanide,**

$(\text{NH}_4)_2\text{Pt}(\text{CN})_4\text{Cl}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Barium —,  $\text{BaPt}(\text{CN})_4\text{Cl}_2 + 5\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ .

**Calcium —,  $\text{CaPt}(\text{CN})_4\text{Cl}_2$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Magnesium —,  $\text{MgPt}(\text{CN})_4\text{Cl}_2 + x\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Manganous —,  $\text{MnPt}(\text{CN})_4\text{Cl}_2 + 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Potassium —,  $\text{K}_2\text{Pt}(\text{CN})_4\text{Cl}_2 + 2\text{H}_2\text{O}$ .**

Very efflorescent, and sol. in  $\text{H}_2\text{O}$  and alcohol.

**Percolumbic acid,  $\text{HCbO}_4 + n\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. with decomp. in warm  $\text{H}_2\text{SO}_4$ . (Melikoff, Z. anorg. 1899, **20**, 341.)

**Cæsium percolumbate,  $\text{Cs}_2\text{CbO}_8$ .**

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, **30**, 1658.)

**Cæsium magnesium percolumbate,**  
 $\text{MgCsCbO}_5 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (E. F. Smith.)

**Calcium potassium percolumbate,**  
 $\text{CaKCbO}_5 + 4\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Calcium sodium percolumbate,**  $\text{CaNaCbO}_5 + 4\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Magnesium potassium percolumbate,**  
 $\text{MgKCbO}_5 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (E. F. Smith.)

**Magnesium rubidium percolumbate,**  
 $\text{MgRbCbO}_5 + 7\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (E. F. Smith.)

**Magnesium sodium percolumbate,**  
 $\text{MgNaCbO}_5 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (E. F. Smith.)

**Potassium percolumbate,**  $\text{K}_2\text{CbO}_5$ .

Sol. in  $\text{H}_2\text{O}$ . Ppt. from aq. solution by alcohol. (E. F. Smith.)

$\text{K}_2\text{Cb}_2\text{O}_{11} + 3\text{H}_2\text{O}$ . Sol. with decomp. in  $\text{H}_2\text{O}$ . Ppt. by alcohol. Sol. in  $\text{KOH} + \text{H}_2\text{O}_2 + \text{Aq}$ . (Melikoff, Z. anorg. 1899, 20, 342.)

**Rubidium percolumbate,**  $\text{Rb}_2\text{CbO}_5$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (E. F. Smith.)

**Sodium percolumbate,**  $\text{Na}_2\text{CbO}_5$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (E. F. Smith.)

**Perferricyanhydric acid.**

**Potassium perferricyanide,**  $\text{K}_2\text{Fe}(\text{CN})_6 + \text{H}_2\text{O}$  (?).

Very hygroscopic, and sol. in  $\text{H}_2\text{O}$ . Nearly insol. in absolute alcohol. Decomp. by hot  $\text{H}_2\text{O}$ . (Skraup, A. 189, 368.)

**Periodic acid,**  $\text{H}_5\text{IO}_6$ .

Deliquescent in moist air; very sol. in  $\text{H}_2\text{O}$ . (Bengieser, A. 17, 254.)

Rather easily sol. in alcohol and ether. (Bengieser.)

Rather easily sol. in alcohol, less in ether. (Langtoch.)

Sl. sol. in alcohol, still less in ether. (Langlois, J. pr. 56, 36.)

Sp. gr. of  $\text{H}_5\text{IO}_6 + \text{Aq}$ .

$\text{H}_5\text{IO}_6 + 20\text{H}_2\text{O} = 1.4008$ .

$\text{H}_5\text{IO}_6 + 40\text{H}_2\text{O} = 1.2165$ .

$\text{H}_5\text{IO}_6 + 80\text{H}_2\text{O} = 1.1121$ .

$\text{H}_5\text{IO}_6 + 160\text{H}_2\text{O} = 1.0570$ .

$\text{H}_5\text{IO}_6 + 320\text{H}_2\text{O} = 1.0288$ .

(Thomsen, B. 7, 71.)

**Periodates.**

Most periodates are insol. or sl. sol. in  $\text{H}_2\text{O}$ ; all are insol. or very sl. sol. in alcohol, but they all dissolve in dil.  $\text{HNO}_3 + \text{Aq}$ . (Bengieser.)

**Aluminum metaperiodate,**  $\text{Al}(\text{IO}_4)_3 + 3\text{H}_2\text{O}$ .

Stable in solution containing  $\text{HNO}_3$ . (Eakle, C. C. 1896, II, 649.)

**Ammonium metaperiodate,**  $\text{NH}_4\text{IO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Cryst. with  $3\text{H}_2\text{O}$  (Ihre, B. 3, 316),  $2\text{H}_2\text{O}$  (Langlois, A. ch. (3) 34, 257).

Stable in solution containing free ammonia. (Eakle, Zeit. Kryst. 1896, 26, 258-88.)

100 pts.  $\text{H}_2\text{O}$  dissolve 2.7 pts.  $\text{NH}_4\text{IO}_4$  at  $16^\circ$ ; sp. gr. of sat. solution at  $16^\circ/4^\circ = 1.0178$ . (Barker, Chem. Soc. 1908, 93, 17.)

**Ammonium dimesoperiodate,**  $(\text{NH}_4)_2\text{I}_2\text{O}_8 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 134, 379.)

Stable in solution containing free ammonia. Two modifications. (Eakle, Zeit. Kryst. 1896, 26, 558-88; C. C. 1896, II, 649.)

**Ammonium lithium dimesoperiodate,**  
 $(\text{NH}_4)_2\text{Li}_2\text{I}_2\text{O}_8 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ihre.)

**Ammonium magnesium mesoperiodate,**  
 $\text{NH}_4\text{MgIO}_5 + 3\text{H}_2\text{O}$ .

Precipitate. (Rammelsberg, Pogg. 134, 510.)

**Barium metaperiodate,**  $\text{Ba}(\text{IO}_4)_2$ .

Known only in solution.

**Barium dimesoperiodate,**  $\text{Ba}_2\text{I}_2\text{O}_8$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 134, 391.)

Cryst. also with  $3\text{H}_2\text{O}$ ,  $5\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$ .

**Barium mesoperiodate,**  $\text{Ba}_2(\text{IO}_4)_2 + 6\text{H}_2\text{O}$ .

(Ihre.)

**Barium orthoperiodate,**  $\text{Ba}_2(\text{IO}_6)_2$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)

**Barium dimesodiperiodate,**  $\text{Ba}_2\text{I}_2\text{O}_{12} + 5\text{H}_2\text{O}$ .

Precipitate. Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 134, 395.)

**Barium periodate tungstate.**

See Tungstoperiodate, barium.

**Cæsium metaperiodate,**  $\text{CsIO}_4$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ ; readily sol. in hot  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1901, 36, 279.)

2.15 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . Sp. gr. of the sat. aq. solution at  $15^\circ/4^\circ = 1.0166$ . (Barker, Chem. Soc. 1908, 93, 17.)

**Cæsium periodate hydrogen fluoride**,  $2\text{CsIO}_4$ ,  $3\text{HF} + \text{H}_2\text{O}$ .

Sol. in 40–60%  $\text{HF} + \text{Aq}$ . Decomp. by  $\text{H}_2\text{O}$ . Efflorescent. (Weinland, Z. anorg. 1899, 22. 263.)

**Cadmium metaperiodate**,  $\text{Cd}(\text{IO}_4)_2$ .

Ppt. (Rammelsberg, Pogg. 134. 516.)

**Cadmium dimesoperiodate**,  $\text{Cd}_2\text{I}_2\text{O}_9 + 9\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Cadmium mesoperiodate**,  $\text{Cd}_3(\text{IO}_4)_2 + 5\text{H}_2\text{O}$ .

Ppt.

$\text{CdHIO}_4$ . (Kimmins, Chem. Soc. 55. 151.)

**Cadmium diperiodate**,  $\text{Cd}_4\text{I}_2\text{O}_{11} + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Cadmium periodate**,  $\text{Cd}_{10}\text{I}_2\text{O}_{31} + 15\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Calcium metaperiodate**,  $\text{Ca}(\text{IO}_4)_2$ .

Sol. in  $\text{H}_2\text{IO}_6 + \text{Aq}$  and acids. (Rammelsberg, Pogg. 134. 405.)

**Calcium dimesoperiodate**,  $\text{Ca}_2\text{I}_2\text{O}_9 + 7\text{H}_2\text{O}$ , and  $9\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

$+ 3\text{H}_2\text{O}$ . (Langlois.)

**Calcium orthoperiodate**,  $\text{Ca}_3(\text{IO}_6)_2$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 44. 577.)

**Cobaltous periodate**,  $7\text{CoO}$ ,  $2\text{I}_2\text{O}_7 + 18\text{H}_2\text{O}$ .

Attacked by  $\text{HCl}$ , and sol. on warming. Slowly but completely sol. in  $\text{NHO}_3$ . (Lautsch, J. pr. 100. 89.)

Could not be obtained by Rammelsberg.

**Cupric dimesoperiodate**,  $\text{Cu}_2\text{I}_2\text{O}_9 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  without dissolving. (Rammelsberg.)

**Cupric orthoperiodate**,  $\text{Cu}_3\text{HIO}_4$ .

Very sol. in  $\text{HNO}_3 + \text{Aq}$ . (Kimmins, Chem. Soc. 55. 150.)

**Cupric diperiodate**,  $\text{Cu}_4\text{I}_2\text{O}_{11} + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg.)

$+ 7\text{H}_2\text{O}$ . (R.)

**Cupric periodate**,  $5\text{CuO}$ ,  $\text{I}_2\text{O}_5 + 5\text{H}_2\text{O}$ .

Wholly insol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 1. 73.)

**Didymium perodate**,  $\text{Di}_2\text{O}_2(\text{IO}_4)_2$ .

Precipitate.

$\text{DiIO}_4 + 4\text{H}_2\text{O}$ . Ppt. (Cleve, Bull. Soc. (2) 48. 362.)

**Erbium periodate**.

Sol. in  $\text{H}_2\text{O}$ . (Höglund.)

**Glucinum periodate**,  $\text{Gl}_2(\text{IO}_4)_2 + 11\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  without dissolving. Easily sol. in  $\text{HNO}_3 + \text{Aq}$ .

$+ 13\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Atterberg, B. 7. 474.)

**Iron (ferrous) orthoperiodate**,  $\text{Fe}_2(\text{IO}_6)_2$ .

(Kimmins, Chem. Soc. 55. 150.)

$\text{FeH}_2\text{IO}_4$ . (Kimmins.)

**Iron (ferric) periodate**,  $2\text{Fe}_2\text{O}_3$ ,  $\text{I}_2\text{O}_7 + 21\text{H}_2\text{O}$ .

Ppt. (Rammelsberg.)

**Iron (ferric) dimesoperiodate**,  $\text{FeHI}_2\text{O}_9$ .

Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Kimmins, Chem. Soc. 55. 149.)

**Iron (ferric) metaperiodate**,  $\text{Fe}(\text{IO}_4)_3$ .

(Kimmins.)

**Lanthanum periodate**,  $\text{La}(\text{IO}_4)_3 + 2\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

**Lead metaperiodate**,  $\text{Pb}(\text{IO}_4)_2$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Kimmins.)

**Lead orthoperiodate**,  $\text{Pb}_2\text{H}_4(\text{IO}_6)_2$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Kimmins, Chem. Soc. 55. 149.)

**Lead mesoperiodate**,  $\text{Pb}_3(\text{IO}_4)_2 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or excess of periodic acid +  $\text{Aq}$ . Decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Bengieser, A. 17. 254.)

**Lithium metaperiodate**,  $\text{LiIO}_4$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 1. 132.)

Somewhat deliquescent.

$+ \text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{O}$ . (Barker, Chem. Soc. 1911, 99. 1326.)

**Lithium dimesoperiodate**,  $\text{Li}_2\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 134. 387.)

**Lithium orthoperiodate**,  $\text{Li}_3\text{IO}_6$ .

$\text{H}_2\text{O}$  dissolves out a slight amount of  $\text{LiI}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Rammelsberg, Pogg. 137. 313.)

**Magnesium metaperiodate**,  $\text{Mg}(\text{IO}_4)_2 + 10\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Magnesium diperiodate**,  $\text{Mg}_2\text{I}_2\text{O}_{11} + 6\text{H}_2\text{O}$ , or  $9\text{H}_2\text{O}$ .

Sl. efflorescent. Insol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Magnesium dimesoperiodate**,  $\text{Mg}_2\text{I}_2\text{O}_7 + 3\text{H}_2\text{O}$ .

(Rammelsberg, Pogg. 134. 499.)  
+15 $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in periodic acid + Aq. (Langlois.)

**Manganic periodate.**

See Manganiperiodic acid.

**Mercurous diperiodate**,  $5\text{Hg}_2\text{O}$ ,  $\text{I}_2\text{O}_7$ , or  $4\text{Hg}_2\text{O}$ ,  $\text{I}_2\text{O}_7 = \text{Hg}_4\text{I}_2\text{O}_{11}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$  + Aq and in  $\text{HCl}$  + Aq. (Lautsch, J. pr. 100. 86.)

**Mercuric orthoperiodate**,  $\text{Hg}_2(\text{IO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$ . Sl. sol. in  $\text{HNO}_3$ . (Lautsch.)

**Mercuric potassium periodate**,  $10\text{HgO}$ ,  $5\text{K}_2\text{O}$ ,  $6\text{I}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . Difficultly sol. in warm  $\text{HNO}_3$  without decomp. (Rammelsberg, Pogg. 134. 526.)

**Nickel dimesoperiodate**,  $\text{Ni}_2\text{I}_2\text{O}_7$ .

(Kimmins, Chem. Soc. 55. 151.)

**Nickel mesoperiodate**,  $\text{Ni}_2(\text{IO}_3)_2$ .

(Kimmins.)

**Nickel periodate**,  $7\text{NiO}$ ,  $4\text{I}_2\text{O}_7 + 63\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{IO}_6$  + Aq. (Rammelsberg, Pogg. 134. 514.)

**Potassium metaperiodate**,  $\text{KIO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in 290 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 134. 320.)

Almost insol. in  $\text{KOH}$  + Aq.  
0.66 pt. is sol. in 100 pts.  $\text{H}_2\text{O}$  at  $13^\circ$ . Sp. gr. of the sat. sol. at  $13^\circ/4^\circ = 1.0051$ . (Barker, Chem. Soc. 1908, 93. 16.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Potassium mesoperiodate**,  $\text{K}_2\text{IO}_5 + 4\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Ihre.)

**Potassium dimesoperiodate**,  $\text{K}_4\text{I}_2\text{O}_9 + 9\text{H}_2\text{O}$ .

Sol. in 9.7 pts. cold  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 134. 320.)

Sol. in  $\text{KOH}$  + Aq.  
+  $3\text{H}_2\text{O}$ .

**Potassium hydrogen dimesoperiodate**,  $\text{K}_2\text{HI}_2\text{O}_9$ .

Less sol. in  $\text{H}_2\text{O}$  than  $\text{KIO}_4$ . (Kimmins, Chem. Soc. 51. 356.)

**Potassium manganic periodate.**

See Manganiperiodate, potassium.

**Potassium zinc periodate**,  $\text{K}_2\text{O}$ ,  $4\text{ZnO}$ ,  $2\text{I}_2\text{O}_7 + 4\text{H}_2\text{O}$ .

Ppt. (Rammelsberg, Pogg. 134. 368.)

**Potassium periodate tungstate.**

See Tungstoperiodate, potassium.

**Rubidium periodate**,  $\text{RbIO}_4$ .

0.65 pt. is sol. in 100 pts.  $\text{H}_2\text{O}$  at  $13^\circ$ . Sp. gr. of the sat. aq. solution at  $13^\circ/4^\circ = 1.0052$ . (Barker, Chem. Soc. 1908, 93. 16.)

**Samarium periodate**,  $\text{Sm}(\text{IO}_3)_3 + 4\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

**Silver metaperiodate**,  $\text{AgIO}_4$ .

Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{Ag}_2\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ , and by warm  $\text{H}_2\text{O}$  into  $\text{Ag}_2\text{I}_2\text{O}_9 + \text{H}_2\text{O}$ . (Ammermüller and Magnus, Pogg. 28. 516.)  
+  $\text{H}_2\text{O}$ . Insol. ppt. (Kimmins.)

**Silver mesoperiodate**,  $\text{Ag}_2\text{IO}_5$ .

(Fernlunda, J. pr. 100. 99.)

$\text{Ag}_2\text{HIO}_6$ . Insol. ppt. (Kimmins, Chem. Soc. 51. 358.)

Ppt. by dil.  $\text{HNO}_3$ ; sol. in  $\text{HNO}_3$ . (Rosenheim, A. 1899, 308. 57.)

**Silver dimesoperiodate**,  $\text{Ag}_4\text{I}_2\text{O}_9 + \text{H}_2\text{O}$ , or  $3\text{H}_2\text{O}$ .

Insol. ppt. (Kimmins.)

Decomp. by boiling  $\text{H}_2\text{O}$  into  $\text{Ag}_2\text{IO}_5$ . (Rammelsberg.)

**Silver orthoperiodate**,  $\text{Ag}_3\text{IO}_6$ .

Sol. in  $\text{HNO}_3$  or  $\text{NH}_4\text{OH}$  + Aq. (Rammelsberg, Pogg. 134. 386.)

Sol. in excess  $\text{NH}_4\text{OH}$  + Aq; pptd. by  $\text{HNO}_3$ . (Rosenheim, A. 1899, 308. 56.)

$\text{Ag}_3\text{H}_2\text{IO}_6$ . Insol. ppt. (Kimmins, Chem. Soc. 51. 358.)

$\text{Ag}_2\text{H}_2\text{IO}_6$ . As above. (Kimmins.)

Sol. in dil.  $\text{HNO}_3$ . (Rosenheim, A. 1899, 308. 53.)

**Silver diperiodate**,  $\text{Ag}_2\text{I}_2\text{O}_{11}$ .

Sl. sol. in  $\text{HNO}_3$  + Aq; insol. in  $\text{NH}_4\text{OH}$  + Aq. (Lautsch, J. pr. 100. 75.)

**Silver dimesodiperiodate**,  $\text{Ag}_{10}\text{I}_2\text{O}_{19}$ .

$\text{HNO}_3$  + Aq dissolves out  $\text{Ag}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Lautsch.)

**Sodium metaperiodate**,  $\text{NaIO}_4$ .

Easily sol. in  $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ . (Langlois.)

+  $3\text{H}_2\text{O}$ . Efflorescent; sol. in 12 pts.  $\text{H}_2\text{O}$  at ord. temp. (Rammelsberg, J. pr. 103. 278.)

**Sodium dimesoperiodate**,  $\text{Na}_4\text{I}_2\text{O}_9 + 3\text{H}_2\text{O}$ .

Scarcely sol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Magnus and Ammermüller, Pogg. 28. 514.)

Very sol. in dil.  $\text{HNO}_3$  + Aq. (Langlois.)

Sol. in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq with decomp. (Bengieser, A. 17. 254.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $4\text{H}_2\text{O}$ .

**Sodium mesoperiodate**,  $\text{Na}_5\text{IO}_6 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ihre.)  
 $+\text{H}_2\text{O} = \text{Na}_2\text{H}_3\text{IO}_6$ . Less sol. in  $\text{H}_2\text{O}$  than  
 $\text{Na}_4\text{I}_2\text{O}_7 + 3\text{H}_2\text{O} (= \text{Na}_2\text{H}_3\text{IO}_6)$ . (Kimmins,  
 Chem. Soc. 51. 357.)

**Sodium orthoperiodate**,  $\text{Na}_5\text{IO}_6$ .

$\text{Na}_2\text{H}_3\text{IO}_6$ . Correct composition for  
 $\text{Na}_4\text{I}_2\text{O}_7 + 3\text{H}_2\text{O}$ . (Kimmins.)  
 $\text{Na}_2\text{H}_3\text{IO}_6$ . Correct composition for  $\text{Na}_5\text{IO}_6$   
 $+\text{H}_2\text{O}$ . (Kimmins.)

**Strontium metaperiodate**,  $\text{Sr}(\text{IO}_4)_2 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Strontium dimesoperiodate**,  $\text{Sr}_2\text{I}_2\text{O}_8$ .

Decomp. by  $\text{H}_2\text{O}$ .  
 $+3\text{H}_2\text{O}$ .

**Strontium mesoperiodate**,  $\text{Sr}_2(\text{IO}_4)_2$ .

Precipitate.

**Strontium orthoperiodate**,  $\text{Sr}_2(\text{IO}_4)_2$ .

(Rammelsberg, Pogg. 44. 577.)

**Thallic periodate**,  $3\text{Ti}_2\text{O}_5, \text{I}_2\text{O}_7 + 30\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by alkalis.  
 (Rammelsberg, B. 3. 361.)

**Thorium periodate**.

Precipitate. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

**Uranous periodate**.

Precipitate, which quickly decomposes.

**Ytterbium periodate**,  $\text{YbIO}_6 + 2\text{H}_2\text{O}$ .

Hydroscopic. (Cleve, Z. anorg. 1902, 32.  
 136.)

**Yttrium periodate**,  $\text{Y}_2(\text{IO}_4)_2 + 8\text{H}_2\text{O}$ .

Very slightly sol. (Cleve.)  
 $3\text{Y}_2\text{O}_3, 2\text{I}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Precipitate. (Cleve.)

**Zinc dimesoperiodate**,  $\text{Zn}_2\text{I}_2\text{O}_8 + 6\text{H}_2\text{O}$ .

(Rammelsberg, Pogg. 134. 513.)

**Zinc periodate**,  $3\text{ZnO}, 2\text{I}_2\text{O}_7 + 7\text{H}_2\text{O}$ .

(Langlois.)

**Zinc diperiodate**,  $\text{Zn}_2\text{I}_2\text{O}_{11} + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , al. acid with  $\text{HNO}_3$ .  
 (Langlois, A. ch. (3) 34. 257.)

**Zinc dimesodiperiodate**,  $\text{Zn}_2\text{I}_2\text{O}_{13} + 14\text{H}_2\text{O} (?)$ .

(Rammelsberg.)

**Zinc periodate**,  $9\text{ZnO}, 2\text{I}_2\text{O}_7 + 12\text{H}_2\text{O}$ .

(Rammelsberg.)

**Periodoplatinocyanhydric acid**.

**Barium periodoplatinocyanide**,  $\text{BaPt}(\text{CN})_4\text{I}_2$   
 $+ x\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol. (Holst, Bull.  
 Soc. (2) 22. 347.)

**Potassium periodoplatinocyanide**,  
 $\text{K}_2\text{Pt}(\text{CN})_4\text{I}_2$ .

Permanent. Easily sol. in  $\text{H}_2\text{O}$  or alcohol.

**Permanganic acid**,  $\text{HMnO}_4$ .

Known only in solution, which decomposes  
 by evaporation or warming.

**Permanganates**.

All permanganates are sol. in  $\text{H}_2\text{O}$ , except-  
 ing  $\text{AgMnO}_4$ , which is al. sol.

**Ammonium permanganate**,  $\text{NH}_4\text{MnO}_4$ .

Sol. in 12.6 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Aschoff.)  
 Sol. in  $\text{H}_2\text{O}$  with decomp. (Christensen,  
 Z. anorg. 1900, 24. 206.)

**Barium permanganate**,  $\text{Ba}(\text{MnO}_4)_2$ .

Sol. in  $\text{H}_2\text{O}$ .

**Cadmium permanganate**,  $\text{Cd}(\text{MnO}_4)_2 + 8\text{H}_2\text{O}$ .

Stable. (Klobb, Bull. Soc. 1894, (3) 11  
 607.)

**Cadmium permanganate ammonia**,  
 $\text{Cd}(\text{MnO}_4)_2, 4\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Klobb, Bull.  
 Soc. (3) 3. 510.)

**Cæsium permanganate**,  $\text{CaMnO}_4$ .

Sl. sol. in cold, somewhat more easily sol.  
 in hot  $\text{H}_2\text{O}$ . (Muthmann, B. 1893, 26. 1018.)  
 Solubility in  $\text{H}_2\text{O}$ .

100 ccm. of the sat. solution contain at:

$1^\circ$	$19^\circ$	$59^\circ$
0.097	0.23	1.25 g. $\text{CaMnO}_4$ .

(Patterson, J. Am. Chem. Soc. 1906, 28.  
 1735.)

**Calcium permanganate**,  $\text{Ca}(\text{MnO}_4)_2 + 5\text{H}_2\text{O}$ .

Deliquescent.

**Cupric permanganate**.

Deliquescent.



**Cupric permanganate ammonia,  $\text{Cu}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with slow decomp. (Klobb, Bull. Soc. (3) 3. 509.)

**Didymium permanganate,  $\text{Di}(\text{MnO}_4)_2 + 21\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 331.)

Has not been prepared. (Cleve, B. 11. 912.)

**Lanthanum permanganate,  $\text{La}(\text{MnO}_4)_3 + 21\text{H}_2\text{O}$ .**

Ppt. (Frerichs and Smith, A. 191. 331.)

Has not been prepared. (Cleve, B. 11. 910.)

**Lead permanganate.**

Sol. in  $\text{HNO}_3 + \text{Aq.}$  (Forchhammer.)

**Lithium permanganate,  $\text{LiMnO}_4 + 3\text{H}_2\text{O}$ .**

Sol. in 1.4 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ . (Aschoff.)

**Magnesium permanganate,  $\text{Mg}(\text{MnO}_4)_2$ .**

Insol. in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ , toluene, nitrobenzene, ligroin, ether and  $\text{CS}_2$ . Sol. in methyl alcohol, acetone, pyridine, and readily sol. in glacial acetic acid. Only pyridine and glacial acetic acid are sufficiently stable toward the salt to be of any practical use for oxidation purposes. (Michael and Garner, Am. Ch. J. 1906, 35. 268.)

+ $6\text{H}_2\text{O}$ . Easily deliquescent.

**Nickel permanganate ammonia,  $\text{Ni}(\text{MnO}_4)_2 \cdot 4\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Klobb, Bull. Soc. (3) 3. 509.)

**Potassium permanganate,  $\text{KMnO}_4$ .**

Sol. in 16 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Mitscherlich.)

**Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	Pts. $\text{KMnO}_4$
0	2.83
9.8	4.31
19.8	6.34
24.8	7.59
29.8	9.03
34.8	10.67
40.0	12.56
45.0	14.58
50.0	16.89
55.0	19.33
65.0	25.03

(Baxter, J. Am. Chem. Soc. 1906, 28. 1343.)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

p = pts.  $\text{KMnO}_4$  sol. in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	p	$t^\circ$	p	$t^\circ$	p	$t^\circ$	p
0	2.76	19	6.26	38	11.74	57	20.29
1	2.90	20	6.48	39	12.12	58	20.83
2	3.06	21	6.70	40	12.51	59	21.39
3	3.22	22	6.94	41	12.91	60	21.96
4	3.38	23	7.18	42	13.31	61	22.55
5	3.54	24	7.42	43	13.72	62	23.15
6	3.70	25	7.68	44	14.14	63	23.76
7	3.86	26	7.94	45	14.56	64	24.38
8	4.04	27	8.20	46	15.00	65	25.01
9	4.22	28	8.48	47	15.44	66	25.67
10	4.40	29	8.77	48	15.88	67	26.34
11	4.58	30	9.07	49	16.32	68	27.03
12	4.78	31	9.37	50	16.77	69	27.84
13	4.98	32	9.69	51	17.23	70	28.56
14	5.18	33	10.01	52	17.71	71	29.30
15	5.38	34	10.34	53	18.21	72	30.06
16	5.60	35	10.68	54	18.71	73	30.81
17	5.82	36	11.02	55	19.23	74	31.57
18	6.04	37	11.38	56	19.75	74.5	31.95

(Worden, J. Soc. Chem. Ind. 1907, 26. 453.)

**Solubility in  $\text{H}_2\text{O}$ .**

100 ccm. of the sat. solution contain at:

$0^\circ$   $15^\circ$   $15.3^\circ$   $30^\circ$   
2.84 5.22 5.30 8.69 g.  $\text{KMnO}_4$ .

Sp. gr. of sat. solution at  $15^\circ = 1.035$ .  
(Patterson, J. Am. Chem. Soc. 1906, 28. 1735.)

1 l. sat.  $\text{KMnO}_4 + \text{Aq}$  contains at:

$0^\circ$   $10^\circ$   $20^\circ$   $30^\circ$   $40^\circ$   
0.176 0.278 0.411 0.573 0.792 mol.  $\text{KMnO}_4$ .

$53^\circ$   $63^\circ$   $70^\circ$   $75^\circ$   
1.154 1.429 1.812 2.047 mol.  $\text{KMnO}_4$ .  
(Sackur, Z. Elektrochem. 1912, 18. 723.)

**Solubility of  $\text{KMnO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

Grams $\text{KMnO}_4$ sol. in 100 grams $\text{H}_2\text{O}$	$t^\circ$
0.58	— 0.18
1.01	— 0.27
2.02	— 0.48
2.91	— 0.58
4.22	+10
5.20	+15
7.53	+25
11.61	+40
16.75	+50

(Voerman, C. C. 1906, I. 125.)

Sol. in conc.  $\text{H}_2\text{SO}_4$ . Deliquesces in liquid  $\text{HCl}$ , but does not dissolve. (Gore.)

Slowly sol. in  $\text{H}_3\text{PO}_4 + \text{Aq.}$  (Chevillat and Edwards.)

Solubility in KOH + Aq at t° expressed in mol. per l. of the sat. solution.

t°	H <sub>2</sub> O	1-n KOH	2-n KOH	4-n KOH	6-n KOH	8-n KOH	10-n KOH
0	0.176	0.050	0.031	0.027	0.023	0.017	0.012
10	0.278	0.112	0.068	0.048	0.042	0.028	0.016
20	0.411	0.179	0.119	0.079	19° 0.074	0.032	0.029
30	0.573	32° 0.316	32° 0.213	32° 0.149	0.114	32° 0.062	0.040
40	0.792	0.439	0.306	0.211	0.161	0.084	0.052
50	53° 1.154	50° 0.638	0.462	0.304	0.219	0.111	...
63	1.429	61° 0.904	60° 0.639	0.427	0.291	61° 0.143	0.071
70	1.812	1.172	0.869	0.572	0.390	0.188	0.082
75	2.047	.....	.....	0.651	.....	.....	0.089
80	.....	1.513	1.190	.....	0.500	0.231	...
84	.....	1.655	1.352	83° 0.803	85° 0.572	.....	.....
90	.....	.....	.....	.....	0.649	0.297	...

(Sackur, Z. Elektrochem. 1912, 18. 723.)

Solubility in salts + Aq. at t°.

Solvent	t°	Mol. KMnO <sub>4</sub> in 1 l. of sat. solution
0.1-n $\frac{K_2CO_3}{2}$	0	0.1462
	25	0.4375
	40	0.7380
1-n $\frac{K_2CO_3}{2}$	0	0.0629
	25	0.2589
	40	0.5007
2-n $\frac{K_2CO_3}{2}$	0	0.0446
	40	0.3519
4-n $\frac{K_2CO_3}{2}$	0	0.0270
	25	0.0930
6-n $\frac{K_2CO_3}{2}$	0	0.0156
0.1-n KCl	0	0.1395
	25	0.4315
	40	0.7380
0.5-n KCl	0	0.0760
	25	0.3060
	40	0.5840
1-n KCl	0	0.0532
	25	0.220
	40	0.444
2-n KCl	0	0.0379
	25	0.1432
	40	0.288

(Sackur, Z. Elektrochem. 1912, 18. 723.)

 Very sol. in liquid NH<sub>3</sub>. (Moissan, A. ch. 1895 (7) 6. 428; Franklin, Am. Ch. J. 1898, 20. 829.)

Decomp. immediately by alcohol. Sol. in acetone. (Eidmann, C. C. 1899. II, 1014; Naumann, B. 1904, 37. 4328.)

Solubility in acetone + Aq. at 13°.

 A = ccm. acetone in 100 ccm. acetone + Aq.  
 $\frac{1}{10}$  KMnO<sub>4</sub> = millimols KMnO<sub>4</sub> in 100 ccm. of the solution.

A	$\frac{1}{10}$ KMnO <sub>4</sub>
0	148.5
10	162.2
20	177.3
30	208.2
40	257.4
50	289.7
60	316.8
70	328.0
80	312.5
90	227.0
100	67.6

(Hers and Knoch, Z. anorg. 1904, 41. 317.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3795.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

 Rubidium permanganate, RbMnO<sub>4</sub>.

 Solubility in H<sub>2</sub>O lies between K and Cs salts. (Muthmann, B. 1893, 26. 1018.)

 Solubility in H<sub>2</sub>O.

100 ccm. of the sat. solution contain at:

2°	19°	60°
0.46	1.06	4.68 g. RbMnO <sub>4</sub> .

(Patterson, J. Am. Chem. Soc. 1906, 28. 1735.)

 Silver permanganate, Ag<sub>2</sub>MnO<sub>4</sub>.

 Sol. in 109 pts. cold H<sub>2</sub>O and much less hot H<sub>2</sub>O. Decomp. by boiling. (Mitscherlich, Pogg. 25. 301.)

Silver permanganate ammonia.

 Sl. sol. in cold, more easily in hot H<sub>2</sub>O. (Klobb, C. R. 103. 384.)

**Sodium permanganate,  $\text{NaMnO}_4 + 3\text{H}_2\text{O}$ .**

Deliquescent. Extremely sol. in  $\text{H}_2\text{O}$ .  
Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

**Strontium permanganate,  $\text{Sr}(\text{MnO}_4)_2 + 4\text{H}_2\text{O}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Fromherz.)

**Thalious permanganate,  $\text{TlMnO}_4$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (R. Meyer, Z. anorg. 1899, 22. 188.)

**Zinc permanganate,  $\text{Zn}(\text{MnO}_4)_2 + 6\text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Martenson, J. B. 1873. 274.)

**Zinc permanganate ammonia,**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Klobb, Bull. Soc. (3) 3. 509.)

**Permanganomolybdic acid,  $\text{MnO}_3$ ,**

Sol. in  $\text{H}_2\text{O}$ . Decomp. by alkalis. Sol. in alcohol. (Péchar, C. R. 1897, 125. 31.)

**Ammonium permanganomolybdate,**

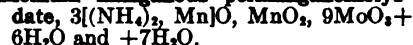
(Friedheim and Samelson, Z. anorg. 1900, 24. 73.)

$3(\text{NH}_4)_2\text{O}, \text{MnO}_3, 9\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. 1904. 23.)

$+ 7\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 70.)

$4(\text{NH}_4)_2\text{O}, \text{MnO}_3, 11\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Friedheim and Samelson.)

$3(\text{NH}_4)_2\text{O}, \text{MnO}_3, 12\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by alkalis. Insol. in alcohol. (Péchar, C. R. 1897, 125. 30.)

**Ammonium manganous permanganomolybdate,**

(Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. 1904. 23.)

$3(\text{NH}_4)_2\text{O}, \text{MnO}, \text{MnO}_3, 10\text{MoO}_3 + 10\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 94.)

$4(\text{NH}_4)_2\text{O}, \text{MnO}, \text{MnO}_3, 10\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 75.)

$4(\text{NH}_4)_2\text{O}, \text{MnO}, \text{MnO}_3, 11\text{MoO}_3 + 8\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 72.)

**Ammonium manganous potassium permanganomolybdate,  $2(\text{NH}_4)_2\text{O}, \text{MnO}, \text{K}_2\text{O}, \text{MnO}_3, 10\text{MoO}_3 + 5\text{H}_2\text{O}$ .**

Very sl. sol. in cold, easily sol. in  $\text{H}_2\text{O}$  at  $70-80^\circ$ . (Rosenheim, Z. anorg. 1898, 16. 79.)  
 $3(\text{NH}_4)_2\text{O}, \text{K}_2\text{O}, \text{MnO}, \text{MnO}_3, 9\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. 1904. 23.)

$4(\text{NH}_4)_2\text{O}, \text{K}_2\text{O}, \text{MnO}, \text{MnO}_3, 10\text{MoO}_3 + 5\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 97.)

$3(\text{NH}_4)_2\text{O}, \text{K}_2\text{O}, \text{MnO}, \text{MnO}_3, 10\text{MoO}_3 + 6\text{H}_2\text{O}$ , and  $+ 10\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 92.)

**Ammonium potassium permanganomolybdate,  $3(\text{NH}_4)_2\text{O}, \text{K}_2\text{O}, \text{MnO}_3, 8\text{MoO}_3 + 4\text{H}_2\text{O}$ .**

(Friedheim and Samelson.)

**Barium permanganomolybdate,  $3\text{BaO}, \text{MnO}_3, 9\text{MoO}_3 + 12\text{H}_2\text{O}$ .**

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 700.)

**Manganous potassium permanganomolybdate,  $2\text{K}_2\text{O}, \text{MnO}, \text{MnO}_3, 9\text{MoO}_3 + 8\text{H}_2\text{O}$ .**

True formula for  $5\text{K}_2\text{O}, \text{Mn}_2\text{O}_3, 16\text{MoO}_3 + 12\text{H}_2\text{O}$  of Struve. (Friedheim and Samelson, Z. anorg. 1900, 24. 86.)

$3(\text{K}_2\text{MnO}), \text{MnO}_3, 9\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. 1904. 23.)

$2.6 \text{ K}_2\text{O}, 0.4 \text{ MnO}, \text{MnO}_3, 9\text{MoO}_3 + 7\text{H}_2\text{O}$ . Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 700.)

$4(\text{K}_2\text{MnO}), \text{MnO}_3, 11\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 80.)

**Manganous potassium sodium permanganomolybdate,  $3(\text{K}_2\text{O}, \text{Na}_2\text{O}, \text{MnO}), \text{MnO}_3, 8\text{MnO}_3 + 4\text{H}_2\text{O}$ .**

(Friedheim and Allemann, Mitt. d. Nat. Ges. Bern. 1904. 48.)

**Manganous sodium permanganomolybdate,**

(Friedheim and Allemann.)

**Potassium permanganomolybdate,  $3\text{K}_2\text{O}, \text{MnO}_3, 8\text{MoO}_3 + 3\text{H}_2\text{O}$ .**

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  comp. (Friedheim and Samelson, Z. anorg. 1900, 24. 78.)

$+ 5\text{H}_2\text{O}$ . Nearly insol. in cold or hot  $\text{H}_2\text{O}$ . (Rosenheim and Itzig, Z. anorg. 1898, 16. 81.)

$3\text{K}_2\text{O}, \text{MnO}_3, 9\text{MoO}_3 + 5\text{H}_2\text{O}$ . (Friedheim and Samelson, Z. anorg. 1900, 24. 81.)

$+ 6\text{H}_2\text{O}$ . (Hall, J. Am. Chem. Soc. 1907, 29. 700.)

$3\text{K}_2\text{O}, \text{MnO}_3, 12\text{MoO}_3 + 4\text{H}_2\text{O}$ . Nearly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by alkalis. Insol. in alcohol. (Péchar, C. R. 1897, 125. 31.)

**Silver permanganomolybdate,  $3\text{Ag}_2\text{O}, \text{MnO}_3, 9\text{MoO}_3 + 6\text{H}_2\text{O}$ .**

Ppt. (Hall, J. Am. Chem. Soc. 1907, 29. 700.)

**Sodium permanganomolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{MnO}_3$ ,  $12\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . Decomp. by alkalis. Insol. in alcohol. (Péchar, C. R. 125. 31.)

**Permanganotungstic acid.**

**Ammonium manganous permanganotungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $\text{MnO}_3$ ,  $12\text{WO}_3 + 23\text{H}_2\text{O}$ .

Readily sol. in  $\text{H}_2\text{O}$ . Can be cryst. therefrom. (Rogers and Smith, J. Am. Chem. Soc. 1904, 26. 1475.)

**Sodium permanganotungstate**,  $3\text{Na}_2\text{O}$ ,  $\text{MnO}_3$ ,  $5\text{WO}_3 + 18\text{H}_2\text{O}$ .

Rather easily sol. in hot  $\text{H}_2\text{O}$ . Solution decomp. on long boiling with separation of manganese peroxide. (Just, B. 1903, 36. 3621.)

**Permolybdic acid**,  $\text{Mo}_2\text{O}_7$ ,  $5\text{H}_2\text{O} = \text{HMoO}_4 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , and not decomp. by boiling. (Péchar, A. ch. (6) 28. 550.)

$\text{H}_2\text{MoO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ . "Ozo-molybdic acid." Only very sl. sol. in  $\text{H}_2\text{O}$  after being dried in the air. Sol. in fairly conc.  $\text{H}_2\text{SO}_4$ . (Muthmann, B. 1898, 31. 1838.)

$\text{H}_2\text{Mo}_2\text{O}_7$ ,  $\text{H}_2\text{O}_2$ . Sl. sol. in cold, more easily sol. in hot  $\text{H}_2\text{O}$ , but does not separate on cooling. Sol. in dil. acids, also in  $\text{H}_3\text{PO}_4$ . (Cammerer, Ch. Z. 1891, 15. 957.)

**Ammonium permolybdate**,  $\text{NH}_4\text{MoO}_4 + 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol, but alcohol extracts it from  $\text{H}_2\text{O}$ , forming a very conc. supersat. solution, which is pptd. by a crystal of  $\text{NH}_4\text{MoO}_4$ , and only a sl. amount remains in solution. (Péchar.)

$3(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{MoO}_4 + 6\text{H}_2\text{O}$ . (Muthmann, B. 1898, 31. 1837.)

$3(\text{NH}_4)_2\text{O}$ ,  $7\text{MoO}_4 + 12\text{H}_2\text{O}$ . Ppt. (Muthmann, Z. anorg. 1898, 17. 76.)

$3(\text{NH}_4)_2\text{O}$ ,  $5\text{MoO}_4 + 6\text{H}_2\text{O}$ . Ppt. (Muthmann.)

**Ammonium nickel permolybdate ammonia**,  $(\text{NH}_4)_2\text{Ni}(\text{MoO}_4)_2, 2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH}$ . (Briggs, Chem. Soc. 1904, 85. 674.)

**Barium permolybdate**,  $\text{Ba}(\text{MoO}_4)_2 + 2\text{H}_2\text{O}$ .

(Péchar, A. ch. 1893, (6) 28. 537.)  
 $8\text{BaO}$ ,  $19\text{MoO}_3$ ,  $2\text{H}_2\text{O}_2 + 13\text{H}_2\text{O}$ . (Baerwald, Dissert. 1885.)

**Cesium permolybdate**,  $\text{Cs}_2\text{O}$ ,  $4\text{MoO}_4 + 6\text{H}_2\text{O}$ . Sol. hot  $\text{H}_2\text{O}$ . (Muthmann, B. 1898, 31. 1841.)

$3\text{Cs}_2\text{O}$ ,  $7\text{MoO}_3$ ,  $3\text{MoO}_4 + 4\text{H}_2\text{O}$ . Ppt. (Muthmann.)

**Copper permolybdate**,  $\text{Cu}(\text{MoO}_4)_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. (Péchar.)

**Magnesium permolybdate**,  $\text{Mg}(\text{MoO}_4)_2 + 10\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Péchar.)

**Mercurous permolybdate.**

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Péchar.)

**Potassium permolybdate**,  $\text{KMoO}_4 + 2\text{H}_2\text{O}$ .

Sl. sol. in cold, more in hot  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Péchar.)

$\text{K}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{MoO}_4 + 3\text{H}_2\text{O}$ . Ppt. (Muthmann, Z. anorg. 1898, 17. 77.)

$\text{K}_2\text{O}_3$ ,  $\text{MoO}_4$ ,  $\text{H}_2\text{O}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Melikoff and Pissarjewsky, B. 1898, 31. 2449.)

$\text{K}_2\text{MoO}_4 + 3\text{H}_2\text{O}$ . Nearly insol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Mazzuchelli and Zangrilli, Gazz. ch. it. 1910, 40. (2) 56.)

**Rubidium permolybdates.**

"Rubidium ozo-molybdate."

$3\text{Rb}_2\text{O}$ ,  $10\text{MoO}_4 + 14\text{H}_2\text{O}$ . Ppt.

$\text{Rb}_2\text{O}$ ,  $2\text{MoO}_3$ ,  $\text{MoO}_4 + 3\text{H}_2\text{O}$ . May be recryst. from  $\text{H}_2\text{O} + \text{Aq}$ .

$3\text{Rb}_2\text{O}$ ,  $5\text{MoO}_3$ ,  $2\text{MoO}_4 + 6\text{H}_2\text{O}$ . Ppt.

$\text{Rb}_2\text{O}$ ,  $3\text{MoO}_3$ ,  $\text{MoO}_4 + 4\text{H}_2\text{O}$ . Ppt. (Muthmann, B. 1898, 31. 1839-41.)

**Silver permolybdate**,  $\text{AgMoO}_4$ .

(Péchar.)

**Sodium permolybdate**,  $\text{NaMoO}_4 + 3\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol, but behaves similarly to K salt. (Péchar.)

**Thallous permolybdate.**

Insol. in  $\text{H}_2\text{O}$ . (Péchar, A. ch. 1893, (6) 28. 559.)

**Pernitric acid**,  $\text{NO}_3$ .

See Nitrogen hexoxide.

**Silver pernitrate, basic**,  $3\text{Ag}_2\text{O}_2$ ,  $\text{AgNO}_3$ .

Decomp.  $\text{H}_2\text{O}$ . (Mulder, R. t. c. 1898, 17. 142.)

**Perosmic acid.**

**Potassium perosmate (?)**.

Sol. in  $\text{H}_2\text{O}$ , but very easily decomp.

**Peroxyntic acid.**

**Silver peroxyntitate.**

Analysis of the black compound formed, under certain circumstances, in a silver voltameter when an aqueous solution of  $\text{AgNO}_3$

is electrolyzed, points to the composition  $3\text{Ag}_2\text{O}$ ,  $5\text{O}$ ,  $\text{AgNO}_3$ , perhaps  $2\text{Ag}_2\text{O}_4$ ,  $\text{AgNO}_3$  or  $3\text{Ag}_2\text{O}_3$ ,  $\text{AgNO}_3$ . (Mulder, Chem. Soc. 1896, 70. (2) 561.)

### Peroxyaminesulphonic acid.

#### Potassium peroxyaminesulphonate, $\text{N}_2\text{O}_5(\text{SO}_3\text{K})_4$ .

Very unstable in  $\text{H}_2\text{O}$ . Very sl. sol. in cold  $\text{H}_2\text{O}$ . More stable in  $\text{N}/10$   $\text{KOH} + \text{Aq}$ .

100 pts.  $\text{N}/10$   $\text{KOH} + \text{Aq}$  dissolve 0.62 pt. of the salt at  $3^\circ$ ; 6.6 pts. at  $29^\circ$ . (Haga, Chem. Soc. 1904, 86. 86.)

#### Perstannic acid, $\text{H}_2\text{Sn}_2\text{O}_7$ .

Known in colloidal state, sol. in  $\text{H}_2\text{O}$ . (Spring, Bull. Soc. (2) 51. 180.)

#### Potassium perstannate, $\text{KSnO}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Tanatar, B. 1905, 38. 1185.)

#### Sodium perstannate, $\text{NaSnO}_4 + 2\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$  with decomp. (Tanatar.)

#### Persulphuric acid, $\text{H}_2\text{S}_2\text{O}_7$ .

See Sulphur heptoxide.

$\text{H}_2\text{S}_2\text{O}_8$ .

Sp. gr. of  $\text{H}_2\text{S}_2\text{O}_8 + \text{Aq}$ .

Sp. gr. $14^\circ/14^\circ$	% $\text{H}_2\text{S}_2\text{O}_8$	g. $\text{H}_2\text{S}_2\text{O}_8$ per l.
1.042	7.2	75
1.096	15.4	169
1.154	23.6	272
1.246	35.2	438

(Elbs and. Schönherr, Z. Elektrochem. 1896, 2. 245.)

#### Ammonium persulphate, $(\text{NH}_4)_2\text{S}_2\text{O}_8$ .

Very sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 58.2 pts.  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ . (Marshall, Chem. Soc. 59. 771.)

Solubility in  $\text{H}_2\text{O}$  equals 58% at  $8^\circ$ . (Moreau, C. C. 1901, II. 56.)

100 pts.  $\text{H}_2\text{O}$  dissolve 65 pts. at ord. temp. (Elbs, J. pr. 1893, (2) 48. 185.)

#### Ammonium lead persulphate, $(\text{NH}_4)_2\text{Pb}(\text{SO}_4)_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Almost insol. in cold  $\text{H}_2\text{SO}_4$  of sp. gr. = 1.7. Sl. sol. in  $\text{H}_2\text{SO}_4$  (sp. gr. = 1.7) at  $50^\circ$ . Sol. in fuming  $\text{H}_2\text{SO}_4$  and in cold conc.  $\text{HCl}$ . Sol. in acetic acid, in  $\text{Na}$  acetate +  $\text{Aq}$  acidified with acetic acid and in excess of cold 20%  $\text{NaOH} + \text{Aq}$ . (Elbs, Z. Elektrochem. 1900, 7. 346.)

#### Ammonium mercurous persulphate ammonia, $(\text{NH}_4)\text{HgS}_2\text{O}_8$ , $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Insol. in dil. or conc., hot or cold  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . Sol. in  $\text{HCl}$ . (Tarugi, Gazz. ch. it. 1903, 33. (1) 131.)

#### Barium persulphate, $\text{BaS}_2\text{O}_8 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 39.1 pts.  $\text{BaS}_2\text{O}_8$ , or 52.2 pts.  $\text{BaS}_2\text{O}_8 + 4\text{H}_2\text{O}$ . Sol. in absolute alcohol with pptn. of  $\text{BaS}_2\text{O}_8 + \text{H}_2\text{O}$ . Insol. in alcohol. (Marshall.)

#### Cadmium persulphate ammonia, $\text{CdS}_2\text{O}_8$ , $6\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Barbieri, Z. anorg. 1911, 71. 350.)

#### Cesium persulphate, $\text{Cs}_2\text{S}_2\text{O}_8$ .

Sol. in  $\text{H}_2\text{O}$ . 8.71–8.98 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . (E. F. Smith, J. Am. Chem. Soc. 1899, 21. 935.)

#### Calcium persulphate.

Very sol. in  $\text{H}_2\text{O}$ . (Marshall, J. Soc. Chem. Ind. 1897, 16. 396.)

#### Copper persulphate ammonia, $\text{CuS}_2\text{O}_8$ , $4\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Barbieri, Z. anorg. 1911, 71. 351.)

#### Lead persulphate, $\text{PbS}_2\text{O}_8$ .

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{SO}_4$ , and in pyrosulphuric acid. Sol. in cold conc.  $\text{HCl}$ . Insol. or sol. with decomp. in all ord. solvents. (Elbs, Z. Elektrochem. 1900, 7. 345.)

Solubility of  $\text{Pb}(\text{SO}_4)_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . at  $22^\circ$ .  
v = moles of  $\text{H}_2\text{SO}_4$  per mole of  $\text{H}_2\text{O}$ ;  
c = millimols  $\text{Pb}(\text{SO}_4)_2$  in 1 l.

v	c	v	c
0.304	0.00	0.558	37.2
0.348	1.8	0.699	40.5
0.387	3.0	0.917	23.3
0.407	3.9	1.11	23.7
0.435	5.3	1.54	49.6
0.477	14.4	2.08	83.5
0.515	23.3	2.13	88.2

(Dolzsalek and Finckli, Z. anorg. 1906, 51. 321.)

+  $3\text{H}_2\text{O}$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Marshall.)

#### Lead potassium persulphate, $\text{K}_2\text{Pb}(\text{SO}_4)_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Almost insol. in cold  $\text{H}_2\text{SO}_4$  of sp. gr. = 1.7. Sl. sol. in  $\text{H}_2\text{SO}_4$  (sp. gr. = 1.7) at  $50^\circ$ . Sol. in fuming  $\text{H}_2\text{SO}_4$ , cold conc.  $\text{HCl}$ , excess of cold 20%  $\text{NaOH} + \text{Aq}$ , acetic acid, and in  $\text{Na}$  acetate +  $\text{Aq}$  acidified with acetic acid. (Elbs, Z. Elektrochem. 1900, 7. 346.)

**Nickel persulphate ammonia**,  $\text{NiS}_2\text{O}_8$ ,  $6\text{NH}_3$ .

Unstable in the air. Sol. in  $\text{H}_2\text{O}$  with decomp. (Barbieri, Z. anorg. 1911, 71. 351.)

**Potassium persulphate**,  $\text{K}_2\text{S}_2\text{O}_8$ .

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 1.77 pts.  $\text{K}_2\text{S}_2\text{O}_8$ ; more sol. in hot  $\text{H}_2\text{O}$  with very sl. decomp. Less sol. in  $\text{H}_2\text{O}$  than any other persulphate. (Marshall.)

**Rubidium persulphate**,  $\text{Rb}_2\text{S}_2\text{O}_8$ .

Sol. in  $\text{H}_2\text{O}$ . 3.32–3.49 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $22.5^\circ$ . (E. F. Smith, J. Am. Chem. Soc. 1899, 21. 934.)

**Silver persulphate, basic**,  $5\text{Ag}_2\text{O}_3$ ,  $2\text{Ag}_2\text{SO}_7$ .

Decomp. by  $\text{H}_2\text{O}$  and acids. (Mulder, C. C. 1899, I, 16.)

**Sodium persulphate**,  $\text{Na}_2\text{S}_2\text{O}_8$ .

Very sol. in  $\text{H}_2\text{O}$ . (Löwenherz.)

**Strontium persulphate**.

Very sol. in  $\text{H}_2\text{O}$ . (Marshall, J. Soc. Chem. Ind. 1897, 16. 396.)

**Thallium persulphate**,  $\text{Tl}_2\text{S}_2\text{O}_8$ .

Very sol. in  $\text{H}_2\text{O}$ . (Smith, J. Am. Chem. Soc. 1898, 21. 936.)

**Zinc persulphate ammonia**,  $\text{ZnS}_2\text{O}_8$ ,  $4\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Barbieri, Z. anorg. 1911, 71. 350.)

**Persulphomolybdic acid**.

See Persulphomolybdic acid.

**Pertantalic acid**,  $\text{HTaO}_4 + n\text{H}_2\text{O}$ .

Ppt. (Melikoff, Z. anorg. 1899, 20. 345.)

**Cæsium pertantalate**,  $\text{Cs}_2\text{TaO}_5$ .

Ppt. (E. F. Smith, J. Am. Chem. Soc. 1906, 30. 1667.)

**Calcium potassium pertantalate**,  $\text{CaKTaO}_5 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Insol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$ . (Melikoff, Z. anorg. 1899, 20. 347.)

**Calcium sodium pertantalate**,  $\text{CaNaTaO}_5 + 4\frac{1}{2}\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1668.)

**Magnesium potassium pertantalate**,

$\text{MgKTaO}_5 + 7\text{H}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Magnesium rubidium pertantalate**,

$\text{MgRbTaO}_5 + 9\text{H}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Magnesium sodium pertantalate**,  $\text{MgNaTaO}_5 + 8\text{H}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Potassium pertantalate**,  $\text{K}_2\text{TaO}_5 + \frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.; sol. in  $\text{KOH} + \text{H}_2\text{O}_2 + \text{Aq}$ ; pptd. by alcohol. (Melikoff, Z. anorg. 1899, 20. 346.)

**Rubidium pertantalate**,  $\text{Rb}_2\text{TaO}_5$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)

**Sodium pertantalate**,  $\text{Na}_2\text{TaO}_5 + \text{H}_2\text{O}$ .

Pptd. by alcohol. Sl. sol. in  $\text{H}_2\text{O}$ , decomp. on heating with  $\text{H}_2\text{O}$ . (Melikoff, Z. anorg. 1899, 20. 348.)

$\text{NaTaO}_4 + \text{NaOTaO}_4 + 13\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; pptd. by alcohol. (Melikoff, Z. anorg. 1899, 20. 349.)

**Pertitanic acid**.

**Ammonium pertitanate**,  $(\text{NH}_4)_2\text{O}_3$ ,  $\text{TiO}_2 + \text{H}_2\text{O}$ .

Fairly stable; decomp. rapidly in aq. solution. (Melikoff, B. 1898, 31. 955.)

**Barium pertitanate**,  $\text{BaO}_3$ ,  $\text{TiO}_2 + 5\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Melikoff and Pissarjewsky, Z. anorg. 1898, 18. 59.)

**Potassium pertitanate**,  $\text{K}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{K}_2\text{O}_4 + 10\text{H}_2\text{O}$ .

Stable at zero; deliquesces and decomp. at ordinary temp. (Melikoff, B. 1898, 31. 680.)

**Sodium pertitanate**,  $\text{Na}_2\text{O}_3$ ,  $\text{TiO}_2 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Pptd. in alcohol. (Melikoff, B. 1898, 31. 955.)

$4\text{Na}_2\text{O}_3$ ,  $\text{Ti}_2\text{O}_7 + 10\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Melikoff.)

**Pertungstic acid**.

**Barium pertungstate**,  $\text{BaO}$ ,  $2\text{WO}_3$ ,  $\text{O} + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Kellner, Dissert. 1909.)

**Cæsium pertungstate**,  $3\text{Cs}_2\text{O}$ ,  $12\text{WO}_3$ ,  $2\text{O} + 12\text{H}_2\text{O}$ .

Sl. sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$ . (Kellner.)

$5\text{Cs}_2\text{O}$ ,  $12\text{WO}_3$ ,  $24\text{O} + 11\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Calcium pertungstate**,  $3\text{CaO}$ ,  $6\text{WO}_3$ ,  $8\text{O} + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Lithium pertungstate**,  $\text{Li}_2\text{O}$ ,  $2\text{WO}_3$ ,  $2\text{O} + 6\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Kellner.)

$3\text{Li}_2\text{O}$ ,  $4\text{WO}_3$ ,  $\text{O} + 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Magnesium pertungstate**,  $2\text{MgO}$ ,  $4\text{WO}_3$ ,  $6\text{O} + 9\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Potassium pertungstate**,  $\text{K}_2\text{O}$ ,  $\text{WO}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.; explodes in the air at  $80^\circ$ . (Melikoff, B. 1898, 31. 634.)

$\text{K}_2\text{O}$ ,  $2\text{WO}_3$ ,  $4\text{O} + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  from which it is ppt. by alcohol and ether. (Kellner.)

$7\text{K}_2\text{O}$ ,  $10\text{WO}_3$ ,  $5\text{O} + 22\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Rubidium pertungstate**,  $2\text{Rb}_2\text{O}$ ,  $4\text{WO}_3$ ,  $\text{O} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with slow decomp. (Kellner.)  $5\text{Rb}_2\text{O}$ ,  $12\text{WO}_3$ ,  $3\text{O} + 12\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Kellner.)

**Sodium pertungstate**,  $\text{NaWO}_4 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 112. 1060.)

$+2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  but easily decomp. (Kellner.)

$\text{Na}_2\text{W}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and can be cryst. therefrom. (Pissarjewsky, Z. anorg. 1900, 24. 113.)

$\text{Na}_2\text{O}$ ,  $\text{WO}_3 + \text{H}_2\text{O}$ ,  $(\text{Na}_2\text{O})_2\text{WO}_4 + 7\text{H}_2\text{O}$ . Decomp. in the air. Sol. in  $\text{H}_2\text{O}$  with decomp. (Melikoff, B. 1898, 31. 633.)

$\text{Na}_2\text{O}$ ,  $\text{WO}_3$ ,  $\text{H}_2\text{O}$ . Very unstable. Decomp. in the air and by  $\text{H}_2\text{O}$ . (Melikoff.)

**Strontium pertungstate**,  $\text{SrO}$ ,  $2\text{WO}_3$ ,  $\text{O} + 6\text{H}_2\text{O}$ .

(Kellner.)

**Peruranic acid**,  $\text{UO}_3 \cdot x\text{H}_2\text{O}$  (?).

Known only in its salts.

**Ammonium peruranate**,  $(\text{NH}_4)_2\text{O}_3$ ,  $(\text{UO}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and by  $\text{Al}(\text{OH})_3$  in aq. solution. (Melikoff, B. 1897, 30. 2904.)

**Ammonium uranyl peruranate**,  $(\text{NH}_4)_2(\text{UO}_4)_2 + 8\text{H}_2\text{O}$  (?).

Easily sol. in  $\text{H}_2\text{O}$ . (Fairley, Chem. Soc. (2) 31. 134.)

**Barium peruranate**,  $\text{BaUO}_4$ .

As K salt. (de Coninck, C. C. 1909, I. 1970.)

$(\text{BaO})_2\text{UO}_4 + 8\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{CO}_3$ . (Melikoff, B. 1897, 30. 2905.)

$\text{BaO}_2(\text{UO}_4)_2 + 9\text{H}_2\text{O}$ . Ppt. (Melikoff.)

**Calcium peruranate**,  $\text{CaUO}_4$ .

As K salt. (de Coninck.)

**Calcium peruranate**,  $(\text{CaO})_2\text{UO}_4 + 10\text{H}_2\text{O}$ .

Ppt. (Melikoff, B. 1897, 30. 2906.)

**Copper peruranate**,  $(\text{CuO})_2\text{UO}_4$ .

Ppt. (Melikoff.)

**Lead peruranate**,  $(\text{PbO})_2\text{UO}_4$ ,  $\text{PbO}$ ,  $\text{UO}_3$ .

Ppt. (Melikoff.)

**Lithium peruranate**,  $(\text{Li}_2\text{O})_2(\text{UO}_4)_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids and by  $\text{Al}(\text{OH})_3$  in aq. solution; very unstable. (Melikoff.)

**Nickel peruranate**,  $(\text{NiO})_2\text{UO}_4$ .

Ppt. (Melikoff.)

**Potassium peruranate**,  $\text{K}_4\text{UO}_8 + 10\text{H}_2\text{O}$  (?).

Unstable. (Fairley.)

$\text{K}_2\text{UO}_6$ . (de Coninck, C. R. 1909, 148. 1769.)

$+3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HCl}$  and dil.  $\text{HNO}_3$ . (Aloy, Bull. Soc. 1903, (3) 29. 293.)

**Silver peruranate**,  $\text{Ag}_3\text{U}_2\text{O}_{11}$  (?).

(Guyard, Bull. Soc. (2) 1. 95.)

Does not exist. (Alibegoff, A. 233. 117.)

**Sodium peruranate**,  $\text{Na}_4\text{UO}_8 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Fairley.)  $\text{Na}_2\text{UO}_6$ . As K salt. (de Coninck, C. C. 1909, I. 1970.)

$+5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  and  $\text{HCl}$ . (Aloy, Bull. Soc. 1903, (3) 29. 293.)

$(\text{Na}_2\text{O})_2\text{UO}_6 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; decomp. by dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and by  $\text{Al}(\text{OH})_3$  in aq. solution. (Melikoff, B. 1897, 30. 2903.)

**Sodium uranyl peruranate**,  $\text{Na}_2(\text{UO}_2)_2\text{UO}_6 + 6\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Fairley.)

**Pervanadic acid**,  $\text{HVO}_4$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Pissarjewsky, C. C. 1902, II. 565.)

**Ammonium pervanadate**,  $\text{NH}_4\text{VO}_4$ .

Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol. (Scheuer Z. anorg. 1898, 16. 294.)

$(\text{NH}_4)_2\text{VO}_6 + 2\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Melikoff, B. 1909, 42. 2292.)

$(\text{NH}_4)_4\text{V}_2\text{O}_{11}$ . Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; ppt. from aq. solution by alcohol. (Melikoff, Z. anorg. 1899, 19. 406.)

**Barium pervanadate**,  $\text{Ba}(\text{VO}_4)_2$ .

Sl. sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$  free from  $\text{H}_2\text{SO}_4$ ; insol. in alcohol. (Scheuer, Z. anorg. 1898, 16. 288.)

**Cadmium pervanadate**,  $\text{Cd}(\text{VO}_4)_2$ .

Sl. sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol. (Scheuer.)

**Calcium pervanadate**,  $\text{Ca}(\text{VO}_4)_2$ .

Sol. in  $\text{H}_2\text{O}_2 + \text{Aq}$ ; insol. in alcohol. (Scheuer.)

**Lead pervanadate, Pb(VO<sub>3</sub>)<sub>2</sub>.**

Sl. sol. in H<sub>2</sub>O<sub>2</sub> + Aq free from H<sub>2</sub>SO<sub>4</sub>; insol. in alcohol. (Scheuer.)

**Lithium pervanadate, LiVO<sub>3</sub>.**

Sol. in H<sub>2</sub>O<sub>2</sub> + Aq; insol. in alcohol. (Scheuer.)

**Potassium pervanadate, KVO<sub>3</sub>.**

Sol. in H<sub>2</sub>O<sub>2</sub> + Aq acidified with H<sub>2</sub>SO<sub>4</sub>; insol. in alcohol. (Scheuer.)

K<sub>2</sub>VO<sub>3</sub> + 2½H<sub>2</sub>O. Sol. in H<sub>2</sub>O; insol. in alcohol. (Melikoff, B. 1909, 42. 2293.)

3K<sub>2</sub>O·VO<sub>3</sub>·2KVO<sub>3</sub> + 2H<sub>2</sub>O. 0.855 g. is sol. in 100 g. H<sub>2</sub>O at 19°; sl. sol. in KOH + Aq; very stable in the air. (Melikoff and Pissarjewsky, Z. anorg. 1899, 19. 406.)

K<sub>4</sub>V<sub>2</sub>O<sub>11</sub> + 2H<sub>2</sub>O. (Melikoff and Pissarjewsky, Z. anorg. 1899, 19. 411.)

K<sub>4</sub>V<sub>2</sub>O<sub>11</sub> + 3½H<sub>2</sub>O. Moderately sol. in H<sub>2</sub>O with slow decomp. (Melikoff and Pissarjewsky, Z. anorg. 1899, 19. 410.)

**Silver pervanadate, AgVO<sub>3</sub>.**

Sl. sol. in H<sub>2</sub>O<sub>2</sub> + Aq free from H<sub>2</sub>SO<sub>4</sub>; sol. in alcohol. (Scheuer.)

**Sodium pervanadate, NaVO<sub>3</sub>.**

Sol. in H<sub>2</sub>O<sub>2</sub> acidified with H<sub>2</sub>SO<sub>4</sub>; insol. in alcohol. (Scheuer.)

**Strontium pervanadate, Sr(VO<sub>3</sub>)<sub>2</sub>.**

Sl. sol. in H<sub>2</sub>O<sub>2</sub> + Aq free from H<sub>2</sub>SO<sub>4</sub>; insol. in alcohol. (Scheuer.)

**Philippium, Ph (?).**

(Delafontaine, C. R. 87. 559.)

Consists of terbium and yttrium. (Roscoe, B. 15. 1274.)

**Phosgene, CoCl<sub>2</sub>.**

See Carbonyl chloride.

**Phosphame, PN<sub>2</sub>H (?).**

Insol. in H<sub>2</sub>O. Insol. in dil. HNO<sub>3</sub> + Aq; gradually decomp. by conc. HNO<sub>3</sub>. (Rose, Pogg. 24. 306.)

Insol. in conc. HNO<sub>3</sub>. (Pauli, A. 123. 236.)

Sol. in H<sub>2</sub>SO<sub>4</sub> with decomp. (Rose.)

Insol. in dil., but decomp. by conc. KOH or NaOH + Aq.

Insol. in alcohol or ether.

Formula is perhaps P<sub>2</sub>N<sub>2</sub>H<sub>4</sub>. (Salzmann, B. 6. 494.)

**Phosphamic acid, PO $\begin{smallmatrix} \diagup \text{NH} \\ \diagdown \text{OH} \end{smallmatrix}$ .**

(Schiff.)

Does not exist, but was impure pyrophosphodiamic acid. (Gladstone.) Also Mente (A. 248, 245).

**Pyrophosphamic acid, P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub> = P<sub>2</sub>O<sub>3</sub>(OH)<sub>2</sub>NH<sub>2</sub>.**

Deliquescent in moist air; easily sol. in H<sub>2</sub>O or alcohol; sl. sol. in ether. (Gladstone, Chem. Soc. 3. 152.)

Correct composition is imidodiphosphoric acid, P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub> = HO—PO $\begin{smallmatrix} \diagup \text{O} \\ \diagdown \text{NH} \end{smallmatrix}$ —PO—OH.

(Mente, A. 248. 232.)

**Barium pyrophosphamate, Ba<sub>2</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub>)<sub>2</sub>.**

Sol. in HCl or HNO<sub>3</sub> + Aq, not in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Gladstone and Holmes, Chem. Soc. (2) 2. 233.)

**Cupric —, Cu<sub>2</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub>)<sub>2</sub> + 2H<sub>2</sub>O.**

Ppt. Decomp. by cold KOH + Aq. (Gladstone, Chem. Soc. 3. 135.)

**Ferric —, Fe<sub>2</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub>)<sub>2</sub> + 2H<sub>2</sub>O.**

Insol. in dil. acids. Sol. in conc. H<sub>2</sub>SO<sub>4</sub>, and decomp. by warming. Easily sol. in NH<sub>4</sub>OH + Aq. Decomp. by KOH + Aq. (Gladstone, Chem. Soc. 3. 142.)

**Lead —, Pb<sub>2</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.**

Insol. in NH<sub>4</sub>OH + Aq.

**Potassium —, K<sub>2</sub>P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub>.**

Deliquescent. Sol. in H<sub>2</sub>O. Insol. in alcohol. (Gladstone, A. 76. 85.)

**Silver —, Ag<sub>2</sub>P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub> + 5H<sub>2</sub>O.**

Ppt.

**Zinc —, Zn<sub>2</sub>(P<sub>2</sub>NH<sub>2</sub>O<sub>4</sub>)<sub>2</sub>.**

(Gladstone and Holmes, Chem. Soc. (2) 2. 225.)

**Phosphamide, PON.**

See Phosphoryl nitride.

PN<sub>2</sub>H<sub>2</sub>O.

See Phosphoryl imidoamide.

**Triphosphamide, PON<sub>2</sub>H<sub>2</sub>.**

See Phosphoryl triamide.

**Trimetaphosphimic acid, P<sub>3</sub>N<sub>2</sub>H<sub>2</sub>O<sub>6</sub>.**

Sol. in H<sub>2</sub>O; aq. solution does not coagulate albumen. (Stokes, Am. Ch. J. 1895, 17. 275.)

**Ammonium trimetaphosphimate,**

(NH<sub>4</sub>)<sub>2</sub>P<sub>3</sub>N<sub>2</sub>O<sub>6</sub>H<sub>2</sub>.

Sol. in H<sub>2</sub>O, insol. in alcohol; unstable. (Stokes, Am. Ch. J. 1896, 18. 643.)

**Barium trimetaphosphimate, Ba<sub>2</sub>(P<sub>3</sub>N<sub>2</sub>O<sub>6</sub>H<sub>2</sub>)<sub>2</sub> + 4H<sub>2</sub>O.**

+ 6H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. Easily sol. in NH<sub>4</sub>Cl + Aq and in NaCl + Aq. (Stokes.)



**Barium sodium trimetaphosphimate,**  
 $P_3N_3O_6H_2NaBa + 1\frac{1}{2}H_2O$ .

Almost insol. in  $H_2O$ ; easily sol. in  $NH_4Cl$  + Aq and in  $NaCl$  + Aq. (Stokes.)

**Magnesium trimetaphosphimate,**  
 $(P_3N_3O_6H_2)_2Mg_3$  (?).

Sol. in  $H_2O$ ; insol. in alcohol; aq. solution decomp. on boiling. (Stokes.)

**Potassium trimetaphosphimate,**  $K_3P_3N_3O_6H_2$ .  
 Sol. in  $H_2O$ ; insol. in alcohol. (Stokes.)

**Silver trimetaphosphimate,**  $Ag_3P_3N_3O_6H_2$ .

Ppt.; sol. in  $NH_4OH$  + Aq; insol. in  $H_2O$ ; sl. sol. in  $HNO_3$  + Aq. (Stokes.)

**$\alpha$  Sodium trimetaphosphimate,**  $P_3N_3O_6H_2Na_3 + 4H_2O$ .

18.3 pts. are sol. in 100 pts.  $H_2O$  at  $20^\circ$ ; very sol. in hot  $H_2O$ ; decomp. by alkali on long boiling. (Stokes.)

**$\beta$  Sodium trimetaphosphimate,**  $P_3N_3O_6H_2Na_3 + H_2O$ .

Sol. in  $H_2O$ ; insol. in alcohol. (Stokes.)

**Tetrametaphosphimic acid,**  
 $P_4N_4O_8H_4 + 2H_2O$ .

Very sl. sol. in  $H_2O$ ; decomposes the sol. salts of  $HCl$ ,  $H_2SO_4$ , and  $HNO_3$ . (Stokes, Am. Ch. J. 1895, 17, 290.)

100 pts.  $H_2O$  at  $20^\circ$  dissolve 0.64 pt. crystallized acid. Somewhat more sol. in boiling  $H_2O$ . (Stokes.)

100 pts. 10%  $HNO_3$  + Aq at  $20^\circ$  dissolve 0.26 pt. of crystallized acid. (Stokes.)

Not decomp. by boiling alkalies + Aq. (Stokes, Am. Ch. J. 1896, 18, 785.)

Insol. in alcohol. (Stokes, Am. Ch. J. 1896, 18, 784.)

**Ammonium tetrametaphosphimate,**  
 $P_4N_4O_8H_4(NH_4)_2$ .

Only sl. sol. in boiling  $H_2O$ ; sol. in excess of hot 5%  $HNO_3$ . (Stokes.)

$P_4N_4O_8H_4(NH_4)_2 + 4H_2O$ . Readily sol. in  $H_2O$ ; sl. sol. in  $NH_4OH$  + Aq. (Stokes.)

**Barium tetrametaphosphimate,**  $P_4N_4O_8H_4Ba_2 + 2H_2O$ .

Ppt.; insol. in  $H_2O$ . (Stokes.)

**Potassium tetrametaphosphimate,**  
 $P_4N_4O_8H_4K_4$ .

Sl. sol. in boiling  $H_2O$ ; sol. in cold dil.  $KOH$  + Aq. (Stokes.)

$P_4N_4O_8H_4K_4$  (?). Very sol. in  $H_2O$ . (Stokes.)

**Silver tetrametaphosphimate,**  $P_4N_4O_8H_4Ag_4$ .

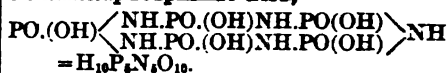
Ppt.; insol. in  $H_2O$ ; sl. sol. in  $HNO_3$  + Aq. (Stokes.)

$P_4N_4O_8Ag_4$ . Ppt.; sol. in  $NH_4NO_3$  + Aq. (Stokes.)

**Sodium tetrametaphosphimate,**  $P_4N_4O_8H_4Na_4 + 2\frac{1}{2}$  (?)  $H_2O$ .

Sl. sol. in cold  $H_2O$ . Easily sol. in hot  $H_2O$ . Ppt. from aqueous solution by excess of alkali. (Stokes.)

**Pentametaphosphimic acid,**



Sol. in  $H_2O$ ; pptd. by alcohol. (Stokes, Am. Ch. J. 1898, 20, 748.)

**Magnesium pentametaphosphimate,**  
 $(P_5N_5O_{15}Hg)_2Mg$ .

Ppt. (Stokes.)

$P_5N_5O_{15}H_4Mg_2 + 5H_2O$ . Ppt., insol. in alcohol; almost insol. in  $H_2O$ ; sl. sol. in conc. acetic acid. (Stokes.)

**Silver pentametaphosphimate,**  $P_5N_5O_{15}H_4Ag_5$ .

Ppt., sol. in cold  $KOH$  + Aq with decomp. (Stokes.)

**Sodium pentametaphosphimate,**  
 $P_5N_5O_{15}H_4Na_5 + 2H_2O$ .

Sol. in  $H_2O$ ; insol. in alcohol. (Stokes.)  
 $P_5N_5O_{15}H_4Na_5 + 2H_2O$ . Sol. in 80% acetic acid; pptd. by alcohol. (Stokes.)

**Hexametaphosphimic acid.**

**Silver hexametaphosphimate,**  $P_6N_6O_{18}H_6Ag_6$ .

Ppt.; decomp. by cold  $KOH$  + Aq. (Stokes, Am. Ch. J. 1898, 20, 757.)

**Sodium hexametaphosphimate,**  $P_6N_6O_{18}H_6Na_6 + 2H_2O$ .

Sol. in  $H_2O$ ; pptd. by alcohol. (Stokes.)

**Phosphine.**

See Hydrogen phosphide.

**Pyrophosphodiamic acid,**



Deliquescent. Easily sol. in  $H_2O$ , alcohol, or ether. Sol. in cold conc.  $H_2SO_4$  without decomp. (Gladstone, Chem. Soc. 3, 353.)

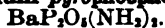
Correct composition is dimidodiphosphoric acid,  $P_2N_2H_2O_4 + H_2O = HO-PO = (NH)_2 = PO-OH$ . (Mente.)

**Aluminum pyrophosphodiamate.**

Precipitate. Sol. in  $NH_4OH$  + Aq. Insol. in acids. (Gladstone, A. 76, 82.)

**Ammonium —,**  $P_2O_5(ONH_2)_2$

Very deliquescent in moist air. Sol. in  $H_2O$ . (Schiff, A. 103, 168.)

**Barium pyrophosphodiamate,**


Precipitate. Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone.)

**Calcium —,  $\text{CaP}_2\text{O}_6(\text{NH}_2)_2$ .**

Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  and acids. (Gladstone and Holmes.)

**Lead —.**

Ppt. Decomp. by  $\text{H}_2\text{O}$ .

**Magnesium —.**

Ppt. (Gladstone and Holmes.)

**Silver —,  $\text{Ag}_3\text{P}_2\text{O}_6(\text{NH}_2)_2$ .**

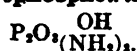
Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq.}$  (Gladstone and Holmes.)

**Strontium —.**

Sol. in acids and  $\text{NH}_4\text{Cl} + \text{Aq.}$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 4. 295.)

**Zinc —,  $\text{ZnP}_2\text{O}_6(\text{NH}_2)_2$ .**

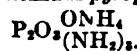
Ppt. (Gladstone and Holmes.)

**Pyrophosphotriamic acid,  $\text{P}_2\text{N}_3\text{H}_7\text{O}_4 =$** 


Decomp. by boiling  $\text{H}_2\text{O}$  or  $\text{HCl}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$  upon heating. (Gladstone and Holmes.)

Correct formula is  $\text{HO}-\text{PO} < \begin{smallmatrix} \text{NH} \\ \text{NH} \end{smallmatrix} > \text{PO}-$

$\text{NH}_2 = \text{diimidodiphosphomonamic acid.}$  (Mente, A. 248. 241.)

**Ammonium pyrophosphotriamate,**


Insol. in  $\text{H}_2\text{O}$ . (Gladstone and Holmes.)

**Barium —,  $\text{BaP}_2\text{N}_3\text{H}_7\text{O}_4$ .**

$\text{BaH}_2(\text{P}_2\text{N}_3\text{H}_7\text{O}_4)_2$ . Decomp. by  $\text{HCl} + \text{Aq.}$  (Gladstone, Chem. Soc. 4. 6.)

**Cobaltous —,  $\text{CoP}_2\text{N}_3\text{H}_7\text{O}_4$ .**

Slowly decomp. by dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  not by  $\text{HCl} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 4. 1.)

**Cupric —,  $\text{CuP}_2\text{N}_3\text{H}_7\text{O}_4$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 4. 1.)

**Ferrous —,  $\text{FeH}_4(\text{P}_2\text{N}_3\text{H}_7\text{O}_4)_2$ .**

Insol. in dil. acids. (Gladstone, Chem. Soc. (2) 4. 1.)

**Lead —,  $\text{H}_2\text{Pb}_2(\text{P}_2\text{N}_3\text{H}_7\text{O}_4)_2$ .**

Ppt. (Gladstone and Holmes, Chem. Soc. (2) 4. 1.)

$\text{H}_2\text{Pb}_2(\text{P}_2\text{N}_3\text{H}_7\text{O}_4)_2$ . Ppt. (G. and H.)

$\text{H}_2\text{Pb}(\text{P}_2\text{N}_3\text{H}_7\text{O}_4)_2$ . (G. and H.)

**Mercuric pyrophosphotriamate,**


Insol. in  $\text{H}_2\text{O}$  or dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 4. 1.)

**Platinum —,  $\text{Pt}_2\text{P}_2\text{N}_3\text{H}_7\text{O}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  when freshly pptd. (G. and H.)

**Potassium —,  $\text{KP}_2\text{N}_3\text{H}_7\text{O}_4$ .**

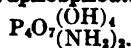
Almost insol. in  $\text{H}_2\text{O}$ . (Gladstone, Chem. Soc. 4. 10.)

**Silver —,  $\text{Ag}_3\text{P}_2\text{N}_3\text{H}_7\text{O}_4$ .**

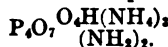
Ppt. Sl. attacked by  $\text{HC}_2\text{H}_3\text{O}_2$ ; decomp. by  $\text{HNO}_3$  or  $\text{NH}_4\text{OH} + \text{Aq.}$  into—  
 $\text{AgH}_2\text{P}_2\text{N}_3\text{H}_7\text{O}_4$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{HCl}$ . (Gladstone, Chem. Soc. (2) 4. 1.)

**Zinc —.**

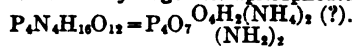
Insol. in  $\text{H}_2\text{O}$ . (Gladstone and Holmes.)

**Tetraphosphodiamic acid,  $\text{P}_4\text{N}_2\text{H}_5\text{O}_{11} =$** 


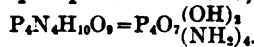
Known only as  $\text{NH}_4$  salt.

**Ammonium tetraphosphodiamate,**


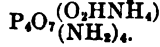
Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Gladstone.)

**Ammonium dihydrogen tetraphosphodiamate,**


Insol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  and dil. acids. (Gladstone.)

**Tetraphosphotetramic acid,**


Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Gladstone.)

**Ammonium tetraphosphotetramate,**


Sol. in  $\text{H}_2\text{O}$ , and precipitated from solution by alcohol. (Gladstone.)

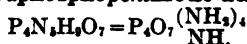
**Silver —,  $\text{Ag}_3\text{P}_4\text{N}_4\text{H}_4\text{O}_8$ .**

Ppt.

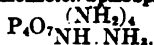
$\text{Ag}_2\text{H}_4\text{P}_4\text{N}_4\text{H}_4\text{O}_8$ . Ppt.

**Ammonium phosphoarseniovanadico-vanadiotungstate.**

See Arseniovanadico-vanadiotungstate, ammonium.

**Tetraphosphopentazotic acid,**

Insol. in  $H_2O$ . Decomp. gradually by boiling with  $H_2O$ . (Gladstone.)

**Ammonioitetrphosphopentazotic acid (?)**,

Decomp. by  $H_2O$ . (Gladstone.)

**Cupric tetraphosphopentazotate.**

(Gladstone, Chem. Soc. (2) 6. 261.)

**Lead —.**

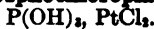
(Gladstone, Chem. Soc. (2) 6. 261.)

**Potassium —,  $KOP_4N_5H_5O_4$ .**

Insol. in  $H_2O$ . (Gladstone, Chem. Soc. (2) 6. 268.)

**Phosphoboric acid,  $H_3BO_3$ ,  $H_2PO_4 = BPO_4 + 3H_2O$ .**

Not decomp. by boiling  $H_2O$  or conc. acids. Sol. in boiling solution of caustic alkalies. (Vogel, N. Repert. Pharm. 18. 611.)

**Phosphochloroplatinous acid,**

See Chloroplatinophosphoric acid.

**Phosphochromic acid.****Ammonium phosphochromate,  $3(NH_4)_2O$ ,  $P_2O_5$ ,  $8CrO_3 + H_2O$ .**

Sol. in  $H_2O$  with decomp. (Friedheim, Z. anorg. 1894, 6. 284.)

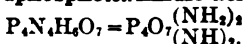
**Potassium phosphochromate,  $2K_2O$ ,  $P_2O_5$ ,  $4CrO_3 + H_2O$ .**

Sol. in  $H_2O$  but cannot be cryst. therefrom without decomp. Can be cryst. without decomp. from  $H_2O$  containing phosphoric acid. (Friedheim.)

$3K_2O$ ,  $P_2O_5$ ,  $8CrO_3$ . Sol. in  $H_2O$  but cannot be cryst. therefrom without decomp. (Blondel, C. R. 1894, 118. 194.)

**Phosphohypophosphotungstic acid.****Potassium sodium phosphohypophosphotungstate,  $9K_2O$ ,  $Na_2O$ ,  $4P_2O_5$ ,  $2PO_2H_4$ ,  $26WO_3 + 23H_2O$ .**

Precipitate. Easily sol. in hot  $H_2O$ . (Gibbs, Am. Ch. J. 7. 313.)

**Tetraphosphotetrimidic acid,**

Known only in its salts. (Gladstone.)

**Silver tetraphosphotetrimidate.**

Ppt. (Gladstone.)

**Phosphoiodic acid,  $P_2O_5$ ,  $18I_2O_5 + 4H_2O$ .**

Decomp. by  $H_2O$ . (Chrétien, A. ch. 1898, (7) 15. 389.)

**Ammonium phosphiodate,  $4(NH_4)_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 12H_2O$ .**

Sol. in  $H_2O$ . Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Lithium phosphiodate,  $3Li_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 11H_2O$ .**

Sol. in  $H_2O$ . Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Potassium phosphiodate,  $4K_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 5H_2O$ .**

Decomp. by a small amt. of  $H_2O$ ; sol. in a large amt. Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Sodium phosphiodate,  $6Na_2O$ ,  $P_2O_5$ ,  $18I_2O_5 + 5H_2O$ .**

Sol. in  $H_2O$ . Sl. sol. in conc.  $H_3PO_4 + Aq$ . (Chrétien.)

**Phosphoiridic acid.**

See Chlorophosphoiridic acid.

**Phospholuteotungstic acid,  $H_4PW_6O_{28}$ .**

See under Phosphotungstic acid.

**Phosphomolybdic acid,  $P_2O_5$ ,  $18MoO_3 + xH_2O$ .**

"Phospholuteomolybdic acid."

Deliquescent. Sol. in  $H_2O$  in all proportions. (Kehrmann, Z. anorg. 1894, 7. 418.)

$3H_2O$ ,  $P_2O_5$ ,  $20MoO_3 + 21H_2O$ . Very sol. in  $H_2O$ . Sol. in ether. By evaporation of  $H_2O$  solution crystals with  $44H_2O$ , or from a strong solution in conc.  $HNO_3 + Aq$ , with  $19H_2O$ , are obtained; also crystals with 38, and  $48H_2O$  are known. (Debray, C. R. 66. 704.)

According to Rammelsberg (B. 10. 1776) formula is  $3H_2O$ ,  $P_2O_5$ ,  $22MoO_3$ .

According to Gibbs (Am. Ch. J. 3. 317) formula is  $3H_2O$ ,  $P_2O_5$ ,  $24MoO_3 + 59H_2O$ .

Finkener (B. 11. 1638) gives the formula as  $3H_2O$ ,  $P_2O_5$ ,  $24MoO_3 + 58H_2O$ , also with  $29H_2O$ .

$P_2O_5$ ,  $20MoO_3 + 52H_2O$ . Sol. in dry ether with evolution of heat, and subsequent separation into two layers, the upper consisting of pure ether, and lower of a solution of acid in ether. Sp. gr. of lower layer, when sat. at  $13^\circ$ , is 1.3. On warming lower layer, ether separates out and forms an upper layer. This redissolves on cooling and shaking. The lower layer is insol. in  $H_2O$  and miscible with alcohol.

100 pts. ether thus dissolve 80.6 pts. acid at 0°; 84.7 pts. at 8.1°; 96.7 pts. at 19.3°; 103.9 pts. at 27.4°; 107.9 pts. at 32.9°. (Parmentier, C. R. 104. 688.)

$P_2O_5$ , 22MoO<sub>3</sub>+57H<sub>2</sub>O, and +58H<sub>2</sub>O.

(Pohl, Dissert. 1906.)

$P_2O_5$ , 23MoO<sub>3</sub>+61H<sub>2</sub>O. (Pohl.)

$P_2O_5$ , 24MoO<sub>3</sub>+61H<sub>2</sub>O. (Miolati, C. C. 1903, 11. 789.)

+64H<sub>2</sub>O. (Pohl.)

### Diphosphopentamolybdic acid,

$H_2P_2Mo_5O_{21}$ =3H<sub>2</sub>O,  $P_2O_5$ , 5MoO<sub>3</sub>.

Not known in free state.

### Ammonium phosphomolybdate, (NH<sub>4</sub>)<sub>3</sub>O,

$P_2O_5$ , 2MoO<sub>3</sub>+2H<sub>2</sub>O.

(Meschoirer, Dissert. 1894.)

2(NH<sub>4</sub>)<sub>2</sub>O,  $P_2O_5$ , 4MoO<sub>3</sub>+5H<sub>2</sub>O. (Friedheim, Z. anorg. 1894, 6. 33.)

+6H<sub>2</sub>O. (Perlberger, Dissert. 1904.)

(NH<sub>4</sub>)<sub>3</sub>PO<sub>4</sub>, 11MoO<sub>3</sub>+6H<sub>2</sub>O.

Formula is (NH<sub>4</sub>)<sub>3</sub>PO<sub>4</sub>, 10MoO<sub>3</sub>+1½H<sub>2</sub>O, according to the older authorities.

Scarcely sol. in H<sub>2</sub>O or aqueous acid solutions. Easily sol. in ammonia, and alkalies+ Aq. (Svanberg and Struve, J. pr. 44. 291.)

It is almost completely insol. in a mixture of (NH<sub>4</sub>)<sub>2</sub>MoO<sub>4</sub>+Aq. and dil. HNO<sub>3</sub>+Aq. Absolutely insol. in a dil. nitric acid solution of ammonium nitrate. (Richters, Z. anal. 10. 471.)

Solubility is increased even in presence of ammonium molybdate and free HNO<sub>3</sub> by HCl, ammonium, and other chlorides, tartaric acid, or large quantities of ammonium oxalate or citrate. Not precipitated in presence of excess of H<sub>3</sub>PO<sub>4</sub>. (Fresenius, Z. anal. 3. 446.)

Sol. in 10,000 pts. H<sub>2</sub>O at 16°; in 6600 pts. H<sub>2</sub>O containing 1 vol. % HNO<sub>3</sub>; in 550 pts. HCl+Aq of 1.12 sp. gr.; in 620 pts. alcohol of 0.80 sp. gr.; in 190 pts. HNO<sub>3</sub>+Aq (sp. gr.=1.2) at 50°; in 5 pts. conc. H<sub>2</sub>SO<sub>4</sub> at 100°; in 3 pts. NH<sub>4</sub>OH+Aq of 0.95 sp. gr. (Eggertz, J. pr. 79. 496.)

Sol. in 21,186 pts. H<sub>2</sub>O, 38,117 pts. dil. alcohol, and 13,513 pts. strong alcohol. (Hehner, Analyst, 1879. 23.)

According to Sonnenschein, the solubility is increased by much H<sub>2</sub>O or alcohol, alkaline hydroxides, carbonates, ortho-, pyro-, and metaphosphates; sodium borate, hyposulphate, thiosulphate, acetate, arsenate, and arsenite; potassium sodium tartrate, ammonium oxalate, orthophosphoric acid, and sulphuric acid. It is not increased by ammonium molybdate or sulphate, potassium sulphate, acid tartrate, acid oxalate, nitrate, or chlorate, iodide, chloride, or bromide; sodium bromide or nitrate; nitric, hydrochloric, boric, tartaric, oxalic, and dilute sulphuric acids. (Sonnenschein, J. pr. 53. 342.)

Sol. in hot H<sub>2</sub>O. Sol. in cold caustic alkalies, alkali carbonates, and phosphates,

NH<sub>4</sub>Cl, and (NH<sub>4</sub>)<sub>2</sub>C<sub>2</sub>O<sub>4</sub>+Aq; al. sol. in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, KNO<sub>3</sub>, and KCl+Aq; very al. sol. in NH<sub>4</sub>NO<sub>3</sub>+Aq. Sol. in K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>, NaCl, MgCl<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, HCl, and conc. or dil. HNO<sub>3</sub>+Aq.

Presence of (NH<sub>4</sub>)<sub>2</sub>MoO<sub>4</sub> totally changes the effect of acid liquids; insol. in dil. HNO<sub>3</sub> or H<sub>2</sub>SO<sub>4</sub>+Aq containing (NH<sub>4</sub>)<sub>2</sub>MoO<sub>4</sub>, but somewhat sol. in HCl+Aq, even in presence of that salt. Tartaric acid and similar organic substances totally prevent the precipitation of this salt. (Eggertz in Fresenius' Quant. anal.)

5(NH<sub>4</sub>)<sub>2</sub>O, 48MoO<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>+17H<sub>2</sub>O=3(NH<sub>4</sub>)<sub>2</sub>O, 24MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+2(NH<sub>4</sub>)<sub>2</sub>O, H<sub>2</sub>O, 24MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+16H<sub>2</sub>O. Formula of above salt according to Gibbs.

3(NH<sub>4</sub>)<sub>2</sub>O, 22MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+9H<sub>2</sub>O, or 12H<sub>2</sub>O.

8(NH<sub>4</sub>)<sub>2</sub>O, H<sub>2</sub>O, 60MoO<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+11H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O.

3(NH<sub>4</sub>)<sub>2</sub>O, 16MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O. Insol. in cold, sol. with decomp. in hot H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+Aq. (Gibbs, Am. Ch. J. 3. 317.)

5(NH<sub>4</sub>)<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, 16MoO<sub>3</sub>. (Meschoirer, Dissert. 1894.)

3(NH<sub>4</sub>)<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, 18MoO<sub>3</sub>+14H<sub>2</sub>O. Sol. in H<sub>2</sub>O. The aqueous solution is stable at ordinary temp. for several days, but when warmed ordinary ammonium phosphomolybdate separates. (Kehrmann, Z. anorg. 1894, 7. 414.)

3(NH<sub>4</sub>)<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, 28MoO<sub>3</sub>+8H<sub>2</sub>O. 100 g. H<sub>2</sub>O dissolve 0.0238 g. at 15°. 1 pt. is sol. at 15° in 4206 pts. H<sub>2</sub>O: 7300 pts. 5% NH<sub>4</sub>NO<sub>3</sub>+Aq; 4930 pts. 1% HNO<sub>3</sub>+Aq. (de Lucchi, Rass. Min. 1910, 32. 21.)

9(NH<sub>4</sub>)<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>, 28MoO<sub>3</sub>+8H<sub>2</sub>O. (Meschoirer, Dissert. 1894.)

### Ammonium diphosphopentamolybdate,

2(NH<sub>4</sub>)<sub>3</sub>PO<sub>4</sub>, 5MoO<sub>3</sub>+7H<sub>2</sub>O=3(NH<sub>4</sub>)<sub>2</sub>O, 5MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+7H<sub>2</sub>O.

Easily sol. in hot, less in cold H<sub>2</sub>O. (Zenkner, J. pr. 58. 256.)

5(NH<sub>4</sub>)<sub>2</sub>O, H<sub>2</sub>O, 10MoO<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>+6H<sub>2</sub>O=3(NH<sub>4</sub>)<sub>2</sub>O, 5MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+2(NH<sub>4</sub>)<sub>2</sub>O, H<sub>2</sub>O, 5MoO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+6H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Gibbs, Am. Ch. J. 1895, 17. 87.)

+8H<sub>2</sub>O. (Perlberger.)

+18H<sub>2</sub>O. (Mazzuchelli and Zangrilli, Gazz. ch. it. 1910, 40. (2) 55.)

5(NH<sub>4</sub>)<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>, 10MoO<sub>3</sub>+13H<sub>2</sub>O, and +14H<sub>2</sub>O. (Perlberger, Dissert. 1904.)

### Ammonium barium phosphomolybdate,

3(NH<sub>4</sub>)<sub>2</sub>O, 30BaO, P<sub>2</sub>O<sub>5</sub>, 30MoO<sub>3</sub>.

Insol. precipitate. (Seligsohn, J. pr. 67. 478.)

### Ammonium cadmium phosphomolybdate,

5(NH<sub>4</sub>)<sub>2</sub>O, CdO, P<sub>2</sub>O<sub>5</sub>, 6MoO<sub>3</sub>+8H<sub>2</sub>O.

(Perlberger, Dissert. 1904.)

3(NH<sub>4</sub>)<sub>2</sub>O, 2CdO, 2P<sub>2</sub>O<sub>5</sub>, 9MoO<sub>3</sub>+141H<sub>2</sub>O. (Perlberger.)

**Ammonium cobaltous phosphomolybdate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . Sol. in acids and hot  $\text{H}_2\text{O}$ . (Arnfeld, Dissert. 1898.)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{CoO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$ .  
 Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)

**Ammonium manganous phosphomolybdate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ , but dissolves clear on heating. (Arnfeld.)

$4(\text{NH}_4)_2\text{O}$ ,  $\text{MnO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 13\text{H}_2\text{O}$ .  
 (Arnfeld.)

$5(\text{NH}_4)_2\text{O}$ ,  $10\text{MnO}$ ,  $2\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 10\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17. 87.)

**Ammonium nickel phosphomolybdate**,  
 $(\text{NH}_4)_2\text{O}$ ,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$ .

Decomp. by cold, but sol. in hot  $\text{H}_2\text{O}$ .  
 (Arnfeld.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{NiO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

**Ammonium potassium phosphomolybdate**,  
 $6(\text{NH}_4)_2\text{O}$ ,  $15\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $60\text{MoO}_3 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Seligsohn, J. pr. 67. 477.)

**Ammonium sodium phosphomolybdate**,  
 $6(\text{NH}_4)_2\text{O}$ ,  $15\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $60\text{MoO}_3 + 18\text{H}_2\text{O}$ .

Sol. in much boiling  $\text{H}_2\text{O}$ . Insol. in alcohol.  
 (Seligsohn, J. pr. 67. 474.)

**Barium phosphomolybdate**,  $3\text{BaO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $24\text{MoO}_3 + x\text{H}_2\text{O}$ .

Moderately sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . Decomp. in aqueous solution at ordinary temp. on standing. (Kehrmann, Z. anorg. 1894, 7. 414.)

**Cæsium phosphomolybdate**,  $3\text{Cs}_2\text{O}$ ,  $\frac{1}{2}\text{P}_2\text{O}_5$ ,  
 $6\text{MoO}_3 + 8\text{H}_2\text{O}$ .

Ppt. (Ephraim, Z. anorg. 1910, 65. 240.)  
 $2\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $14\text{MoO}_3 + 3\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . (Ephraim.)

$3\text{Cs}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $21\text{MoO}_3 + 4\text{H}_2\text{O}$  (?).  
 (Ephraim.)

**Calcium potassium phosphomolybdate**,  $2\text{CaO}$ ,  
 $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 22\text{H}_2\text{O}$ .

(Friedheim, Z. anorg. 1893, 4. 293.)

**Cobaltous phosphomolybdate**,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $4\text{MoO}_3 + x\text{H}_2\text{O}$ .

(Arnfeld, Dissert. 1898.)

$3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\frac{1}{2}\text{H}_2\text{O}$ , and  $+17\frac{1}{2}\text{H}_2\text{O}$ . Extremely sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

$3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 38\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

$3\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

**Cobaltous potassium phosphomolybdate**,  
 $\text{K}_2\text{O}$ ,  $2\text{CoO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 15\text{H}_2\text{O}$ .

(Arnfeld.)

$4\text{K}_2\text{O}$ ,  $\text{CoO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$ . Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)

**Croceocobaltic phosphomolybdate**,  $24\text{MoO}_3$ ,  
 $\text{P}_2\text{O}_5$ ,  $[\text{Co}(\text{NH}_3)_4(\text{NO}_2)_2]\text{O}$ ,  $2\text{H}_2\text{O} + 21\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 317.)

**Gold phosphomolybdate ammonia**,  $12\text{Au}_2\text{O}_3$ ,  
 $7\text{P}_2\text{O}_5$ ,  $3\text{MoO}_3$ ,  $24\text{NH}_3 + 21\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17. 172.)

**Gold sodium phosphomolybdate ammonia**,  
 $5\text{Au}_2\text{O}_3$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $11\text{MoO}_3$ ,  $15\text{NH}_3 + 10\text{H}_2\text{O}$ .

Sol. in dil.  $\text{HCl}$ . Almost insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gibbs.)

**Lead phosphomolybdate**,  $23\text{PbMoO}_4$ ,  $\text{P}_2\text{O}_5$ ,  
 $2\text{PbPO}_4 + 7\text{H}_2\text{O}$ .

Sol. in 500,000 pts.  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{HNO}_3 + \text{Aq}$ ; somewhat less sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Beuf, Bull. Soc. (3) 3. 852.)

**Lithium phosphomolybdate**,  $12\text{Li}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$ ,  
 $5\text{MoO}_3 + 18\text{H}_2\text{O}$ .

Partially sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1909, 64. 233.)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$ . Ppt.

(Ephraim, Z. anorg. 1910, 65. 233-6.)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 17\text{H}_2\text{O}$ . Ppt. (E.)

$5\text{Li}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $8\text{MoO}_3 + 28\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (E.)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$ . Ppt. (E.)

$3\text{Li}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 27\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (E.)

**Manganous phosphomolybdate**,  $3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $5\text{MoO}_3 + 20\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. (Arnfeld.)

$3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 38\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

$3\text{MnO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

**Manganous potassium phosphomolybdate**,  
 $2\text{MnO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 30\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . (Arnfeld.)

**Manganous sodium phosphomolybdate**,  
 $7\text{MnO}$ ,  $9\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 57\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . Sol. in boiling  $\text{H}_2\text{O}$  but decomp. thereby. (Gibbs, Am. Ch. J. 1895, 17. 85.)

**Nickel phosphomolybdate**,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  
 $4\text{MoO}_3 + x\text{H}_2\text{O}$ .

Ppt. (Arnfeld.)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 20\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Arnfeld.)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 34\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

$3\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 58\text{H}_2\text{O}$ , and  $+60\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

**Nickel potassium phosphomolybdate**,  $\text{K}_2\text{O}$ ,  $2\text{NiO}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 13\text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ , but goes into solution by boiling. (Arnfeld.)

$4\text{K}_2\text{O}$ ,  $\text{NiO}$ ,  $2\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Arnfeld.)

**Potassium phosphomolybdate**,  $\text{K}_3\text{PO}_4$ ,

$11\text{MoO}_3 + 1\frac{1}{2}\text{H}_2\text{O} = 3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in alkalis. (Svanberg and Struve.)

100 g.  $\text{H}_2\text{O}$  dissolve 0.007 g. at  $30^\circ$ ; 100 g. 10%  $\text{HNO}_3 + \text{Aq}$  dissolve 0.204 g. at  $30^\circ$ . (Donk, Bull. 90, Bur. of Chem., U. S. Dept. of Agric. 1906.)

According to older authorities the formula is  $\text{K}_3\text{PO}_4$ ,  $10\text{MoO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .

$+6\text{H}_2\text{O}$ . (Rammelsberg.)  
 $2\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $24\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ .

$5\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $44\text{MoO}_3$ ,  $2\text{P}_2\text{O}_5 + 21\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 3. 317.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 11\text{H}_2\text{O}$ , and  $+15\text{H}_2\text{O}$  (Elias.)

$+14\text{H}_2\text{O}$ . Sl. sol. in cold, very easily sol. in hot  $\text{H}_2\text{O}$ . Can be cryst. from hot  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1894, 7. 416.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{MoO}_3 + 12\text{H}_2\text{O}$ . Moderately sol. in  $\text{H}_2\text{O}$ . (Elias, Dissert. 1906.)

$5\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $17\text{MoO}_3 + x\text{H}_2\text{O}$ . Aqueous solution decomp. rapidly in the cold. (Kehrmann, Z. anorg. 1894, 7. 423.)

$4\text{K}_2\text{O}$ ,  $2\text{H}_2\text{O}$ ,  $9\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 18\text{H}_2\text{O}$ . (Zenkner.)

$5\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $10\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 19\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 10. 1776.)

$6\text{K}_2\text{O}$ ,  $15\text{MoO}_3$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KOH} + \text{Aq}$ . (Rammelsberg.)

$\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $2\text{MoO}_3 + 13\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Friedheim, Z. anorg. 4. 287.)

$2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $4\text{MoO}_3 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

**Potassium diphosphopentamolybdate**,  $3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; precipitated by  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Zenkner, J. pr. 58. 261.)

$2\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Friedheim.)

**Potassium diphosphopentamolybdate nitrate**,  $2\text{K}_3\text{PO}_4$ ,  $5\text{MoO}_3$ ,  $6\text{KNO}_3 + 9\text{H}_2\text{O}$ .

(Debray, C. R. 66. 706.)

**Rubidium phosphomolybdates:**

$7\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{MoO}_3 + 12\text{H}_2\text{O}$ ;  $3\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 12\text{H}_2\text{O}$ ;  $6\text{Rb}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 10\text{H}_2\text{O}$ ;  $5\text{Rb}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $9\text{MoO}_3 + 13\text{H}_2\text{O}$ ;  $7\text{Rb}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ ,  $10\text{MoO}_3 + 15\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1910, 65. 237-9.)

**Silver phosphomolybdate**,  $7\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 24\text{H}_2\text{O}$ .

Ppt. Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , forming— $2\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{MoO}_3 + 7\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

Formula of first salt is—

$7\text{Ag}_2\text{O}$ ,  $22\text{MoO}_3$ ,  $\text{P}_2\text{O}_5 + 14\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{O}$ , but solution is quickly decomp. (Gibbs, Am. Ch. J. 3. 317.)

$7\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3$ . Ppt. (Miolati, J. pr. 1908 (2) 77. 451.)

**Silver diphosphopentamolybdate**,

$\text{Ag}_2\text{Mo}_2\text{P}_2\text{O}_{11} + 7\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Debray, C. R. 66. 705.)

**Sodium phosphomolybdate.**

Sol. in  $\text{H}_2\text{O}$  and  $\text{HNO}_3 + \text{Aq}$ . (Sonnenschein, A. 104. 45.)

$\text{Na}_2\text{O}$ ,  $5\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + x\text{H}_2\text{O}$ .

$2\text{Na}_2\text{O}$ ,  $4\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + x\text{H}_2\text{O}$ .

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $18\text{MoO}_3 + 26\text{H}_2\text{O}$ . (Friedheim.)

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{MoO}_3 + 42\text{H}_2\text{O}$ . (Rosenheim and Pinsker, Z. anorg. 1911, 70. 79.)

**Sodium diphosphopentamolybdate**,  $3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $5\text{MoO}_3 + 14\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Debray.)

**Sodium auramine phosphomolybdate**,  $\text{Na}_2\text{O}$ ,  $5\text{Au}_2\text{O}_3$ ,  $2\text{P}_2\text{O}_5$ ,  $11\text{MoO}_3$ ,  $15\text{NH}_3$ .

Sol. in hot  $\text{H}_2\text{O}$ . Very sol. in hot  $\text{HCl}$ . (Gibbs, Am. Ch. J. 1895, 17. 171.)

**Metaphosphomolybdic acid.**

**Ammonium monometaphosphomolybdate**,

$3(\text{NH}_4)_2\text{O}$ ,  $4\text{NH}_4\text{PO}_3$ ,  $10\text{MoO}_3 + 9\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 392.)

**Barium hexametaphosphomolybdate**,  $\text{BaO}$ ,  $\text{Ba}_3(\text{PO}_3)_6$ ,  $14\text{MoO}_3 + 55\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Pyrophosphonitrylic acid**,  $\text{P}_2\text{HNO}_4 =$

$\text{P}_2\text{O}_5\text{N}$

Not known in free state.

**Ammonium pyrophosphonitrylate**,

$\text{P}_2\text{O}_5\text{N}$

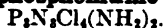
Insol. but gradually decomp. by  $\text{H}_2\text{O}$ . (Gladstone.)

**Potassium —**,  $\text{K}_2\text{P}_2\text{NO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Gladstone.)

**Silver —**,  $\text{AgP}_2\text{NO}_4$ .

Ppt.

**Triphosphonitrilic chloramide,**

Sol. in  $H_2O$  without decomp.; sol. in ether, alcohol; sl. sol. in benzene. (Stokes, Am. Ch. J. 1895, 17. 287.)

**Triphosphonitrilic tetrachlorhydrin,**

Sol. in ether, alcohol, and  $H_2O$ ; insol. in benzene and  $CS_2$ . (Stokes, Am. Ch. J. 1895, 17. 286.)

**Triphosphonitrilic chloride,  $P_3N_3Cl_4$ .**

Sol. in glacial acetic acid and  $H_2SO_4$ . 100 pts. ether dissolve 46.5 pts. at  $20^\circ$ . (Liebig.)

Insol. in light petroleum; sol. in benzene. (Stokes, Am. Ch. J. 1897, 19. 783.)

**Tetraphosphonitrilic chloride,  $P_4N_4Cl_4$ .**

Sol. in alcohol, ether, benzene,  $H_2SO_4$ . Sl. sol. in  $H_2O$  with decomp. 100 pts. ether dissolve 12.3 pts. at  $20^\circ$ . (Stokes, Am. Ch. J. 1895, 17. 281.)

**Pentaphosphonitrilic chloride,  $(PNCl_2)_5 = P_5N_5Cl_{10}$ .**

Sol. in benzene, light petroleum, acetic acid, ether,  $CS_2$ ; insol. in  $H_2O$ . (Stokes, Am. Ch. J. 1897, 19. 790.)

**Hexaphosphonitrilic chloride,  $(PNCl_2)_6 = P_6N_6Cl_{12}$ .**

Sol. in benzene, light petroleum, ether,  $CS_2$ ; insol. in  $H_2O$ . (Stokes.)

**Heptaphosphonitrilic chloride,  $(PNCl_2)_7 = P_7N_7Cl_{14}$ .**

Sol. in benzene, light petroleum, ether,  $CS_2$ ; insol. in  $H_2O$ ; sol. in alcohol with decomp. (Stokes.)

**Polyphosphonitrilic chloride,  $(PNCl_2)_x$ .**

Depolymerises on distillation; insol. in benzene and light petroleum and all neutral solvents; sol. in  $H_2O$  with decomp. (Stokes.)

**Phosphonitrilochloramide,  $P_2N_2Cl_3(NH_2)$ .**

Slowly sol. in  $H_2O$  with decomp. Insol. in ether and  $CS_2$ . Sl. sol. in boiling  $CCl_4$ . (Besson and Rosset, C. R. 1908, 146. 1149.)

**Phosphonium bromide,  $PH_4Br$ .**

Decomp. violently by  $H_2O$ .

**Phosphonium chloride,  $PH_4Cl$ .**

(Ogier, Bull. Soc. (2) 32. 483.)

**Phosphonium titanium chloride,  $2PH_4Cl, 3TiCl_4$ .**

Decomp. by  $H_2O$ ,  $HCl$ , or alkalis + Aq. R ose.)

**Phosphonium iodide,  $PH_4I$ .**

Decomp. by  $H_2O$ , alkalis, alcohol, etc. (Rose, Pogg. 46. 636.)

Decomp. by  $PCl_5$ . (Wilde, B. 16. 217.)

**Phosphonium sulphate (?)**

Deliquescent; very unstable. (Besson, C. R. 109. 644.)

**Phosphoramidate,  $P(NH_2)_5$ .**

Insol. in  $NH_4Br, 3NH_3$ ; sol. in  $NH_4I, 3NH_3$ . (Hugot, C. R. 1905, 141. 1235.)

**Phosphorotriamide,  $PON_3H_3$ .**

See Phosphoryl triamide.

**Phosphoric acid, anhydrous,  $P_2O_5$ .**

See Phosphorus pentoxide.

**Metaphosphoric acid,  $HPO_3$ .**

Sol. in  $H_2O$ . Not isolated. (Fleitmann, Pogg. 78. 362.)

Deliquescent. Sol. in  $H_2O$ , but aqueous solution decomp. into  $H_2PO_4$ , slowly in the cold, but more rapidly on heating. Conc. solutions decomp. more rapidly than when dil. (Giran, A. ch. 1903, (7) 80. 203.)

Insol. in liquid  $CO_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

**Dimetaphosphoric acid,  $H_2P_2O_6$ .**

Not isolated. (Fleitmann.)

**Trimetaphosphoric acid,  $H_3P_3O_9$ .**

Sol. in  $H_2O$ ; the solution is permanent in the cold, but on evaporation it is quickly decomp. to  $H_2PO_4$ .

**Tetrametaphosphoric acid,  $H_4P_4O_{12}$ .**

Not isolated.

**Hexametaphosphoric acid,  $H_6P_6O_{18}$ .  
(Glacial phosphoric acid.)**

Deliquescent; easily sol. in  $H_2O$  with evolution of heat and conversion into  $H_2PO_4$ . Not easily sol. in presence of slight impurities.

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

**Orthophosphoric acid,  $H_3PO_4$ .**

Very sol. in  $H_2O$ .

100 pts. of the solution contain at:

26.23°	27.02°	29.42°	29.77°
95.9	95.98	96.15	96.11 pts. $H_2PO_4$
37.65°	39.35°	42.30° (mpt.)	
97.8	98.48	100 pts. $H_2PO_4$	

(Smith and Menzies, J. Am. Chem. Soc. 1909, 31. 1186.)

See also  $10H_2PO_4 + H_2O$ , and  $2H_2PO_4 + H_2O$ .

Sp. gr. of  $H_2PO_4 + Aq$  containing:

10	20	30	40	50	% $P_2O_5$
1.1	1.23	1.39	1.6	1.85	

(Dalton.)

Sp. gr. of  $H_3PO_4 + Aq.$ 

Sp. gr.	% $P_2O_5$	Sp. gr.	% $P_2O_5$	Sp. gr.	% $P_2O_5$
1.508	49.60	1.328	36.15	1.144	17.89
1.492	48.41	1.315	34.82	1.136	16.95
1.476	47.10	1.302	33.49	1.124	15.64
1.464	45.63	1.293	32.71	1.113	14.33
1.453	45.38	1.285	31.94	1.109	13.25
1.442	44.13	1.276	31.03	1.095	12.18
1.434	43.95	1.268	30.13	1.081	10.44
1.426	43.28	1.257	29.16	1.073	9.53
1.418	42.61	1.247	28.24	1.066	8.62
1.401	41.60	1.236	27.30	1.056	7.39
1.392	40.86	1.226	26.36	1.047	6.17
1.384	40.12	1.211	24.79	1.031	4.15
1.376	39.66	1.197	23.23	1.022	3.03
1.369	39.21	1.185	22.07	1.014	1.91
1.356	38.00	1.173	20.91	1.006	0.79
1.347	37.37	1.162	19.73	...	...
1.339	36.74	1.153	18.81	...	...

(Watts, C. N. 12. 160.)

Specific gravity of  $H_3PO_4 + Aq$  containing:

6	12	18	% $H_3PO_4$
1.0333	1.0388	1.1065	
24	36	54	% $H_3PO_4$
1.1463	1.2338	1.3840	

(Schiff, A. 113. 183.)

Sp. gr. of  $H_3PO_4 + Aq$  at  $15^\circ$ . a=sp. gr. if % is  $P_2O_5$ ; b=sp. gr. if % is  $H_3PO_4$ .

%	a	b	%	a	b
1	1.009	1.0054	31	1.288	1.1962
2	1.017	1.0109	32	1.299	1.2036
3	1.025	1.0164	33	1.310	1.2111
4	1.032	1.0220	34	1.321	1.2186
5	1.039	1.0276	35	1.333	1.2262
6	1.047	1.0333	36	1.345	1.2338
7	1.055	1.0390	37	1.357	1.2415
8	1.063	1.0449	38	1.369	1.2493
9	1.071	1.0508	39	1.381	1.2572
10	1.080	1.0567	40	1.393	1.2651
11	1.089	1.0627	41	1.407	1.2731
12	1.098	1.0688	42	1.420	1.2812
13	1.106	1.0749	43	1.432	1.2894
14	1.115	1.0811	44	1.445	1.2976
15	1.124	1.0874	45	...	1.3059
16	1.133	1.0937	46	...	1.3143
17	1.142	1.1001	47	...	1.3227
18	1.151	1.1065	48	...	1.3313
19	1.161	1.1130	49	...	1.3399
20	1.171	1.1196	50	...	1.3486
21	1.182	1.1262	51	...	1.3573
22	1.192	1.1329	52	...	1.3661
23	1.202	1.1397	53	...	1.3750
24	1.212	1.1465	54	...	1.3840
25	1.223	1.1534	55	...	1.3931
26	1.233	1.1604	56	...	1.4022
27	1.244	1.1674	57	...	1.4114
28	1.254	1.1745	58	...	1.4207
29	1.265	1.1817	59	...	1.4301
30	1.277	1.1889	60	...	1.4395

(Schiff, calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of  $H_3PO_4 + Aq$  at  $17.5^\circ$ .

% $P_2O_5$	Sp. gr.	% $P_2O_5$	Sp. gr.	% $P_2O_5$	Sp. gr.
1	1.007	24	1.208	47	1.476
2	1.014	25	1.219	48	1.491
3	1.021	26	1.229	49	1.505
4	1.028	27	1.240	50	1.521
5	1.036	28	1.250	51	1.536
6	1.044	29	1.261	52	1.551
7	1.053	30	1.272	53	1.566
8	1.061	31	1.282	54	1.581
9	1.070	32	1.293	55	1.597
10	1.078	33	1.304	56	1.613
11	1.086	34	1.315	57	1.629
12	1.095	35	1.326	58	1.645
13	1.103	36	1.338	59	1.661
14	1.112	37	1.350	60	1.677
15	1.120	38	1.362	61	1.693
16	1.129	39	1.374	62	1.709
17	1.139	40	1.386	63	1.725
18	1.148	41	1.398	64	1.741
19	1.158	42	1.410	65	1.758
20	1.168	43	1.423	66	1.775
21	1.178	44	1.436	67	1.792
22	1.188	45	1.448	68	1.809
23	1.198	46	1.462	..	...

(Hager, Adjumenta varia, Leipzig, 1876.)

Table for correction to be added or subtracted for  $1^\circ$  change in temperature.

% $P_2O_5$	Corr.	% $P_2O_5$	Corr.
10-14	0.00035	36-45	0.00068
15-25	0.0004	46-55	0.00062
26-35	0.00052	56-68	0.001

(Hager.)

Sp. gr. of  $H_3PO_4 + Aq.$ 

G.-equivalents $H_3PO_4$ per litre	$t^\circ$	Sp. gr. $t^\circ/t^\circ$
0.002572	17.714	1.001552
0.005142	17.706	1.0003051
0.01025	17.685	1.000595
0.02042	17.683	1.001158
0.03056	17.687	1.001708
0.04065	17.704	1.002252
0.0507	17.663	1.002790
0.10046	17.696	1.005412
0.19951	17.749	1.010560
0.29716	17.701	1.015584
0.49057	17.719	1.025469
0.5070	17.58	1.02627
5.0700	17.84	1.25162

(Kohlrausch, W. Ann. 1894, 53. 29.)

Miscible with conc.  $HC_2H_3O_2 + Aq.$  Sol. in 30 pts. warm creosote.1 cc. of a sat. solution of ether in  $H_2O$  dissolves 0.0886 grams  $H_3PO_4$ .



1 cc. of a sat. solution of  $H_2O$  in ether dissolves 0.000033 grams  $H_3PO_4$ .

Solutions of  $H_3PO_4$  in  $H_2O$  containing less than 0.434 grams acid per 1 cc. lose an insignificant amount of acid to ether when agitated therewith. (Berthelot, C. R. 1896, 123. 345.)

The composition of the hydrates formed by  $H_3PO_4$  at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by  $H_3PO_4$  and of the conductivity and sp. gr. of  $H_2PO_4 + Aq.$  (Jones, Am. Ch. J. 1905, 34. 331.)

$10H_2PO_4 + H_2O$ . Solubility in  $H_2O$ .

100 pts. of the solution contain at:

24.11°	24.38°	24.40°
94.78	94.80	94.84 pts. $H_3PO_4$ ,

24.81°	25.41°	25.85°
94.95	95.26	95.54 pts. $H_3PO_4$ .

(Smith and Menzies, J. Am. Chem. Soc. 1909, 31. 1186.)

$2H_3PO_4 + H_2O$ . Solubility in  $H_2O$ .

100 pts. of the solution contain at:

-16.3°	0.5°	14.95°	24.03°	27.0°
76.7	78.7	81.7	85.7	87.7 pts. $H_3PO_4$ ,

29.15°	29.35° (mpt.)
90.5	91.6 pts. $H_3PO_4$ ,

28.5°	27.0°	25.41°
92.5	93.4	94.1 pts. $H_3PO_4$ .

Retroflex part of curve.

(Smith and Menzies, J. Am. Chem. Soc. 1909, 31. 1186.)

**Pyrophosphoric acid (Diphosphoric acid),  $H_4P_2O_7$ .**

Very sol. in  $H_2O$ . The solution may be kept without change, but on heating it is converted into  $H_3PO_4$ .

The acid in solution gradually changes to  $H_3PO_4$ ; the conversion being more rapid with more concentrated solutions. (Montemartini and Egidi, Gazz. ch. it. 1902, 32. (1) 381.)

**Phosphoric acid,  $H_3P_2O_7$  (?)**

Sol. in  $H_2O$ . (Joly, C. R. 100. 447.)

**Phosphates.**

The phosphates of  $NH_4$ , K, Na, Li, Cs, and Rb are sol. in  $H_2O$ , with the exception of certain metaphosphates; the other phosphates excepting neutral Tl salts, are nearly insol. in  $H_2O$ , excepting when an excess of  $H_3PO_4$  is present. The latter are all sol. in  $HNO_3 + Aq.$

(a) **Metaphosphates.**

**Monometaphosphates.** Only alkali monometaphosphates are known, and they are all insol. in  $H_2O$ .

**Dimetaphosphates.** Alkali dimetaphosphates and some double salts containing an alkali as one of the bases are sol. in  $H_2O$ , the rest are al. sol. or insol. in  $H_2O$ .

**Trimetaphosphates.** All salts are sol. in  $H_2O$ .

**Tetrametaphosphates.** The alkali salts are sol. in  $H_2O$ , the others are insol.

**Hexametaphosphates.** The alkali salts are sol., the others insol., in  $H_2O$ , but are mostly sol. in Na hexametaphosphate + Aq.

(b) **Orthophosphates.** K, Na, Li, Cs, and Rb orthophosphates are sol. in  $H_2O$ . All the others are insol. in  $H_2O$ , but sol. in excess of  $H_3PO_4$  and  $HNO_3 + Aq.$ ; less easily sol. in  $HC_2H_3O_2 + Aq.$  Pb, Al, and Fe phosphates are insol. in  $HC_2H_3O_2 + Aq.$  Sl. sol. in  $NH_4$  salts + Aq, especially  $NH_4Cl + Aq.$  from which solution they are pptd. by  $NH_4OH + Aq.$  Orthophosphates insol. in  $H_2O$  are also insol. in an excess of alkali orthophosphates + Aq.

All orthophosphates are insol., or very sl. sol. in alcohol.

(c) **Pyrophosphates.** Alkali pyrophosphates are sol. in  $H_2O$ ; the others are insol. in  $H_2O$ , but are mostly sol. in an excess of Na pyrophosphate + Aq.

**Aluminum metaphosphate,  $Al_2(PO_3)_4$ .**

Insol. in  $H_2O$  and conc. acids. (Maddrell, A. 61. 59.)

**Aluminum orthophosphate, basic,  $3Al_2O_3, P_2O_5 + 18H_2O$ .**

Min. *Evansite*.

$4Al_2O_3, 3P_2O_5 + 18H_2O$ . Ppt. Insol. in  $H_2O$ . (Rammelsberg.)

$2Al_2O_3, P_2O_5$ .

+  $3H_2O$ . Min. *Angelite*.

+  $5H_2O$ . Min. *Kalaite* (Turquoise). Sol. in  $HCl + Aq.$

+  $6H_2O$ . Decomp. by  $H_2O$ . (Hautefeuille, J. pr. (2) 37. 111.)

Min. *Peganite*. More or less sol. in  $HCl$ , and  $HNO_3 + Aq.$

+  $8H_2O$ . Ppt. (Munroe, A. 159. 278.)

Min. *Fischerite*. Sl. attacked by  $HCl$  or  $HNO_3 + Aq.$  sol. in  $H_2SO_4 + Aq.$

$3Al_2O_3, 2P_2O_5 + 8H_2O$ , or  $12H_2O$ . Sol. in acids, even after ignition. (Millot, C. R. 83. 89.)

+  $10H_2O$ . Min. *Caruleolactite*. Sol. in acids.

+  $12H_2O$ . Min. *Wavellite*.

**Aluminum orthophosphate,  $Al_2(PO_4)_3$ .**

**Crystalline.** Not attacked by conc.  $HCl$  or  $HNO_3 + Aq.$  difficultly by hot conc.  $H_2SO_4$ . (de Schulten, C. R. 98. 1583.)

Ignited  $Al_2(PO_4)_3$  is sl. decomp. by  $H_2O$ , so that solubility determinations are variable. For an extended discussion, see original paper. (Cameron and Hurst, 1904, 28. 898.)

+4H<sub>2</sub>O. Easily sol. in mineral acids, insol. in acetic and other organic acids. Easily sol. in KOH+Aq, but is reprecipitated by NH<sub>4</sub>Cl+Aq. Sol. in NH<sub>4</sub>OH+Aq. Sol. in a large amount of alum+Aq (Rose), in aluminum acetate and other aluminum salts +Aq (Fleischer, Z. anal. 6. 28). More sol. than ferric phosphate in ammonium oxalate or citrate+Aq. (Millot.)

Acid NH<sub>4</sub> citrate+Aq dissolves 3% of the P<sub>2</sub>O<sub>5</sub>; neutral NH<sub>4</sub> citrate+Aq dissolves 6.6 % of the P<sub>2</sub>O<sub>5</sub>; ammoniacal NH<sub>4</sub> citrate+Aq dissolves completely in 25 min. (Erlenmeyer, B. 14. 1869.)

Sol. in NH<sub>4</sub>OH+Aq, especially in presence of alkali phosphates. (de Koninck, Z. anal. 23. 90.)

Not pptd. in presence of alkali tartrates or citrates, sugar, glycerine, etc.

Insol. in ethyl acetate. (Naumann, B. 1910. 43. 314.)

Min. *Variscite*. Very quickly sol. in warm conc. HCl+Aq.

+5H<sub>2</sub>O. Min. *Zepharovichite*.

+8H<sub>2</sub>O. Min. *Gibbsite*.

**Aluminum orthophosphate, acid**, 2Al<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+16H<sub>2</sub>O.

Insol. in acids after being ignited. (Millot, Bull. Soc. (2) 22. 244.)

+4H<sub>2</sub>O, and 6H<sub>2</sub>O. Insol. in H<sub>2</sub>O or alcohol. (Hautefeuille and Margottet, J. pr. (2) 37. 111.)

Al<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O. Insol. in acids or aqua regia after being ignited. (Millot.)

2Al<sub>2</sub>O<sub>3</sub>, 5P<sub>2</sub>O<sub>5</sub>+14H<sub>2</sub>O. Decomp. by cold H<sub>2</sub>O into—

4Al<sub>2</sub>O<sub>3</sub>, 7P<sub>2</sub>O<sub>5</sub>+9H<sub>2</sub>O. Decomp. by hot H<sub>2</sub>O. (Erlenmeyer, A. 194. 200.)

Al<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O=Al<sub>2</sub>(H<sub>2</sub>PO<sub>4</sub>)<sub>3</sub>. Deliquescent; completely sol. in a little cold H<sub>2</sub>O, and conc. solution can be boiled without decomp., but dil. solution (1:20) separates Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub> on boiling, which redissolves on cooling, the more quickly the more dilute the original solution. (Erlenmeyer, A. 194. 198.)

**Aluminum pyrophosphate**, Al<sub>4</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>2</sub>+10H<sub>2</sub>O.

Precipitate. Sol. in mineral acids, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Aq; insol. in acetic acid. Sol. in KOH+Aq; sol. in NH<sub>4</sub>OH+Aq, but when dissolved in HCl+Aq is reprecipitated by NH<sub>4</sub>OH+Aq, and is not redissolved in an excess thereof. (Schwarzenberg, A. 65. 147.)

Sol. in alum+Aq. (Rose, Pogg. 76. 19.)

**Aluminum pyrometaphosphate**, Al<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>.

(Hautefeuille and Margottet, C. R. 96. 849.)

**Aluminum ammonium dihydrogen orthophosphate**, NH<sub>4</sub>H<sub>2</sub>PO<sub>4</sub>, AlPO<sub>4</sub>.

Partially decomp. by H<sub>2</sub>O. Sol. in acids and alkalis. Nearly insol. in 50% acetic acid. (Cohen, J. Am. Chem. Soc. 1907, 29. 720.)

**Aluminum calcium phosphate**, Al<sub>2</sub>O<sub>3</sub>, 3CaO, P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O.

Min. *Tavistockite*.

2Al<sub>2</sub>O<sub>3</sub>, 6CaO, 3P<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O. Min. *Kirrolite*.

**Aluminum calcium phosphate sulphate**, 3Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>, Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O.

Min. *Svanbergite*. Scarcely attacked by HCl+Aq, and only sl. by H<sub>2</sub>SO<sub>4</sub>+Aq.

**Aluminum ferrous magnesium phosphate**, (Mg, Fe)<sub>2</sub>Al<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+4H<sub>2</sub>O.

Min. *Childrenite*. Slowly sol. in HCl+Aq.

Min. *Eosphorite*. Sol. in HNO<sub>3</sub> or HCl+Aq.

(Mg, Fe)Al<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+H<sub>2</sub>O. Min. *Lazulite*. Only sl. attacked by acids, when not previously ignited.

**Aluminum lithium phosphate**, Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>, 4Li<sub>2</sub>PO<sub>4</sub>+30H<sub>2</sub>O.

Precipitate. (Berzelius.)

Insol. in H<sub>2</sub>O; easily sol. in acids.

**Aluminum magnesium phosphate**.

Min. *Lazulite*.

See Phosphate, aluminum ferrous magnesium.

**Aluminum potassium phosphate**, Al<sub>2</sub>O<sub>3</sub>, K<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>.

Insol. in acids. (Ouvrard, A. ch. (6) 16. 289.)

2Al<sub>2</sub>O<sub>3</sub>, 2K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub>. (Ouvrard.)

**Aluminum silver metaphosphate**, 2Al<sub>2</sub>O<sub>3</sub>, Ag<sub>2</sub>O, 4P<sub>2</sub>O<sub>5</sub>.

(Hautefeuille and Margottet, C. R. 96. 849, 1142.)

**Aluminum sodium pyrophosphate**,

Al<sub>2</sub>Na<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>2</sub>.

Insol. in H<sub>2</sub>O and acids. (Wallroth.)

Nearly insol. in acids. (Ouvrard, A. ch. (6) 16. 338.)

2Al<sub>2</sub>O<sub>3</sub>, 3Na<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub>. Sol. in HNO<sub>3</sub>+Aq. (Ouvrard.)

Al<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>2</sub>, 2Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+30H<sub>2</sub>O.

Very difficultly sol. in H<sub>2</sub>O. (Pahl, Bull. Soc. (2) 22. 122.)

**Aluminum phosphate lithium fluoride**,

2Al<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>, 3LiF.

Min. *Amblygonite*. Sl. attacked by HCl+Aq, more easily by H<sub>2</sub>SO<sub>4</sub>+Aq.

**Ammonium metaphosphate**, NH<sub>4</sub>PO<sub>3</sub>.

Insol. in H<sub>2</sub>O. (Fleitmann, Pogg. 78. 345.)

**Ammonium dimetaphosphate**, (NH<sub>4</sub>)<sub>2</sub>(PO<sub>3</sub>)<sub>2</sub>.

Sol. in 1.15 pts. cold or hot H<sub>2</sub>O. (Fleitmann, Pogg. 78. 245.) More sol. in dil. alcohol than Na or K salt.

Sol. in 0.9 pts.  $H_2O$ ; easily sol. in acids especially by boiling with conc.  $H_2SO_4$ . (Glatzel, Dissert. 1880.)

**Ammonium trimetaphosphate,  $(NH_4)_3P_3O_9$ .**

Very sol. in  $H_2O$ . (Lindbom, Acta Lund. 1873. 15.)

**Ammonium tetrametaphosphate,  $(NH_4)_4P_4O_{12}$ .**

Sol. in  $H_2O$ . (Warschauer, Z. anorg. 1903, 36. 177.)

+4 $H_2O$ . Much more sol. in  $H_2O$  than the K or Na salt. 1 pt. is sol. in 8 pts.  $H_2O$ . (Glatzel, Dissert. 1880.)

**Ammonium pentametaphosphate,  $(NH_4)_5P_5O_{15}$ .**

Sol. in  $H_2O$ . (Tammann, J. pr. 1892, (2) 45. 455.)

**Ammonium dekametaphosphate,  $(NH_4)_{10}P_{10}O_{30}$ .**

Very sl. sol. in  $H_2O$ ; 100 g.  $H_2O$  dissolved 1.20–1.54 g. in 2 months. Easily sol. in hot  $H_2O$  with decomp. (Tammann, J. pr. 1892, (2) 45. 448.)

+12 $H_2O$ . (Tammann, J. pr. 1892, (2) 45. 465.)

**Ammonium orthophosphate,  $(NH_4)_3PO_4 + 3H_2O$ .**

Difficultly sol. in  $H_2O$ .

Less sol. in  $H_2O$  than  $(NH_4)_2HPO_4$ . (Berzelius.)

Insol. in alkalis + Aq. (Berzelius.)

Sl. sol. in  $H_2O$ . Decomp. in the air. (Schottländer, Z. anorg. 1894, 7. 344.)

**Solubility in  $H_3PO_4$  + Aq at 25°.**

In 1000 g. of the solution, mols.

NH <sub>4</sub>	PO <sub>4</sub>
7.42	0.084
5.02	0.20
2.95	0.46
3.04	1.02
3.32	1.32
4.78	2.32

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 105.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

+5 $H_2O$ . (Sestini, Gazz. ch. it. 9. 298.)

**Ammonium hydrogen orthophosphate,  $(NH_4)_2HPO_4$ .**

Easily sol. in  $H_2O$ . Effloresces to form  $NH_4H_2PO_4$ . (Schiff, A. 112. 88.)

Sol. in 4 pts. cold, and less hot  $H_2O$ . Solution loses  $NH_3$  by boiling. Insol. in alcohol.

100 g.  $H_2O$  dissolve 131 g. at 15°; sp. gr. of sat. solution = 1.343. (Greenish and Smith, Pharm. J. 1901, 66. 774.)

**Solubility in  $H_3PO_4$  + Aq at 25°.**

In 1000 g. of the solution, mols.

NH <sub>4</sub>	PO <sub>4</sub>
6.42	3.23
6.48	3.74
6.56	4.01
6.78	4.34
7.26	4.83
7.16	4.82

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 105.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium dihydrogen orthophosphate,  $NH_4H_2PO_4$ .**

Does not effloresce.

Less easily sol. in  $H_2O$  than  $(NH_4)_2HPO_4$ . (Mitscherlich, A. ch. 19. 385.)

Sol. in 5 pts. cold, and less hot  $H_2O$ .

**Solubility in  $H_3PO_4$  + Aq at 25°.**

In 1000 g. of the solution, mols.

NH <sub>4</sub>	PO <sub>4</sub>
6.72	4.54
5.62	3.88
4.62	3.36
2.72	2.59
2.50	2.54
2.58	4.29
2.76	6.21
3.06	7.70
3.10	7.86

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 106.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium orthophosphate, acid.**

Decomp. into  $NH_4H_2PO_4$  at 77–78°. (Parravano and Mieli, Gazz. ch. it. 1908, 38, II. 536.)

**Ammonium pyrophosphate,  $(NH_4)_2P_2O_7$ .**

Easily sol. in  $H_2O$ . Alcohol precipitates it from the aqueous solution. (Schwarzenberg, A. 65. 141.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium hydrogen pyrophosphate  $(NH_4)_2H_2P_2O_7$ .**

Very sol. in  $H_2O$ . Insol. in alcohol. (Schwarzenberg, A. 65. 141.)

**Ammonium barium trimetaphosphate,**  
 $(\text{NH}_4)_2\text{BaP}_3\text{O}_{10} + \text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Lindbom.)

**Ammonium cadmium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{O}, \text{CdO}, 2\text{P}_2\text{O}_5 + 3\text{H}_2\text{O} =$   
 $(\text{NH}_4)_2\text{Cd}(\text{P}_2\text{O}_6)_2.$

Efflorescent. (Fleitmann, Pogg. 78. 347.)

**Ammonium cadmium orthophosphate,**  
 $\text{NH}_4\text{CdPO}_4 + 1\frac{1}{2}\text{H}_2\text{O}.$

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and acids.  
 (Drewson, Gm. K. Handb. 6te Aufl. III. 74.)

**Ammonium calcium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Ca}(\text{P}_2\text{O}_6)_2 + 2\text{H}_2\text{O}.$

Very sl. sol. in  $\text{H}_2\text{O}$ . Not decomp. by acids. (Fleitmann, Pogg. 78. 344.)

**Ammonium calcium phosphate,**  $\text{NH}_4\text{CaPO}_4 + \text{H}_2\text{O}.$

Ppt. (Hersfeld and Feuerlein, Z. anal. 20. 191.)

+  $7\text{H}_2\text{O}$ . Not completely decomp. by cold  $\text{H}_2\text{O}$  in  $\frac{3}{4}$  hour; rapidly by hot  $\text{H}_2\text{O}$ . (Lasne, Bull. Soc. 1902, (3) 27. 131.)

**Ammonium chromium orthophosphate, basic,**  
 $5(\text{NH}_4)_2\text{H}_2\text{PO}_4, 2\text{CrPO}_4, 4\text{Cr}(\text{OH})_3.$

(Cohen, J. Am. Chem. Soc. 1907, 29. 1196.)  
 $(\text{NH}_4)_2\text{HPO}_4, 2\text{CrPO}_4 + 3\text{H}_2\text{O}$ . Ppt. (Cohen.)

**Ammonium chromic pyrophosphate,**  
 $\text{NH}_4(\text{CrP}_2\text{O}_7) + 6\text{H}_2\text{O}.$

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 586.)

**Ammonium cobaltous metaphosphate.**

Extremely sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Persoz, J. pr. 3. 215.)

**Ammonium cobaltous orthophosphate,**  
 $\text{NH}_4\text{CoPO}_4 + \text{H}_2\text{O}.$

Not decomp. by boiling  $\text{H}_2\text{O}$ . (Debray, J. Pharm. (3) 46. 121.)

+  $12\text{H}_2\text{O}$ . Ppt. (Chancel, 1863.)  
 $\text{Co}(\text{NH}_4)_2\text{H}_2(\text{PO}_4)_2 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Debray.)

**Ammonium copper dimetaphosphate,**  
 $(\text{NH}_4)_2\text{P}_2\text{O}_6, \text{CuP}_2\text{O}_6 + 2\text{H}_2\text{O}.$

Very sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Fleitmann, Pogg. 78. 345.)

+  $4\text{H}_2\text{O}$ . Efflorescent. Very sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (F.)

Sol. in 50 pts.  $\text{H}_2\text{O}$ . Slowly attacked by acids. Only boiling  $\text{H}_2\text{SO}_4$  attacks easily. (Glatzel, Dissert. 1880.)

**Ammonium glucinum orthophosphate,**  
 $\text{NH}_4\text{GIPO}_4.$

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Rössler, Z. anal. 17. 148.)

**Ammonium glucinum sodium orthophosphate,**  
 $(\text{NH}_4)_2\text{GINa}_2(\text{PO}_4)_2 + 7\text{H}_2\text{O}.$

(Scheffer, A. 109. 146.)

**Ammonium iron (ferrous) orthophosphate,**  
 $\text{NH}_4\text{FePO}_4 + \text{H}_2\text{O}.$

Insol. even in boiling  $\text{H}_2\text{O}$ . When still moist, easily sol. in dil. acids, but sparingly and slowly sol. after drying, even in conc. acids. Decomp. by  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , and  $\text{NaOH} + \text{Aq}$ . Insol. in alcohol. (Otto, J. pr. 2. 409.)

$(\text{NH}_4)_2\text{FeH}_2(\text{PO}_4)_2 + 4\text{H}_2\text{O}$ . (Debray.)

**Ammonium iron (ferric) hydrogen orthophosphate, basic,**  $2(\text{NH}_4)_2\text{HPO}_4, 3\text{FePO}_4, 3\text{Fe}(\text{OH})_3.$

Ppt. Insol. in 95% alcohol. (Cohen, J. Am. Chem. Soc. 1907, 29. 719.)

**Ammonium iron (ferric) hydrogen orthophosphate,**  $\text{NH}_4\text{H}_2\text{Fe}(\text{PO}_4)_2.$

Ppt. Same properties as Na salt. (Weinland, Z. anorg. 1913, 84. 356.)

Partially hydrolyzed by  $\text{H}_2\text{O}$ . Readily sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$ . Partially hydrolyzed by cold  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in excess of hot  $\text{NH}_4\text{OH} + \text{Aq}$ . Completely hydrolyzed by caustic alkalies. Practically insol. in 50% acetic acid. (Cohen, J. Am. Chem. Soc. 1907, 29. 718.)

**Ammonium lead dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Pb}(\text{P}_2\text{O}_6)_2.$

Very difficultly sol. in  $\text{H}_2\text{O}$  and acids. (Fleitmann, Pogg. 78. 343.)

**Ammonium lithium metaphosphate,**  $\text{Li}_2\text{O}, 2(\text{NH}_4)_2\text{O}, 3\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}.$

Not appreciably sol. in cold  $\text{H}_2\text{O}$  but rapidly and abundantly sol. in  $\text{H}_2\text{O}$  at  $70^\circ$ . (Tammann, J. pr. 1892, (2) 45. 442.)

**Ammonium lithium phosphate,**  $(\text{NH}_4)_2\text{LiPO}_4.$

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ammonium magnesium metaphosphate,**  
 $(\text{NH}_4)_2\text{O}, 2\text{MgO}, 2\text{P}_2\text{O}_5 + 9\text{H}_2\text{O} (?)$ .

Sol. with difficulty in  $\text{H}_2\text{O}$  or acids when heated. Easily sol. in  $\text{H}_2\text{O}$  before heating. (Wach, Schw. J. 59. 29.)

Precipitated from aqueous solution by alcohol.

**Ammonium magnesium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Mg}(\text{P}_2\text{O}_6)_2 + 6\text{H}_2\text{O}.$

Efflorescent. (Fleitmann, Pogg. 78. 346.)

**Ammonium magnesium phosphate,**  
 $\text{NH}_4\text{MgPO}_4$ , and +  $6\text{H}_2\text{O}.$

1 l.  $\text{H}_2\text{O}$  dissolves 66 mg. anhydrous  $\text{NH}_4\text{MgPO}_4$  at  $15^\circ$ . (Fresenius, A. 55. 109.)

1 l.  $\text{H}_2\text{O}$  dissolves 74.1 mg. anhydrous  $\text{NH}_4\text{MgPO}_4$  at  $20.5-22.5^\circ$ . (Ebermayer.)

1 l.  $\text{H}_2\text{O}$  dissolves 106 mg. anhydrous  $\text{NH}_4\text{MgPO}_4$ . (Liebig.)

Insol. in  $\text{H}_2\text{O}$ , but when boiled with  $\text{H}_2\text{O}$  it loses  $\text{NH}_3$  and  $\text{H}_2\text{O}$ . (Struve, Z. anal. 1898, 37. 485.)

Solubility of  $\text{NH}_4\text{MgPO}_4 + 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. salt in 100 g. $\text{H}_2\text{O}$
0	0.0231
20	0.0516
40	0.0359
50	0.0303
60	0.0401
70	0.0163
80	0.0195

(Wenger, Dissert. Geneva, 1911.)

Aqueous solution is precipitated by  $\text{NH}_4\text{OH}$ , but not by  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Fresenius.)

Sol. in 44,600 pts.  $\text{H}_2\text{O}$  containing ammonia. More sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ , and is sol. in 7548 pts. of a solution containing 1 pt.  $\text{NH}_4\text{Cl}$  to 5 pts.  $\text{H}_2\text{O}$  and ammonia, and in 15,627 pts. of a solution containing 1 pt. of  $\text{NH}_4\text{Cl}$  to 7 pts.  $\text{H}_2\text{O}$  and ammonia. (Fresenius.)

According to Kremers (J. pr. 55. 190), a solution of 3 pts.  $\text{H}_2\text{O}$  to 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr. is best suited for washing the precipitated  $\text{NH}_4\text{MgPO}_4$ .

According to Ebermayer (J. pr. 60. 41), 1 pt. anhydrous salt is sol. in 13,497 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ ; in 31,098 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (4 pts.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.961 sp. gr.) at  $21.25^\circ$ ; in 36,764 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (3 pts.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $20.6^\circ$ ; in 43,089 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ ; in 45,206 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt.  $\text{H}_2\text{O}$ : 2 pts.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ ; in 52,412 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (1 pt.  $\text{H}_2\text{O}$ : 3 pts.  $\text{NH}_4\text{OH} + \text{Aq}$ ) at  $22.5^\circ$ ; in 60,883 pts. pure  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.961) at  $22.5^\circ$ .

Almost absolutely insol. in  $\text{H}_2\text{O}$  containing  $\frac{1}{4}$  vol.  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.96) and  $\text{NH}_4\text{Cl}$ , i. e., much more insol. than given by Fresenius. (Kubel, Z. anal. 8. 125.)

According to Kissel (Z. anal. 8. 173), 1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (3 pts.  $\text{H}_2\text{O}$ : 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr.) dissolves 4.98 mg. in 24 hours, while 13.9 mg. are dissolved if 18 g.  $\text{NH}_4\text{Cl}$  to a litre of  $\text{H}_2\text{O}$  are also present.

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  containing 2.2 g. per litre dissolves 71.7 mg.; 3.0 g., 113 mg.; 10 g., 147 mg.;  $\text{NaCl} + \text{Aq}$  containing 2 g.  $\text{NaCl}$  per l. dissolves 123.4 mg.;  $\text{NaNO}_3 + \text{Aq}$  containing 3 g.  $\text{NaNO}_3$  per l. dissolves 93.1 mg. (Liebig, A. 106. 196.)

Completely insol. in water containing ammonium phosphate or ammonium sodium phosphate. (Berzelius.)

800 ccm.  $\text{H}_2\text{O}$ , sat. with  $\text{CO}_2$ , dissolve 1.425 g. (Liebig.)

Easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , acetic and other

acids, also in boiling solution of ammonium citrate. (Millot, Bull. Soc. (2) 18. 20.)

When in presence of Fe or Al salts it is sol. to a considerable extent in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_4 + \text{Aq}$ .

6 g.  $\text{NH}_4\text{Cl}$  in 100 ccm.  $\text{H}_2\text{O}$  containing 10 ccm. 6.34%  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve pptd. salt = 0.0029 g.  $\text{Mg}_3\text{P}_2\text{O}_7$ . 1 g.  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  in 100 ccm.  $\text{H}_2\text{O}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve = 0.0061 g.  $\text{Mg}_3\text{P}_2\text{O}_7$ . 2 g. citric acid in excess of  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve = 0.0147 g.  $\text{Mg}_3\text{P}_2\text{O}_7$ . Solubility prevented by excess of magnesia mixture. (Lindo, C. N. 48. 217.)

Solubility of  $\text{NH}_4\text{MgPO}_4 + 6\text{H}_2\text{O}$  in salts +  $\text{Aq}$  at  $t^\circ$ .

(G. salt dissolved in 100 g. solvent.)

$t^\circ$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}$	5% $\text{NH}_4\text{Cl} + \text{Aq}$	1 pt. $\text{NH}_4\text{OH}$ (D = 0.96) + 4 pts. $\text{H}_2\text{O}$
0	0.1100	0.0597	0.0087
20	0.0463	0.1055	0.0098
30	0.0546	0.1133	...
40	0.0645	0.0713	0.0135
50	0.0723	0.0931	0.0153
60	0.0846	0.1728	0.0174
70	0.0834	0.1239	0.0178
80	0.1009	0.1913	0.0145

$t^\circ$	4% $\text{NH}_4\text{OH} + \text{Aq}$ and 5% $\text{NH}_4\text{Cl} + \text{Aq}$	4% $\text{NH}_4\text{OH} + \text{Aq}$ and 10% $\text{NH}_4\text{Cl} + \text{Aq}$
20	0.0165	0.0541
60	0.0274	0.0731

(Wenger, Dissert. Geneva, 1911.)

About 3 times as sol. in  $\text{Ca}(\text{C}_2\text{H}_3\text{O}_4)_2 + \text{Aq}$  as in  $\text{NaC}_2\text{H}_3\text{O}_4 + \text{Aq}$ , but solubility is prevented by excess of  $\text{MgCl}_2$ . (Ville, Bull. Soc. (2) 18. 316.)

Sl. sol. in ammonium citrate +  $\text{Aq}$  containing 400 g. ammonium citrate in a litre. Solubility = 0.457% at ord. temp. and 0.58% at  $50^\circ$ . (Boliz, Ch. Z. 1903, 27. 1151.)

Min. Struvite.

+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or citric acid +  $\text{Aq}$ . (Millot and Maquenne, Bull. Soc. (2) 23. 238.)

**Ammonium magnesium hydrogen orthophosphate,  $(\text{NH}_4)_2\text{MgH}_2(\text{PO}_4)_2 + 3\text{H}_2\text{O}$  (?).**

(Graham.)

**Ammonium magnesium phosphate,  $5\text{MgO}$ ,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{P}_2\text{O}_5 + 24\text{H}_2\text{O}$ .**

(Gawalovsky, C. C. 1885. 721.)

**Ammonium magnesium sodium pyrophosphate,  $(\text{NH}_4)_2\text{Mg}_2\text{Na}(\text{P}_2\text{O}_7)_4$ .**

Insol. in  $\text{H}_2\text{O}$  and not decomp. thereby. (Berthelot and André, A. ch. 1897, (7) 11. 186.)

**Ammonium manganous dimetaphosphate,**  
 $(\text{NH}_4)_2\text{Mn}(\text{PO}_3)_4 + 4\text{H}_2\text{O}.$

Relatively easily attacked by acids. (Glatzel, Dissert. 1880.)  
 $+6\text{H}_2\text{O}.$

Efflorescent. (Fleitmann, Pogg. 78. 346.)

**Ammonium manganous orthophosphate,**  
 $\text{NH}_4\text{MnPO}_4 + \text{H}_2\text{O}.$

Sol. in 32,092 pts. cold, and 20,122 pts. boiling  $\text{H}_2\text{O}$ , and in 17,755 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$  (1.4%  $\text{NH}_4\text{Cl}$ ). (Fresenius.)

$+7\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}$  below  $70^\circ$ ; at  $70^\circ$  100 g.  $\text{H}_2\text{O}$  dissolve 0.0052 g. salt; at  $80^\circ$  0.0067. (Wenger, Dissert. Geneva, 1911.)

Easily sol. in dil. acids. Decomp. by  $\text{KOH} + \text{Aq}$ , but not by  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH}$  or  $\text{NH}_4$  salts  $+ \text{Aq}$ . (Gibbs.)

Solubility in salts  $+ \text{Aq}$  at  $t^\circ$ .  
 (G. in 100 g. solvent.)

$t^\circ$	5% $\text{NH}_4\text{NO}_3 + \text{Aq}.$	5% $\text{NH}_4\text{Cl} + \text{Aq}.$	1 pt. $\text{NH}_4\text{OH}$ D = 0.96 $+4$ pts. $\text{H}_2\text{O}.$
0	0.0206	0.0020	0.0116
20	0.0200	0.0255	0.0122
30	0.0226	0.0345	
40	0.0209	0.0386	0.0118
50	0.0226	0.0355	0.0132
60	0.0270	0.0384	0.0193
70	0.0281	0.0414	0.0191
80	0.0326	0.0451	0.0197

(Wenger, l. c.)

Insol. in alcohol.

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Ammonium manganic pyrophosphate,**  
 $\text{NH}_4\text{MnP}_2\text{O}_7 + 3\text{H}_2\text{O}.$

Decomp. by cold  $\text{H}_2\text{O}$  with separation of  $\text{Mn}_2\text{O}_3$ . (Rosenheim, B. 1915, 48. 584.)

**Ammonium manganous sodium pyrophosphate,**  
 $\text{NH}_4\text{NaMnP}_2\text{O}_7 + 3\text{H}_2\text{O}.$

Insol. in  $\text{H}_2\text{O}$  or alcohol. Easily sol. in very dil. acids. (Otto, J. pr. 2. 418.)

Formula is  $\text{Na}_4(\text{NH}_4)_2\text{Mn}_2(\text{P}_2\text{O}_7)_3 + 12\text{H}_2\text{O}$ , according to Berzelius.

**Ammonium mercuric metaphosphate.**

Sol. in  $\text{H}_2\text{O}$ , or at least in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Persoz, J. pr. 3. 216.)

**Ammonium nickel metaphosphate.**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it is reprecipitated on evaporation of the  $\text{NH}_3$ . (Persoz, J. pr. 3. 215.)

**Ammonium nickel dimetaphosphate,**  
 $(\text{NH}_4)_2\text{NiP}_2\text{O}_7 + 4\text{H}_2\text{O}.$

Sol. in 12.5 pts.  $\text{H}_2\text{O}$ . (Glatzel, Dissert. 1880.)

**Ammonium nickel orthophosphate,**  
 $\text{NH}_4\text{NiPO}_4 + 2\text{H}_2\text{O}.$

Ppt. (Debray, C. R. 59. 40.)  
 $+6\text{H}_2\text{O}.$  Decomp. by boiling  $\text{H}_2\text{O}$ . (Debray.)

**Ammonium potassium dimetaphosphate,**  
 $(\text{NH}_4)_2\text{K}_4(\text{P}_2\text{O}_6)_7.$

More sol. in  $\text{H}_2\text{O}$  than following salt. (Fleitmann, Pogg. 78. 341.)

$\text{NH}_4\text{K}_3\text{P}_4\text{O}_{13} + 2\text{H}_2\text{O}.$  Difficultly sol. in  $\text{H}_2\text{O}$ . (Fleitmann.)

**Ammonium potassium pyrophosphate,**  
 $\text{NH}_4\text{K}_2\text{HP}_2\text{O}_7 + \frac{1}{2}\text{H}_2\text{O}.$

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Decomp. on boiling. (Schwarzenberg.)

**Ammonium sodium dimetaphosphate,**  
 $\text{NH}_4\text{NaP}_2\text{O}_6 + \text{H}_2\text{O}.$

More sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{P}_2\text{O}_6$ , but less than  $(\text{NH}_4)_2\text{P}_2\text{O}_6$ . Less sol. in alcohol than in  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. 78. 340.)

**Ammonium sodium orthophosphate,**  
 $(\text{NH}_4)_2\text{NaPO}_4 + 4\text{H}_2\text{O}.$

Decomp. by  $\text{H}_2\text{O}$ . Cryst. from  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.96 sp. gr. From  $\text{H}_2\text{O}$  solution,  $\text{NaNH}_4\text{HPO}_4 + 4\text{H}_2\text{O}$  separates out. (Uelsmann, Arch. Pharm. (2) 99. 138.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$+5\text{H}_2\text{O}.$   
 $\text{NH}_4\text{Na}_2\text{PO}_4 + 12\text{H}_2\text{O}.$  (Herzfeld, Z. anal. 20. 191.)

$(\text{NH}_4)_2\text{Na}(\text{PO}_3)_2 + 6\text{H}_2\text{O}.$  Sol. in  $\text{H}_2\text{O}$  with decomp. Cryst. from hot conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Uelsmann, Arch. Pharm. (2) 99. 138.)

**Ammonium sodium hydrogen phosphate (Microcosmic salt),**  
 $\text{NH}_4\text{NaHPO}_4 + 4\text{H}_2\text{O}.$

Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . Sol. in 6 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$ . Insol. in alcohol.

Aqueous solution gives off  $\text{NH}_3$ , especially if hot.

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Min. *Stercorile*.  
 $+5\text{H}_2\text{O}.$  (Uelsmann.)

The composition of the hydrates formed by this salt at different dilutions is calculated from determinations of the lowering of the fr.-pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, Am. Ch. J. 1905, 34. 319.)

$(\text{NH}_4)_2\text{Na}_2\text{H}_2(\text{PO}_3)_4 + 3\text{H}_2\text{O}.$  Decomp. by  $\text{H}_2\text{O}$ . (Filhol and Senderens, C. R. 93. 388.)

**Ammonium sodium pyrophosphate,**  
 $(\text{NH}_4)_2\text{Na}_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. by boiling. (Schwarzenberg, A. 65. 142.)  
 $+6\text{H}_2\text{O}.$  (Rammelsberg.)

**Ammonium sodium glucinum orthophosphate,**  $(\text{NH}_4)_2\text{Na}_2\text{Gl}(\text{PO}_4)_2 + 7\text{H}_2\text{O}$ .

Precipitate. (Scheffer.)

**Ammonium thalious orthophosphate,**  $(\text{NH}_4)_3\text{PO}_4$ ,  $(\text{NH}_4)_2\text{TiPO}_4$ , or  $\text{H}_2\text{NH}_4\text{PO}_4$ ,  $\text{HTl}_2\text{PO}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Lamy; Rammelsberg.)

**Ammonium uranyl phosphate,**  $\text{NH}_4(\text{UO}_2)\text{PO}_4 + x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  and  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Sol. in mineral acids, from which it is precipitated by  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , in which it is insol. (Knop.)

+  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and acetic acid. Sol. in all mineral acids, oxalic acid and  $\text{M}_2\text{CO}_3 + \text{Aq}$ . (Lienau, Dissert. 1898.)

**Ammonium vanadium phosphate.**

See Phosphovanadate, ammonium.

**Ammonium zinc dimetaphosphate,**  $(\text{NH}_4)_2\text{Zn}(\text{P}_2\text{O}_5)_2 + 6\text{H}_2\text{O}$ .

Efflorescent. (Fleitmann, Pogg. 78. 347.) +  $4\text{H}_2\text{O}$ . Sol. in 70 pts.  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1880.)

**Ammonium zinc orthophosphate, basic,**  $3\text{NH}_4$ ,  $2\text{ZnO}$ ,  $\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ .

(Rother, A. 1867, 143. 356.)

$4(\text{NH}_4)_2\text{O}$ ,  $6\text{ZnO}$ ,  $3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ . (Schweikert, A. 1868, 145. 57.)

**Ammonium zinc orthophosphate,**  $\text{NH}_4\text{ZnPO}_4 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids, and caustic alkalies. (Bette, A. 15. 129.)

**Ammonium zinc hydrogen phosphate,**  $\text{NH}_4\text{H}_2\text{PO}_4$ ,  $\text{ZnHPO}_4 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Debray.)

$4(\text{NH}_4)_2\text{O}$ ,  $6\text{ZnO}$ ,  $3\text{P}_2\text{O}_5$ . (Schweikert, A. 145. 57.)

$3(\text{NH}_4)_2\text{O}$ ,  $4\text{ZnO}$ ,  $2\text{P}_2\text{O}_5 + 13\text{H}_2\text{O}$ . (Rother, A. 143. 356.)

**Ammonium phosphate selenate.**

See Selenophosphate, ammonium.

**Barium triphosphate,**  $5\text{BaO}$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ ; insol. in acids after heating to a high temp. (Schwarz, Z. anorg. 1895, 9. 264.)

**Barium metaphosphate,**  $\text{Ba}(\text{PO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$  or dil. acids. (Maddrell, A. 61. 61.)

Not decomp. by boiling with acids or alkali carbonates +  $\text{Aq}$ . (Fleitmann, Pogg. 78. 352.)

**Barium dimetaphosphate,**  $\text{BaP}_2\text{O}_6 + 2\text{H}_2\text{O}$ .

More difficultly sol. in  $\text{H}_2\text{O}$  than  $\text{Ba}_2(\text{P}_2\text{O}_5)_2$ . Slightly attacked by boiling conc.  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$ . Easily decomp. by  $\text{H}_2\text{SO}_4$ . (Fleitmann, Pogg. 78. 254.)

**Barium trimetaphosphate,**  $\text{Ba}_3(\text{P}_3\text{O}_{10})_2 + 2\text{H}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ . (Fleitmann, A. 65. 313.)

+  $6\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Lindbom.)

1 l.  $\text{H}_2\text{O}$  dissolves 2.589 g. at ord. temp. (Wiesler, Z. anorg. 1901, 28. 198.)

**Barium hexametaphosphate,**  $\text{Ba}_2\text{P}_6\text{O}_{18}$  (?)

Sol. in  $\text{H}_2\text{O}$  only after boiling several hours. Nearly insol. in  $\text{H}_2\text{O}$ . (Lüder, Z. anorg. 5. 15.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Wackenroder.)

Sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . After ignition it is nearly insol. in  $\text{HNO}_3 + \text{Aq}$ .

**Barium orthophosphate,**  $\text{Ba}_3(\text{PO}_4)_2$ .

Precipitate. Very sl. sol. or insol. in  $\text{H}_2\text{O}$ . (Graham, Pogg. 32. 49.)

Sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{SO}_2 + \text{Aq}$ . Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Barium hydrogen phosphate,**  $\text{BaHPO}_4$ .

Sol. in 10,000 pts.  $\text{H}_2\text{O}$ . (Malaguti, A. ch. (3) 51. 348.)

Sol. in 20,570 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Bischof, 1833.)

Not completely soluble in water containing  $\text{CO}_2$ , but  $\text{BaCl}_2$  causes no ppt. in  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing 7.16 g. or less  $\text{Na}_2\text{HPO}_4$  in a litre after it has been saturated with  $\text{CO}_2$ . (Setschenow, C. C. 1875. 97.)

Easily sol. in  $\text{H}_2\text{PO}_4 + \text{Aq}$ , and dil.  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3 + \text{Aq}$  of 1.275 sp. gr. if not diluted has scarcely any solvent action, but more dissolves on dilution until a maximum is reached, when 10 vols. of  $\text{H}_2\text{O}$  have been added. (Bischof, Schw. J. 67. 39.)

Sol. in 367–403 pts. acetic acid (1.032 sp. gr.) at  $22.5^\circ$ . (Bischof, l. c.)

Easily sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$ ,  $\text{NH}_4\text{NO}_3$ , or  $\text{NH}_4$  succinate, from which solutions it is completely pptd. by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rose.)

Insol. in  $\text{Na}_2\text{HPO}_4$  or  $\text{BaCl}_2 + \text{Aq}$ . (Rose, Pogg. 76. 23.)

More sol. in  $\text{BaCl}_2$  or  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ , 1 pt.  $\text{BaHPO}_4$  being sol. in 4362 pts.  $\text{H}_2\text{O}$  containing 1.2%  $\text{NaCl}$  and 0.8%  $\text{BaCl}_2$ . (Ludwig, Arch. Pharm. (2) 56. 265.)

Sol. in  $\text{Na}$  citrate +  $\text{Aq}$ . (Spiller.)

**Barium tetrahydrogen phosphate,**  $\text{BaH}_4(\text{PO}_4)_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Mitscherlich, 1831.)

Decomp. by much  $\text{H}_2\text{O}$  into  $\text{BaHPO}_4$ . Sol. in phosphoric, and certain other acids. (Berzelius, A. ch. 2. 153.)

**Barium pyrophosphate,**  $\text{Ba}_2\text{P}_2\text{O}_7 + x\text{H}_2\text{O}$ .

Somewhat sol. in  $\text{H}_2\text{O}$ , in much  $\text{H}_2\text{P}_2\text{O}_7 + \text{Aq}$ , also in  $\text{HCl} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4 + \text{Aq}$  or  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Schwarzenberg.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Wackenroder.)

**Barium hydrogen pyrophosphate**,  $\text{BaH}_2\text{P}_2\text{O}_7$ ,  $\text{Ba}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ .

Ppt. (Knorre and Oppelt, B. 21. 773.)

**Barium tetraphosphate**,  $\text{Ba}_3\text{P}_4\text{O}_{13}$ .

Insol. in  $\text{H}_2\text{O}$  or acids when strongly heated. (Fleitmann and Henneberg, A. 65. 331.)

**Barium manganic pyrophosphate**,  $\text{Ba}(\text{Mn}_2\text{P}_2\text{O}_7)_2 + 5\text{H}_2\text{O}$ .

Almost insol. in  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 585.)

**Barium potassium trimetaphosphate**,  $\text{BaKP}_3\text{O}_8 + \text{H}_2\text{O}$ .

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{NH}_4\text{BaP}_3\text{O}_8$  or  $\text{NaBaP}_3\text{O}_8$ . (Lindbom.)

Sol. in  $\text{HCl} + \text{Aq}$  after ignition.

**Barium potassium orthophosphate**,  $\text{BaKPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, A. ch. (6) 16. 297.)

+  $10\text{H}_2\text{O}$ . (de Schulten, C. R. 96. 706.)

**Barium sodium dimetaphosphate**,  $\text{BaNa}_2(\text{P}_2\text{O}_5)_2 + 4\text{H}_2\text{O}$ .

(Glatzel, Dissert. 1880.)

**Barium sodium trimetaphosphate**,  $\text{BaNaP}_3\text{O}_8 + 4\text{H}_2\text{O}$ .

More easily sol. in  $\text{H}_2\text{O}$  than  $\text{Ba}_3(\text{P}_3\text{O}_{10})_2$ . Sol. in acids, unless ignited. (Fleitmann and Henneberg, A. 65. 314.)

Efflorescent. Sol. in  $\text{HCl} + \text{Aq}$  after ignition only by long boiling. When fused it is easily sol. in  $\text{HCl} + \text{Aq}$ . (Lindbom, Acta Lund. 1873. 21.)

**Barium sodium orthophosphate**,  $\text{BaNaPO}_4 + 10\text{H}_2\text{O}$ .

(de Schulten, C. R. 96. 706.)

Not attacked by cold, but decomp. by hot  $\text{H}_2\text{O}$ . (Villiers, C. R. 104. 1103.)

Sl. sol. in  $\text{H}_2\text{O}$ . (Quartaroli, C. A. 1911. 2375.)

**Barium sodium pyrophosphate**,  $\text{Ba}_2\text{Na}_4(\text{P}_2\text{O}_7)_2$ .

Sol. in hot  $\text{HCl}$  and  $\text{HNO}_3$ . (Tammann, J. pr. 1892, (2) 45. 469.)

$6\text{Ba}_2\text{P}_2\text{O}_7$ ,  $\text{Na}_4\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Completely insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , but not insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Baer, Pogg. 75. 164.)

**Barium uranous metaphosphate**,  $\text{UO}_2$ ,  $\text{BaO}$ ,  $\text{P}_2\text{O}_5$ .

(Colani, A. ch. 1907, (8) 12. 142.)

**Barium uranyl orthophosphate**,  $\text{Ba}(\text{UO}_2)_2(\text{PO}_4)_2 + 8\text{H}_2\text{O}$ .

Min. *Uranocircite*.

**Barium phosphate chloride**,  $3\text{Ba}_3(\text{PO}_4)_2$ ,  $\text{BaCl}_2$ .

Min. *Barytapatite*. (Deville and Caron, A. ch. (3) 67. 451.)

$4\text{BaH}_2(\text{PO}_4)_2$ ,  $\text{BaCl}_2$ . (Erlenmeyer, J. B. 1857. 145.)

$15\text{BaO}$ ,  $6\text{P}_2\text{O}_5$ ,  $\text{BaCl}_2 + 6\text{H}_2\text{O}$  (?). Sol. in 18,000 pts. cold  $\text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$  containing  $\text{BaCl}_2$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{OH}$ . (Ludwig, Arch. Pharm. (2) 66. 271.)

**Bismuth orthophosphate, basic**,  $2\text{BiPO}_4$ ,  $3\text{Bi}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . (Cavazzi, Gazz. ch. it. 14. 289.)

**Bismuth orthophosphate**,  $\text{BiPO}_4$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . Sl. sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Chancel, C. R. 50. 416.)

Not decomp. by  $\text{H}_2\text{O}$ . Other phosphates of Bi are decomp. by  $\text{H}_2\text{O}$ . (Montmartini, C. C. 1900, II. 1256.)

Not hydrolyzed by hot  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{BiCl}_3 + \text{Aq}$ ; decomp. by boiling alkali. (Caven, J. Soc. Chem. Ind. 1897, 16. 30.)

More sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{HNO}_3 + \text{Aq}$ . (Rose.)

Sol. in  $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$ . (M'Curdy, Am. J. Sci. (2) 31. 282.)

Insol. in  $\text{MNO}_3 + \text{Aq}$ .

Insol. in Bi salts +  $\text{Aq}$ . (Rose, Pogg. 76. 26.)

Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ , but insol. in  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett, 1837.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ . (Kühn.)

+  $3\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{S}$  or  $\text{KOH} + \text{Aq}$ . (Vanino, J. pr. 1906, (2) 74. 151.)

**Bismuth pyrophosphate, basic**,  $2\text{Bi}_2\text{O}_3$ ,  $\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$  and  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; sol. in hot  $\text{HCl}$  and  $\text{HNO}_3 + \text{Aq}$ . Insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , and  $\text{NH}_4$  citrate +  $\text{Aq}$ . (Passerini, Cim. 9. 84.)

**Bismuth pyrophosphate**,  $\text{Bi}_4(\text{P}_2\text{O}_7)_2$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . (Chancel, C. R. 50. 416.)

Decomp. by  $\text{H}_2\text{O}$ . (Wallroth, Bull. Soc. (2) 39. 316.)

Sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . (Stromeyer.)

**Bismuth sodium pyrophosphate**,  $\text{NaBiP}_2\text{O}_7 + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 588.)

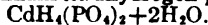
**Boron phosphate**,  $\text{BPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Not attacked by boiling alkalis. (Meyer, B. 22. 2919.)

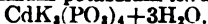


**Bromomolybdenum phosphate.***See under Bromomolybdenum comp.***Cadmium triphosphate,  $\text{Cd}_3(\text{P}_3\text{O}_{10})_2$ .**Insol. in  $\text{H}_2\text{O}$  and acids. (Glühmann, Dissert. 1899.)**Cadmium tetrphosphate,  $6\text{CdO}, 4\text{P}_2\text{O}_5 + 18\text{H}_2\text{O}$ .**

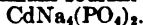
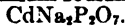
Insol. in acids. (Glühmann.)

**Cadmium metaphosphate.**Very sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Persoz, A. ch. 56. 334.)**Cadmium dimetaphosphate,  $\text{Cd}(\text{PO}_3)_2 + 2\text{H}_2\text{O}$ .**Sol. in 32 pts.  $\text{H}_2\text{O}$ . Scarcely attacked by acids, especially conc.  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1880.)**Cadmium tetrametaphosphate.**Insol. in  $\text{H}_2\text{O}$ . Easily decomp. by  $\text{Na}_2\text{S} + \text{Aq.}$  (Fleitmann, Pogg. 78. 358.) $\text{Cd}_2(\text{PO}_3)_4 + 10\text{H}_2\text{O}$ . Not so very difficultly attacked by acids but insol. after ignition. (Glatzel, Dissert. 1880.)**Cadmium orthophosphate,  $\text{Cd}_3(\text{PO}_4)_2$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in Cd salts + Aq. (Stromeyer.)Easily sol. in  $\text{NH}_4$  sulphate, chloride, nitrate, or succinate + Aq. (Wittstein, Repert. 57. 32.) $\text{H}_2\text{Cd}_4(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_3\text{PO}_4 + \text{Aq.}$  (de Schulten, Bull. Soc. (3) 1. 473.)**Cadmium tetrahydrogen phosphate,**Decomp. by great excess of  $\text{H}_2\text{O}$ . (de Schulten.)**Cadmium pyrophosphate,  $\text{Cd}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ ,  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq.}$  or acids. Insol. in  $\text{KOH} + \text{Aq.}$  Sol. in  $\text{SO}_3 + \text{Aq.}$  (Schwarzenberg, A. 65. 183.)**Cadmium hydrogen orthophosphate hydrate,  $\text{CdHPO}_4 \cdot 2\text{N}_2\text{H}_4$ .**

Decomp. by light. (Franzen, Z. anorg. 1908, 60. 283.)

**Cadmium potassium tetrametaphosphate,**Sol. in 135 pts.  $\text{H}_2\text{O}$ . Difficultly decomp. by acids. (Glatzel, Dissert. 1880.)**Cadmium potassium orthophosphate,**Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl} + \text{Aq.}$  (Ouvrard, A. ch. (6) 16. 321.)**Cadmium potassium pyrophosphate,**Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HCl} + \text{Aq.}$  (Ouvrard.) $5\text{Cd}_2\text{P}_2\text{O}_7, 4\text{K}_4\text{P}_2\text{O}_7 + 30\text{H}_2\text{O}$ . Much more easily sol. in  $\text{H}_2\text{O}$  than the  $\text{CdNa}$  salt. (Pahl, Sv. V. A. F. 30, 7. 39.)**Cadmium sodium triphosphate,  $\text{Na}_5\text{CdP}_3\text{O}_{10} + 12\text{H}_2\text{O}$ .**

Sol. in acids even after ignition. (Glühmann, Dissert. 1899.)

**Cadmium sodium trimetaphosphate,**Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Wiesler, Z. anorg. 1901, 28. 204.)**Cadmium sodium tetrametaphosphate,**Completely insol. in  $\text{H}_2\text{O}$ . (Glatzel, Dissert. 1880.)**Cadmium sodium orthophosphate,**Insol. in  $\text{H}_2\text{O}$ ; very sol. in dil. acids.  $\text{CdNaPO}_4$ . As above. (Ouvrard.)**Cadmium sodium pyrophosphate,**

Sol. in dil. acids, even acetic acid. (Wallroth.)

 $+ 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7. 39.)**Cadmium phosphate bromide,  $3\text{Cd}_2(\text{PO}_4)_2, \text{CdBr}_2$ .**Sol. in cold very dil.  $\text{HNO}_3 + \text{Aq.}$  (de Schulten, Bull. Soc. (3) 1. 472.)**Cadmium phosphate chloride,  $3\text{Cd}_2(\text{PO}_4)_2, \text{CdCl}_2$ .**Sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (de Schulten.)**Cæsium metaphosphate,  $\text{CsPO}_3$ .**Sol. in  $\text{H}_2\text{O}$ . (von Berg, B. 1901, 34. 4185.)**Cæsium orthophosphate,  $\text{Cs}_3\text{PO}_4 + 5\text{H}_2\text{O}$ .**Deliquescent; very sol. in  $\text{H}_2\text{O}$ . (von Berg.)**Cæsium hydrogen orthophosphate,  $\text{Cs}_2\text{HPO}_4 + \text{H}_2\text{O}$ .**Very sol. in  $\text{H}_2\text{O}$ . (von Berg.)**Cæsium dihydrogen orthophosphate,**Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (von Berg.)**Cæsium pyrophosphate,  $\text{Cs}_2\text{P}_2\text{O}_7$ .**Very sol. in  $\text{H}_2\text{O}$ ; very hygroscopic. (von Berg.)

**Calcium triphosphate,  $5\text{CaO}, 3\text{P}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ . (Schwarz, Z. anorg. 1895, 9. 264.)

**Calcium monometaphosphate,  $\text{Ca}(\text{PO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Maddrell, A. 61. 61.)

Not decomp. by digestion with alkali carbonates + Aq. (Fleitmann.)

**Calcium dimetaphosphate,  $\text{Ca}_2(\text{P}_2\text{O}_5)_2 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by warm  $\text{H}_2\text{SO}_4$ , but not appreciably by conc.  $\text{HCl}$  or  $\text{HNO}_3$  + Aq. (Fleitmann, Pogg. 78. 255.)

**Calcium hexametaphosphate (?).**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{Na}_2\text{P}_2\text{O}_7$  + Aq and in  $\text{HCl}$  + Aq. (Rose, Pogg. 76. 3.)

$\text{Ca}_3\text{P}_3\text{O}_{15}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Lüder, Z. anorg. 5. 15.)

**Calcium orthophosphate, basic,  $3\text{Ca}_3(\text{PO}_4)_2 + \text{CaO}, \text{H}_2$ .**

(Warrington, J. B. 1873. 253.)

$4\text{CaO}, \text{P}_2\text{O}_5$ . (Hilgenstock.)

**Calcium orthophosphates,**

Equilibrium in system  $\text{CaO} + \text{P}_2\text{O}_5 + \text{H}_2\text{O}$ .

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5$  + Aq at  $25^\circ$ .

g. CaO per l. of solution	g. $\text{P}_2\text{O}_5$ per l. of solution	Solid phase
1.71	4.69	} $\text{CaHPO}_4, 2\text{H}_2\text{O}$
7.48	22.39	
8.10	23.37	
11.57	36.14	
12.88	41.24	
18.77	59.35	
19.25	63.03	
23.31	75.95	
23.69	79.10	
32.41	109.8	
35.90	129.8	
39.81	139.6	
40.89	142.7	
43.82	154.6	
49.76	191.0	
55.52	216.5	
59.40	234.6	
70.31	279.7	
72.30	351.9	
69.33	361.1	} $\text{CaH}_4(\text{PO}_4)_3, \text{H}_2\text{O}$
65.46	380.3	
63.53	395.1	
59.98	419.7	
59.25	424.6	
57.74	428.0	
53.59	451.7	
48.78	475.3	
44.52	505.8	
41.86	528.9	
39.89	538.3	

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5$  + Aq at  $25^\circ$ .

g. CaO per l. of solution	g. $\text{P}_2\text{O}_5$ per l. of solution	Solid phase
7.61	19.96	} $\text{CaHPO}_4$
6.51	16.52	
5.01	12.82	
3.42	8.16	
2.42	5.75	
1.58	3.66	} Solid phases are evidently solid solutions
0.544	1.516	
0.400	1.108	
0.291	0.773	
0.232	0.662	
0.145	0.381	
0.062	0.109	
0.049	0.088	
0.034	0.015	
0.587	0.013	
0.789	0.012	} $\text{Ca}_3(\text{PO}_4)_2$ Solid phase is probably a solid solution

(Cameron and Seidell, J. Am. Chem. Soc. 1905, 27. 1513.)

Solubility of  $\text{CaO}$  in  $\text{P}_2\text{O}_5$  + Aq at  $50.7^\circ$ .

100 g. of the solution contain		Solid phase
g. $\text{P}_2\text{O}_5$	g. CaO	
62.01	0.336	} $\text{CaH}_2\text{P}_2\text{O}_7 + \text{CaH}_4\text{P}_2\text{O}_7, \text{H}_2\text{O}$
58.08	0.635	
54.67	0.939	} "
50.25	1.428	
46.15	2.100	} "
41.92	2.974	
37.33	3.898	} "
33.18	4.880	
29.61	5.725	} $\text{CaH}_2\text{P}_2\text{O}_7, \text{H}_2\text{O} + \text{CaHPO}_4$
15.48	3.507	
9.465	2.328	} $\text{CaHPO}_4$
6.157	1.563	
2.946	0.852	} "
2.281	0.692	
0.1521	0.0588	} "
0.1527	0.0596	
0.1331	0.0514	} $\text{CaHPO}_4, 2\text{H}_2\text{O}$
0.0942	0.0351	
0.0309	0.0106	} $\text{CaP}_2\text{O}_7, \text{H}_2\text{O}$
0.00068	0.00071	

(Bassett, Z. anorg. 1908, 59. 15.)

(Cameron and Seidell, J. Am. Chem. Soc. 1905, 27. 1508.)

Solubility of CaO in  $P_2O_5 + Aq$  at  $40^\circ$ .

100 g. of the solution contain		Solid phase
g. $P_2O_5$	g. CaO	
45.42	1.768	$CaH_4P_2O_8, H_2O$
41.33	2.588	
36.79	3.584	
32.46	4.505	
28.27	5.501	
21.67	4.813	$CaHPO_4$
17.78	4.100	
16.35	3.810	
9.905	2.536	
6.979	1.847	
4.397	1.267	$Ca_3P_2O_8, H_2O$
1.819	0.576	
0.423	0.156	
0.294	0.110	
0.158	0.0592	
0.146	0.0519	$Ca_4P_2O_8, 4H_2O$
0.128	0.0508	
0.0262	0.0098	
trace	0.0709	
"	0.0814	
"	0.0829	
"	0.0840	

(Bassett, Z. anorg. 1908, 59. 18.)

Solubility of CaO in  $P_2O_5 + Aq$  at  $25^\circ$ .

100 g. the solution contain		Solid phase
g. $P_2O_5$	g. CaO	
36.11	3.088	$CaH_4P_2O_8, H_2O$
31.97	4.128	
28.34	4.908	
27.99	4.930	
25.45	5.489	
22.90	5.523	$CaHPO_4$
17.55	4.499	
15.34	4.027	
9.10	2.638	
6.049	1.878	
3.613	1.181	$CaHPO_4 + CaHPO_4, 2H_2O$
2.387	0.826	
0.417	0.165	
0.178	0.0696	
0.0332	0.0126	
0.0948	0.0352	Probably $Ca_3P_2O_8, H_2O$
0.0571	0.0211	
0.0525	0.0175	
0.0468	0.0186	
trace	0.1131	
	0.118	$Ca_4P_2O_8, 4H_2O + Ca(OH)_2$ $Ca(OH)_2$

(Bassett, Z. anorg. 1908, 59. 20.)

Calcium orthophosphate,  $Ca_3(PO_4)_2$ .

Decomp. by long boiling with  $H_2O$  into basic salt,  $3Ca_3(PO_4)_2, CaO \cdot H_2$ . This decomp. begins with cold  $H_2O$ , so that the solubility at  $6-8^\circ$  varies from 9.9 to 28.6 mg. in a litre. (Warrington, Chem. Soc. (2) 11. 983.)

1 l. cold  $H_2O$  dissolves in 7 days 31 mg. ignited, and 79 mg. freshly precipitated  $Ca_3(PO_4)_2$ . (Völcker, J. B. 1863. 131.)

100,000 pts.  $H_2O$  dissolve 2.36 pts. gelatinous Ca phosphate; 2.56 pts. ignited Ca phosphate; 3.00 pts. Ca phosphate from bone dust. (Maly and Donath, J. pr. (2) 7. 416.)

Solubility of bones in various solvents is given by Maly and Donath, l. c.

0.009 g.  $Ca_3(PO_4)_2$  is sol. in 1 l.  $H_2O$ .  
0.153 " " " " " " " "

sat. with  $CO_2$ . (Joffre, Bull. Soc. 1898, (3) 19. 372.)

Determinations of solubility in  $H_2O$  as stated in the literature vary because  $Ca_3(PO_4)_2$  is apparently a solid solution of  $CaHPO_4$  and  $CaO$ . When placed in contact with  $H_2O$  more  $PO_4$  ions dissolve than Ca ions, the resulting solution is acid and solid phase richer in Ca than before addition of  $H_2O$ . For material of the approximate composition,  $Ca_3(PO_4)_2$ , the amt. dissolved by  $CO_2$  free  $H_2O$  at ord. temp. is 0.01–0.10 g. per l. depending on conditions of experiment.  $H_2O$  sat. with  $CO_2$  dissolves 0.15–0.30 g. per l. (Cameron and Hurst, J. Am. Chem. Soc. 1904, 26. 903.)

The decomposition of  $Ca_3(PO_4)_2$  in  $H_2O$  is increased by presence of  $CaSO_4$ ; decreased by presence of  $CaCO_3$  or of  $CaSO_4$  and  $CO_2$ .  $CO_2$  increases the amount of  $PO_4$  dissolved in the solution of water alone and the sat.  $CaSO_4$  solutions, but has no other effect than to increase the amount of Ca in the solutions in contact with  $CaCO_3$ . (Cameron and Seidell, J. Am. Chem. Soc. 1904, 26. 1458.)

Sol. in  $CO_2 + Aq$ .

1 l.  $H_2O$  containing 1 vol.  $CO_2$  dissolves in 12 hours at  $10^\circ$  0.75 g. precipitated  $Ca_3(PO_4)_2$ ; 0.166 g.  $Ca_3(PO_4)_2$  from bone ash; 0.300 g.  $Ca_3(PO_4)_2$  from bones which had been buried 20 years. (Lassaigne, J. ch. méd. (3) 3. 11.)

1 l.  $H_2O$  containing 0.8 vol.  $CO_2$  dissolves 0.61 g.  $Ca_3(PO_4)_2$ . (Liebig, A. 106. 196.)

$H_2O$  sat. with  $CO_2$  at  $5-10^\circ$  and 760 mm. pressure dissolves 0.527–0.60 g.  $Ca_3(PO_4)_2$ , or, if containing 1%  $NH_4Cl$ , 0.739 g.  $Ca_3(PO_4)_2$ . (Warrington, Chem. Soc. (2) 9. 80.)

Solubility varies according to form of  $Ca_3(PO_4)_2$ .

In apatite, 1 pt.  $Ca_3(PO_4)_2$  dissolves in 222,222 pts.  $H_2O$  sat. with  $CO_2$ ; in raw bones, in 5698 pts.; in bone ash, in 8029 pts.; in So. Carolina phosphate, in 6983 pts.; in phosphatic guano from Orchilla Id., in 8009 pts. (Williams, C. N. 24. 306.)

$Al_2O_3 \cdot H_2O$  and  $Fe_2O_3 \cdot H_2O$  prevent the solubility of  $Ca_3(PO_4)_2$  in  $H_2O$  containing  $CO_2$ . (Warrington, l. c.)

1 l.  $H_2O$  dissolves 0.22848 g.  $Ca_3(PO_4)_2$  under a  $CO_2$ -pressure of 2 atmos. at  $14^\circ$ . (Ehlert, Z. Elektrochem. 1912, 18. 728.)

Sol. in  $SO_2 + Aq$  forming a liquid of 1.3 sp. gr. at  $9^\circ$  from freshly precipitated  $Ca_3(PO_4)_2$ , and of 1.188 sp. gr. from bone ash,

Sol. in  $H_2S + Aq$ . 1 l.  $H_2O$  sat. with  $H_2S$

dissolves 190-240 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Béchamp, A. ch. (4) 16. 241.)

Easily sol. in  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ .

100 pts. very dil.  $\text{HCl} + \text{Aq}$  dissolve 198-225 pts.  $\text{Ca}_3(\text{PO}_4)_2$ . (Crum, A. 63. 294.)

100 pts.  $\text{HCl}$  of 1.153 sp. gr. (containing 31%  $\text{HCl}$ ) dissolve at  $17^\circ$  when diluted with:

0	1	4	7	pts. $\text{H}_2\text{O}$
25.3	45.0	62.3	64.7	pts. $\text{Ca}_3(\text{PO}_4)_2$
10	13	16	19	pts. $\text{H}_2\text{O}$
68.0	71.9	69.5	69.7	pts. $\text{Ca}_3(\text{PO}_4)_2$

(Bischof, Schw. J. 67. 39.)

Decomp. by  $\text{H}_2\text{SO}_4$ .

Completely decomp. to  $\text{CaSO}_4$  and  $\text{H}_3\text{PO}_4$  by a mixture of  $\text{H}_2\text{SO}_4$  and alcohol.

Solubility in  $\text{HNO}_3 + \text{Aq}$ .

1 pt. of  $\text{Ca}_3(\text{PO}_4)_2$  dissolves at  $16.25-17.5^\circ$  in pts.  $\text{HNO}_3 + \text{Aq}$  which contain pts.  $\text{H}_2\text{O}$  to 1 pt.  $\text{HNO}_3$  (sp. gr. = 1.23).

Pts. $\text{HNO}_3 + \text{Aq}$	Pts. $\text{H}_2\text{O}$	Pts. $\text{HNO}_3 + \text{Aq}$	Pts. $\text{H}_2\text{O}$
2.72	0	30.64	10.754
4.23	0.827	26.48	13
10.25	3.309	32.14	13.236
15.45	5.791	36.06	15.718
20.34	8.273	127.81	40
20.82	10	...	...

(Bischof, 1833.)

More sol. in acetic, lactic, malic, and tartaric acids than in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Crum.)

Solubility in  $\text{H}_3\text{PO}_4 + \text{Aq}$ .

G. $\text{H}_3\text{PO}_4$ in 100 cc. of $\text{H}_3\text{PO}_4 + \text{Aq}$	G. $\text{Ca}_3(\text{PO}_4)_2$ dissolved by 100 cc. of solvent
5	3.85
10	7.28
15	9.45
20	12.50
25	13.79
30	15.10

(Causse, C. R. 1892, 114. 414.)

Very small quantities of the salts of the alkali metals increase the solubility in  $\text{H}_2\text{O}$ . (Lassaigne, J. chim. méd. (3) 3. 11.)

1 litre cold  $\text{H}_2\text{O}$  with 2 g.  $\text{NaCl}$  dissolves 45.7 mg.  $\text{Ca}_3(\text{PO}_4)_2$ ; with 3 g.  $\text{NaNO}_3$ , 33 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Liebig.)

1 litre  $\text{H}_2\text{O}$  containing 8.75%  $\text{NaCl}$  dissolves 317.5 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Lassaigne.)

$\text{NH}_4$  salts have even more effect, especially  $\text{NH}_4\text{Cl} + \text{Aq}$ , which dissolves  $\text{Ca}_3(\text{PO}_4)_2$  in the cold; also ammonium nitrate and succinate. (Wittstein.)

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  dissolves  $\text{Ca}_3(\text{PO}_4)_2$  as easily as  $\text{CaSO}_4$ . (Liebig, A. 61. 128.)

1 litre  $\text{H}_2\text{O}$  containing 2 g.  $\text{NaCl}$  dissolves at  $7-12.3^\circ$  45.7 mg.  $\text{Ca}_3(\text{PO}_4)_2$ ; 3 g.  $\text{NaNO}_3$  at  $17.3^\circ$ , 33 mg.  $\text{Ca}_3(\text{PO}_4)_2$ ; 2.2 g.  $(\text{NH}_4)_2\text{SO}_4$ , 76.7 mg.  $\text{Ca}_3(\text{PO}_4)_2$ . (Liebig, A. 106. 185.)

Dry  $\text{Ca}_3(\text{PO}_4)_2$  also dissolves by long boiling with solutions of ammonium chloride, nitrate, succinate (Wittstein), or sulphate (Delkeskamp).

Sol. in 89,448 pts.  $\text{H}_2\text{O}$  (boiled) at  $7^\circ$ ; 19,628 pts.  $\text{H}_2\text{O}$  (boiled) containing 1%  $\text{NH}_4\text{Cl}$  at  $10^\circ$ ; 4324 pts.  $\text{H}_2\text{O}$  (boiled) containing 10%  $\text{NH}_4\text{Cl}$  at  $17^\circ$ ; 1788 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing 10%  $\text{NH}_4\text{Cl}$  at  $10^\circ$  and 751 mm. pressure; 1351 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing 1%  $\text{NH}_4\text{Cl}$  at  $12^\circ$  and 745 mm. pressure; 42,313 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing  $\text{CaCO}_3$  at  $21^\circ$  and 756.3 mm. pressure; 18,551 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  and containing  $\text{CaCO}_3$  and 1%  $\text{NH}_4\text{Cl}$  at  $16^\circ$  and 746.1 mm. pressure. (Warington, Chem. Soc. (2) 4. 296.)

Aqueous solutions of the following  $\text{NH}_4$  salts dissolve the given amts. of  $\text{Ca}_3(\text{PO}_4)_2$ , calculated for 100 pts. of the corresponding acid:  $\text{NH}_4\text{Cl}$ , 0.655 pt.;  $\text{NH}_4\text{NO}_3$ , 0.306 pt.;  $(\text{NH}_4)_2\text{SO}_4$ , 1.050 pts.;  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ , 0.255 pt.;  $\text{NH}_4$  tartrate, 4.56 pts.;  $\text{NH}_4$  citrate, 7.015 pts.;  $\text{NH}_4$  malate, 1.125 pts.  $\text{Ca}_3(\text{PO}_4)_2$ . (Terreil, Bull. Soc. (2) 35. 578.)

Solubility in various salts +  $\text{Aq}$  under a  $\text{CO}_2$  pressure of 2 atmospheres, at  $14^\circ$ .

Salt	G. salt per 100 g. $\text{H}_2\text{O}$	G. $\text{Ca}_3(\text{PO}_4)_2$ sol. in 1 l. of the solvent.
$\text{H}_2\text{O}$		0.22848
$\text{NaCl}$	50 conc.	1.3208 0.64089
$\text{MgCl}_2 + 6\text{H}_2\text{O}$	86.9 conc.	1.2873 2.8923
$\text{KMgCl}_2 + 6\text{H}_2\text{O}$	79.2 conc.	1.5771 1.1536
$\text{K}_2\text{SO}_4$ , $\text{MgSO}_4$ , $\text{MgCl}_2 + 6\text{H}_2\text{O}$	70.95 conc.	1.7777 2.4911
$\text{NaNO}_3$	72.7 conc.	1.5827 0.8638
$\text{K}_2\text{SO}_4$	74.5 conc.	4.9041 4.7649
$(\text{NH}_4)_2\text{SO}_4$	56.5 conc.	2.4131 5.8849
$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	137.7 conc.	2.4911 3.2267
$\text{MgSO}_4 + 7\text{H}_2\text{O}$	105.3 conc.	1.9728 3.6001
$\text{NH}_4\text{Cl}$	45.74 conc.	1.3710 1.2929

(Ehlert and Hempel, Z. Elektrochem. 1912, 18. 728.)

$\text{Ca}_3(\text{PO}_4)_2$  is sol. in  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq.}$  100 ccm.  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq.}$  ( $1\frac{1}{2}\%$   $\text{K}_2\text{C}_2\text{O}_4$ ) dissolves 57.1% of the  $\text{P}_2\text{O}_5$  from phosphorite, 71% from guano by boiling 25 min. At ord. temp. bone meal gives up 50–80% of its  $\text{P}_2\text{O}_5$  to  $\text{K}_2\text{C}_2\text{O}_4 + \text{Aq.}$  in 36 hours. (Liebig, Landw. J. B. 1881. 603.)

Sol. in  $\text{Ca}$  succrate +  $\text{Aq.}$  (Bobierre, C. R. 32. 859.)

More sol. in  $\text{H}_2\text{O}$  containing starch, glue, or other animal substances than in pure  $\text{H}_2\text{O}$ . (Vauquelin, Pogg. 85. 126.)

Sol. in  $\text{H}_2\text{O}$  containing organic matter, therefore when bones decay under  $\text{H}_2\text{O}$ ,  $\text{Ca}_3(\text{PO}_4)_2$  is dissolved in considerable quantity. (Hayes, Edin. Phil. J. 5. 378.)

Sol. in sodium citrate +  $\text{Aq.}$  (Spiller.)

Solubility in  $\text{NH}_4$  citrates +  $\text{Aq.}$

Ammonium citrate solution of 1.09 sp. gr. at 30–35° dissolves precipitated  $\text{Ca}_3(\text{PO}_4)_2$  completely, but not phosphorite. (Fresenius.)

Dried on the air, with  $2\frac{1}{3}\text{H}_2\text{O}$ . Sol. in 40 min. in diammonium citrate +  $\text{Aq.}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq.}$  (sp. gr. =

1.09) dissolves 55.3% of the  $\text{P}_2\text{O}_5$ ; citric acid +  $\text{Aq.}$  ( $\frac{1}{4}\%$ ) dissolves 83.8% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

Dried at 50°, with  $1\frac{1}{3}\text{H}_2\text{O}$ . Sol. in 45 min. in diammonium citrate +  $\text{Aq.}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq.}$  dissolves 52.3% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer.)

Ignited. Diammonium citrate +  $\text{Aq.}$  (sp. gr. 1.09) dissolves 93% of the  $\text{P}_2\text{O}_5$ ; triammonium citrate +  $\text{Aq.}$  (sp. gr. 1.09) dissolves 32% of the  $\text{P}_2\text{O}_5$ ; citric acid ( $\frac{1}{4}\%$ ) dissolves 53.4% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in alcohol and ether.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Min. *Apatite*.

0.002 g. is sol. in 1 l.  $\text{H}_2\text{O}$ .

0.014 " " " " 1 l.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ . (Joffre, Bull. Soc. 1898, (3) 19. 374.)

+  $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ , in  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ , and in  $\text{H}_2\text{O}$  containing  $\text{CO}_2 + \text{CaH}_2(\text{CO}_3)_2$ . Temp. 16°–20°.

Solvent		In 1 l. of the filtrate		
		P <sub>2</sub> O <sub>5</sub> mg.	CaO mg.	
(1)	Boiled distilled H <sub>2</sub> O.	0.74		
(2)	1200 cc. distilled H <sub>2</sub> O + 50 cc. H <sub>2</sub> O sat. with CO <sub>2</sub> .	6.9		
(3)	1000 cc. " " + 250 cc. " " " "	48.5		
(4)	1250 cc. H <sub>2</sub> O sat. with CO <sub>2</sub> .	91.9		
Solutions of CO <sub>2</sub> + CaH <sub>2</sub> (CO <sub>3</sub> ) <sub>2</sub> . 1 l. (filtered) contains:				
(5)	Calcium carbonate	13 mg.	0.38	100.0
	Bicarbonate	166 "		
	Carbonic acid	73 "		
	Free carbonic acid	9 "		
(6)	Calcium carbonate	13 "	1.1	162.3
	Bicarbonate	277 "		
	Carbonic acid	122 "		
	Free carbonic acid	49 "		
(7)	Calcium carbonate	13 "	0.80	218.8
	Bicarbonate	376 "		
	Carbonic acid	165 "		
	Free carbonic acid	105 "		
(8)	Calcium carbonate	13 "	1.77	273.3
	Bicarbonate	475 "		
	Carbonic acid	209 "		
	Free carbonic acid	206 "		
(9)	Calcium carbonate	13 "	1.30	312.7
	Bicarbonate	545 "		
	Carbonic acid	240 "		
	Free carbonic acid	301 "		

**Calcium hydrogen phosphate,  $\text{CaHPO}_4$ , and  $+2\text{H}_2\text{O}$ .**

Insol. or nearly so in  $\text{H}_2\text{O}$ . Gradually decomp. by cold, more quickly by hot  $\text{H}_2\text{O}$ .

1000 pts.  $\text{H}_2\text{O}$  dissolve 0.135–0.152 pt.  $\text{CaHPO}_4+2\text{H}_2\text{O}$ . Solution clouds up on boiling. (Birnbbaum.)

1000 pts.  $\text{H}_2\text{O}$  dissolve 0.28 pt., and if sat. with  $\text{CO}_2$ , 0.66 pt.  $\text{CaHPO}_4+2\text{H}_2\text{O}$ . (Dusart and Pelouze.)

When this salt dissolves in  $\text{H}_2\text{O}$ , decomp. takes place and a very considerable time is necessary to establish equilibrium. (Rindell, C. R. 1902, 134. 112.)

Much less decomp. by  $\text{H}_2\text{O}$  than  $\text{Ca}_3(\text{PO}_4)_2$  or  $\text{CaH}_2(\text{PO}_4)_2$ , and the decomposition of this salt in water depends only slightly upon the relative amounts of solid and solvent which are present. The decomposition is increased by the addition of  $\text{CO}_2$ . The presence of  $\text{CaSO}_4$  or of  $\text{CaCO}_3$  decreased the amount of phosphoric acid which dissolved. See original paper. (Cameron and Seidell, J. Am. Chem. Soc. 1904, 26. 1460.)

When the ratio of  $\text{P}_2\text{O}_5 : \text{CaO}$  is above 1.0 or below 1.27,  $\text{H}_2\text{O}$  dissolves 0.40–0.54 g.  $\text{CaO}$  and 1.11–1.52 g.  $\text{P}_2\text{O}_5$  (see original paper). (Cameron and Bell, J. Am. Chem. Soc. 1905, 27. 1512.)

**Solubility in  $\text{H}_3\text{PO}_4+\text{Aq}$ .**

G. $\text{H}_3\text{PO}_4$ in 100 cc. $\text{H}_3\text{PO}_4+\text{Aq}$	G. $\text{CaHPO}_4$ dissolved by 100 cc. of solvent
5	4.30
10	7.15
15	9.30
20	11.86
25	13.40
30	15.10

(Causse, C. R. 1892, 114. 415.)

1 l.  $\text{H}_2\text{O}$  containing 2.2 g.  $(\text{NH}_4)_2\text{SO}_4$ , 2 g.  $\text{NaCl}$ , or 3 g.  $\text{NaNO}_3$  dissolves 79.2, 66.3, or 78.9 mg.  $\text{CaP}_2\text{O}_7$ , which is present in form of  $\text{CaHPO}_4$ . (Liebig, A. 106. 185.) Slowly but completely sol. in boiling  $\text{NH}_4\text{Cl}+\text{Aq}$ . (Kraut, Arch. Pharm. (2) 111. 102.) Easily sol. in  $\text{H}_2\text{SO}_4+\text{Aq}$ . (Gerland, J. pr. (2) 4. 123.) Very sol. in  $\text{HCl}$  or  $\text{HNO}_3+\text{Aq}$ . Less sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ . (Berzelius.) More sol. in dil. than conc.  $\text{HC}_2\text{H}_3\text{O}_2+\text{Aq}$ , but 60 pts.  $\text{HC}_2\text{H}_3\text{O}_2$  (1 mol.) dissolve at most 23.1 pts.  $\text{P}_2\text{O}_5$  (1 mol. = 142 pts.) from this compound. Aqueous solution of sodium acetate dissolves more easily than  $\text{H}_2\text{O}$ , and becomes turbid on boiling. (Birnbbaum.)

Completely sol. in  $\text{K}_2\text{C}_2\text{O}_4+\text{Aq}$ . (Liebig, Landw. J. B. 1881. 603.)

1 l. of sat. solution in N/200 acid K tartrate +  $\text{Aq}$  at  $25^\circ$  contains 0.235 g.  $\text{CaHPO}_4$ .

Insol. in alcohol. Sol. in many organic substances, as starch or gelatine +  $\text{Aq}$ .

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

$+1/3\text{H}_2\text{O}$ . (Vorbringer, Z. anal. 9. 457.)

$+\text{H}_2\text{O}$ . (Gerlach, J. pr. (2) 4. 104.)

$+2\text{H}_2\text{O}$ . Min. *Brushite*.

$+3\text{H}_2\text{O}$ . Min. *Metabrushite*.

$+5\text{H}_2\text{O}$ . (Dusart, C. R. 66. 327.)

**Calcium tetrahydrogen orthophosphate,**

$\text{CaH}_4(\text{PO}_4)_2+\text{H}_2\text{O}$ .

Very deliquescent. Crystals take up 97.7 pts.  $\text{H}_2\text{O}$  in 16 days, and 226 pts.  $\text{H}_2\text{O}$  in 28 days from air saturated with moisture. (Birnbbaum, Zeit. Ch. (2) 7. 131.)

Not hygroscopic when pure. (Stocklassa, B. 23. 626 R.)

Completely sol. in 100 pts.  $\text{H}_2\text{O}$ , but decomp. by 10–40 pts.  $\text{H}_2\text{O}$  with separation of  $\text{CaHPO}_4$ , which slowly dissolves. (Erlenmeyer, J. B. 1873. 254.)

Later (B. 9. 1839) Erlenmeyer says  $\text{CaH}_4(\text{PO}_4)_2+\text{H}_2\text{O}$  is sol. in 700 pts.  $\text{H}_2\text{O}$  and decomp. into  $\text{CaHPO}_4$  by a less amount of  $\text{H}_2\text{O}$ . Wattenberg (Z. anal. 19. 243) says that the decomposition by small amts. of  $\text{H}_2\text{O}$  down to 144 pts.  $\text{H}_2\text{O}$  to 1 pt. salt is inappreciable.

Completely sol. in 200 pts.  $\text{H}_2\text{O}$  if pure, and in less  $\text{H}_2\text{O}$  in presence of  $\text{H}_3\text{PO}_4$ . (Stocklassa.)

Sol. in 25 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . Solution begins to decompose when warmed to  $50^\circ$ . (Otto, C. C. 1887. 1563.)

Greatly decomp. by  $\text{H}_2\text{O}$  and the resulting solution is to be regarded as a solution of the decomposition products rather than of the substance itself. The presence of an excess of  $\text{CaSO}_4$  does not materially affect the amount of phosphoric acid entering the solution. (Cameron, J. Am. Chem. Soc. 1904, 26. 1462.)

Violently decomp. by  $\text{H}_2\text{O}$  in conc. solution; only sl. decomp. when dissolved in 200 pts.  $\text{H}_2\text{O}$ . (Stocklassa, Z. anorg. 1892, 1. 310.)

**Solubility of  $\text{CaH}_4\text{P}_2\text{O}_7$  in  $\text{H}_3\text{PO}_4+\text{Aq}$  at pressure of 745 mm. at high temp.**

B. pt.	100 g. of the solution contain		Solid phase
	G. $\text{P}_2\text{O}_5$	G. $\text{CaO}$	
115°	43.60	5.623	$\text{CaH}_4\text{P}_2\text{O}_7, \text{H}_2\text{O}+\text{CaHPO}_4$
132°	53.43	4.327	$\text{CaH}_4\text{P}_2\text{O}_7+\text{CaH}_2\text{P}_2\text{O}_7, \text{H}_2\text{O}$
169°	63.95	4.489	$\text{CaH}_4\text{P}_2\text{O}_7$

(Bassett, Z. anorg. 1908, 59. 26.)

Glacial  $\text{HC}_2\text{H}_3\text{O}_2$  ppt. it completely from aqueous solution even in presence of  $\text{HNO}_3$ . (Persoz.)

Decomp. by 50 pts. absolute alcohol at b.-pt. in 1 hour; by 30 pts. in 2 hours. Sol. in absolute ether. (Erlenmeyer, l. c.)

**Calcium pyrophosphate,  $\text{Ca}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ ; completely sol. in mineral acids; less sol. in acetic acid, and insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq.}$  (Schwarzenberg, A. 65. 145.) Less sol. in warm than in cold acetic acid. (Baer, Pogg. 75. 155.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder, A. 41. 316.)

Insol. in  $\text{CaCl}_2 + \text{Aq.}$

Min. *Pyrophosphorite*.

**Calcium hydrogen pyrophosphate,  $\text{CaH}_2\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Pahl, B. 7. 478.)

$2\text{CaH}_2\text{P}_2\text{O}_7, \text{Ca}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$  into—

$\text{CaH}_2\text{P}_2\text{O}_7, \text{Ca}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ . Insol. in hot  $\text{H}_2\text{O}$ . (Knorre and Oppelt, B. 21. 771.)

**Tetracalcium hydrogen phosphate,**

$\text{Ca}_4\text{H}(\text{PO}_4)_3 + \text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith. Sol. in acids. (Warrington, Chem. Soc. (2) 4. 296.)

$+ 2\text{H}_2\text{O}$ .

**Calcium tetraphosphate,  $\text{Ca}_4\text{P}_4\text{O}_{13}$ .**

Insol. in acids when ignited. (Fleitmann and Henneberg, A. 65. 331.)

**Calcium lithium phosphate,  $\text{CaLiPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 77. 298.)

**Calcium potassium dimetaphosphate,**

$\text{CaK}_2(\text{P}_2\text{O}_5)_2 + 4\text{H}_2\text{O}$ .

As BaK comp. (Glatzel, Dissert. 1880.)

**Calcium potassium orthophosphate,  $\text{CaKPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 77. 291.)

Easily sol. in acids. (Ouvrard, A. ch. (6) 16. 308.)

**Calcium potassium pyrophosphate,  $\text{CaK}_2\text{P}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Ouvrard, C. R. 106. 1599.)

**Calcium sodium dimetaphosphate,**

$\text{CaNa}_2(\text{P}_2\text{O}_5)_2 + 4\text{H}_2\text{O}$ .

As BaNa comp. (Glatzel.)

**Calcium sodium trimetaphosphate,**

$\text{CaNaP}_3\text{O}_{10} + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Fleitmann, A. 65. 315.)

Easily sol. in  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{HCl} + \text{Aq}$  when heated to redness. Easily sol. in boiling  $\text{HCl} + \text{Aq}$  after being fused. (Lindbom.)

**Calcium sodium orthophosphate,  $\text{CaNaPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 77. 292.)

Easily sol. in dil. acids. (Ouvrard, A. ch. (6) 16. 308.)

$3\text{CaO}, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5$ . Sol. in dil. acids. (Ouvrard, C. R. 1888, 106. 1599.)

**Calcium sodium pyrophosphate,  $\text{CaNa}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq.}$  Easily sol. in  $\text{HCl} + \text{Aq.}$   $\text{HNO}_3 + \text{Aq.}$  and also in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (Baer, Pogg. 75. 159.)

$\text{Ca}_{10}\text{Na}_{18}(\text{P}_2\text{O}_7)_3$ . Sol. in acids. (Wallroth, Bull. Soc. (2) 39. 316.)

$3\text{CaO}, 3\text{Na}_2\text{O}, 2\text{P}_2\text{O}_5$ . Easily sol. in acids. (Ouvrard, A. ch. (6) 16. 307.)

**Calcium thorium metaphosphate,  $\text{ThO}_2, \text{CaO}, \text{P}_2\text{O}_5$ .**

(Colani, C. R. 1909, 149. 209.)

**Calcium uranous metaphosphate,  $\text{UO}_2, \text{CaO}, \text{P}_2\text{O}_5$ .**

Insol. in acids. (Colani, A. ch. 1907, (8) 12. 140.)

**Calcium uranyl phosphate,  $\text{Ca}(\text{UO}_2)_2\text{H}_2(\text{PO}_4)_2 + 2, 3, \text{ or } 4\text{H}_2\text{O}$ .**

Sol. in  $\text{HNO}_3 + \text{Aq.}$  (Debray.)

$\text{Ca}(\text{UO}_2)_2(\text{PO}_4)_2 + 8\text{H}_2\text{O}$ . Min. *Uranite*.

Sol. in  $\text{HNO}_3 + \text{Aq.}$   
 $3\text{CaO}, 5\text{UO}_3, 2\text{P}_2\text{O}_5 + 16\text{H}_2\text{O}$ . (Blinkoff, Dissert. 1900.)

**Calcium phosphate chloride,  $\text{Ca}_3(\text{PO}_4)_2, \text{CaCl}_2$ .**

(Deville and Caron, A. ch. (3) 67. 458.)

$3\text{Ca}_3(\text{PO}_4)_2, \text{CaCl}_2$ . *Chlorapatite*. Insol. in  $\text{H}_2\text{O}$ . (Daubrée, Ann. Min. (4) 19. 684.)

$7\text{CaH}_2(\text{PO}_4)_2, \text{CaCl}_2 + 14\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq.}$

$4\text{CaH}_2(\text{PO}_4)_2, \text{CaCl}_2 + 8\text{H}_2\text{O}$ .

$\text{CaH}_2(\text{PO}_4)_2, \text{CaCl}_2 + 2\text{H}_2\text{O}$ . Partly sol. in  $\text{H}_2\text{O}$  with decomp. Also with  $8\text{H}_2\text{O}$ . (Erlenmeyer, J. B. 1857. 145.)

**Calcium phosphate chloride fluoride,**

$3\text{Ca}_3(\text{PO}_4)_2, \text{CaClF}$ .

Min. *Apatite*. Boiling  $\text{H}_2\text{O}$  dissolves out  $\text{CaCl}_2$ ; dil. mineral acids dissolve easily, acetic acid with more difficulty. Easily soluble in molten  $\text{NaCl}$ , crystallizing on cooling. (Forchhammer.)

**Calcium phosphate silicate,  $\text{Ca}_3(\text{PO}_4)_2,$** 

$\text{Ca}_2\text{SiO}_4$ .

Insol. in  $\text{H}_2\text{O}$ ; decomp. by  $\text{HCl} + \text{Aq.}$  (Carnot and Richard, C. R. 97. 316.)

$4\text{Ca}_3(\text{PO}_4)_2, \text{Ca}_2\text{SiO}_4$ . (Bücking and Linck, C. C. 1887. 562.)

$4\text{Ca}_3(\text{PO}_4)_2, 3\text{Ca}_2\text{SiO}_4$ . (B. and L.)

$\text{Ca}(\text{PO}_3)_2, \text{CaSiO}_3$ . (Stead and Ridsdate, Chem. Soc. 51. 601.)

**Calcium dihydrogen phosphate sulphite,**

$\text{CaH}_2(\text{PO}_4)_2, \text{CaSO}_3 + \text{H}_2\text{O}$ .

Not decomp. by cold, slowly by boiling  $\text{H}_2\text{O}$ . Slightly sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in mineral acids. Insol. in cold, slowly sol. in boiling acetic acid. More sol. in a solution of oxalic acid. (Gerland, C. N. 20. 268.)

**Cerous metaphosphate,  $\text{Ce}(\text{PO}_3)_2$ .**

(Rammelsberg.)

 $\text{Ce}_2\text{O}_3$ ,  $5\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$  or acids. (Johnsson, B. 22. 976.)**Cerous orthophosphate,  $\text{CePO}_4$ .**Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Grandeau, A. ch. (6) 8. 193.)

Insol. in acids. (Hartley, Proc. Roy. Soc. 41. 202.)

 $+2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Jolin.)Insol. in  $\text{H}_3\text{PO}_4$ +Aq; sl. sol. in  $\text{HCl}$  or  $\text{HNO}_3$ +Aq. (Hisinger.)Insol. in  $\text{HNO}_3$ +Aq. (Boussingault, A. ch. (5) 5. 178.)Min. *Cryptolite*. Completely decomp. by  $\text{H}_2\text{SO}_4$  when finely powdered. Insol. in dil.  $\text{HNO}_3$ +Aq.**Ceric orthophosphate,  $4\text{CeO}_3$ ,  $6\text{P}_2\text{O}_5$ + $26\text{H}_2\text{O}$ .**

Ppt. (Hartley, Proc. Roy. Soc. 41. 202.)

**Cerous pyrophosphate,  $\text{Ce}_2\text{H}_2(\text{P}_2\text{O}_7)_2$ + $6\text{H}_2\text{O}$ .**

Sol. in cerous nitrate+Aq.

 $\text{Ce}_2(\text{P}_2\text{O}_7)_2$ + $12\text{H}_2\text{O}$ . Sol. in excess of sodium pyrophosphate+Aq. Easily sol. in  $\text{HCl}$ . (Rosenheim, B. 1915, 48. 592.)**Cerous lanthanum thorium phosphate,** $(\text{Ce}, \text{La}, \text{Th})_2(\text{PO}_4)_2$ .Min. *Monazite*. Sol. in  $\text{HCl}$ +Aq with white residue.**Cerous potassium orthophosphate,  $2\text{Ce}_2\text{O}_3$ ,** $3\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ = $2\text{CePO}_4$ ,  $\text{K}_3\text{PO}_4$ .Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Ouvrard, C. R. 107. 37.)**Cerous sodium orthophosphate,  $\text{Ce}_2\text{O}_3$ ,  $3\text{Na}_2\text{O}$ ,** $2\text{P}_2\text{O}_5$ = $\text{CePO}_4$ ,  $\text{Na}_3\text{PO}_4$ .Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)**Cerous sodium pyrophosphate,  $\text{CeNaP}_2\text{O}_7$ .**

Insol. in acetic, and cold dil. mineral acids. Sol. in warm acids. (Wallroth.)

**Chromous phosphate,  $\text{Cr}_2(\text{PO}_4)_2$ .**Insol. in  $\text{H}_2\text{O}$ . Easily sol. in citric, tartaric and acetic acids. Sl. sol. in  $\text{H}_2\text{CO}_3$ +Aq. (Moissan, A. ch. 1882, (5) 25. 415.) $+ \text{H}_2\text{O}$ . Precipitate. Easily sol. in acids. (Moberg; Moissan, A. ch. (5) 21. 199.)**Chromic metaphosphate,  $\text{Cr}_2(\text{PO}_3)_2$ .**Insol. in  $\text{H}_2\text{O}$  or conc. acids. (Maddrell, A. 61. 53.)**Chromic orthophosphate,  $\text{CrPO}_4$ .**Hydrolyzed by hot  $\text{H}_2\text{O}$ . Somewhat sol. in  $\text{NH}_4\text{OH}$ +Aq and in  $\text{Cr}_2(\text{SO}_4)_3$ +Aq. (Caven, J. Soc. Chem. Ind. 1897, 16. 29.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Chromic phosphate,  $\text{Cr}_2(\text{PO}_4)_3$ + $12\text{H}_2\text{O}$ .***Violet modification*. Precipitate. (Rammelsberg, Pogg. 68. 383.) $+6\text{H}_2\text{O}$ . *Green modification*. Very sl. sol. in  $\text{H}_2\text{O}$  and still less in  $\text{NH}_4\text{NO}_3$  or  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ +Aq. (Carnot, C. R. 94. 1313.)Insol. in acetic, but easily sol. in mineral acids. Easily sol. in cold  $\text{KOH}$  or  $\text{NaOH}$ +Aq, from which it is separated on boiling. (Dowling and Plunkett, Chem. Gaz. 1858. 220.)**Chromic hydrogen phosphate,  $\text{Cr}_2\text{H}_4(\text{PO}_4)_4$ + $16\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Haushofer.)**Chromic pyrophosphate,  $\text{Cr}_4(\text{P}_2\text{O}_7)_2$ .***Anhydrous*. Insol. in  $\text{H}_2\text{O}$  or acids. (Ouvrard, A. ch. (6) 16. 344.) $+7\text{H}_2\text{O}$ . Precipitate. Sol. in strong mineral acids,  $\text{SO}_3$ +Aq,  $\text{KOH}$ +Aq, and  $\text{Na}_3\text{P}_2\text{O}_7$ +Aq. (Schwarzenberg, A. 65. 149.)Insol. in  $\text{Na}_3\text{P}_2\text{O}_7$ +Aq. (Stromeyer.)**Chromic potassium phosphate,  $\text{Cr}_2\text{O}_3$ ,  $\text{K}_2\text{O}$ ,** $2\text{P}_2\text{O}_5$ .Insol. in  $\text{H}_2\text{O}$  and in acids. (Ouvrard, A. ch. (6) 16. 289.)**Chromic potassium pyrophosphate,** $\text{K}(\text{CrP}_2\text{O}_7)$ + $5\text{H}_2\text{O}$ .Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 586.) $\text{Cr}_2\text{K}_2\text{H}_4(\text{P}_2\text{O}_7)_2$ . Insol. in  $\text{H}_2\text{O}$ , acids, or alkalis. Sl. decomp. by boiling conc.  $\text{H}_2\text{SO}_4$ . (Schjerning, J. pr. (2) 45. 515.)**Chromic silver phosphate,  $2\text{Cr}_2\text{O}_3$ ,  $2\text{Ag}_2\text{O}$ ,** $5\text{P}_2\text{O}_5$ .

(Hautefeuille and Margottet, C. R. 96. 1142.)

**Chromic sodium orthophosphate,  $\text{Na}_2\text{HPO}_4$ ,** $2\text{CrPO}_4$ + $5\text{H}_2\text{O}$ .Decomp. by  $\text{H}_2\text{O}$ . (Cohen, J. Am. Chem. Soc. 1907, 29. 1197.)**Chromic sodium pyrophosphate,** $\text{Cr}_2\text{Na}_2(\text{P}_2\text{O}_7)_2$ .

Insol. in acids. (Wallroth, Bull. Soc. (2) 39. 316.)

 $+10\text{H}_2\text{O}$ , and  $16\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 586.)**Cobaltous monometaphosphate,  $\text{Co}(\text{PO}_3)_2$ (?).**Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{HCl}$ +Aq. (Maddrell, A. 58. 61.)



**Cobaltous dimetaphosphate,  $\text{Co}_2(\text{P}_2\text{O}_5)_2$ .**

Insol. in cold conc.  $\text{H}_2\text{SO}_4$ ; sl. sol. on warming, but sol. in  $\text{H}_2\text{O}$  after treating with  $\text{H}_2\text{SO}_4$ . Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq.}$  Scarcely attacked by boiling  $\text{Na}_2\text{S} + \text{Aq.}$  (Fleitmann.)

**Cobaltous hexametaphosphate (?).**

Ppt. Sol. in sodium hexametaphosphate +  $\text{Aq.}$  (Rose; Pogg. 76. 4.)

**Cobaltous orthophosphate,  $\text{Co}_2(\text{PO}_4)_2 + x\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{PO}_4 + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ ; sl. sol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Salvetat, C. R. 48. 295.) Sol. in Co salts +  $\text{Aq.}$  +  $2\text{H}_2\text{O}$ . (Debray, A. ch. (3) 61. 438.) +  $8\text{H}_2\text{O}$ . (Reynoso, C. R. 34. 795.)

**Cobaltous hydrogen orthophosphate,  $\text{CoHPO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .**

Ppt. (Debray.) +  $2\frac{1}{2}\text{H}_2\text{O}$ . Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{PO}_4 + \text{Aq.}$  (Bödeker, A. 94. 357.)

**Cobaltous tetrahydrogen orthophosphate,  $\text{CoH}_4(\text{PO}_4)_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Reynoso.)

**Cobaltous pyrophosphate.**

Ppt. Sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq.}$  (Stromeyer.) Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Schwarzenberg.)

**Cobaltous pyrometaphosphate,  $3\text{CoO}, 2\text{P}_2\text{O}_5$ .**

(Braun.)

$6\text{CoO}, 5\text{P}_2\text{O}_5$ . (Braun.)

**Cobaltous potassium phosphate,  $\text{CoKPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Ouvrard, C. R. 106. 1729.)  $3\text{CoO}, 3\text{K}_2\text{O}, 2\text{P}_2\text{O}_5$ . As above.

**Cobaltous sodium triphosphate,  $\text{NaCo}_2\text{P}_3\text{O}_{10}$ .**

(Schwarz, Z. anorg. 1895, 9. 260.)  $\text{Na}_2\text{CoP}_3\text{O}_{10} + 12\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ ; decomp. in aq. solution. Sol. in acids. (Schwarz, Z. anorg. 1895, 9. 258.)

**Cobaltous sodium metaphosphate,  $\text{Co}_2\text{Na}_2(\text{PO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or acids, even conc.  $\text{H}_2\text{SO}_4$ . (Watts' Dict.)

**Cobaltous sodium monometaphosphate,  $6\text{Co}(\text{PO}_3)_2, 2\text{NaPO}_3$ .**

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, A. 61. 57.)

**Cobaltous sodium trimetaphosphate,  $\text{CoNa}_4(\text{PO}_3)_3 + 8\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, A. 65. 315.)

**Cobaltous sodium orthophosphate,  $\text{CoNaPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 106. 1729.)  $\text{Co}_2(\text{PO}_4)_2, 2\text{Na}_2\text{HPO}_4 + 8\text{H}_2\text{O}$ . (Debray, J. Pharm. (3) 46. 119.)

**Cobaltous sodium pyrophosphate,  $\text{Co}_2\text{Na}_2(\text{P}_2\text{O}_7)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Wallroth.) +  $x\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Stromeyer.)

**Cobaltous zinc phosphate,  $\text{Co}_2(\text{PO}_4)_2, 3\text{Zn}_2(\text{PO}_4)_2 + 12\text{H}_2\text{O}$ .**

Ppt. Sol. in acids. (Gentile.)  $\text{CoZn}_2(\text{PO}_4)_2 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

**Columbium phosphate (?).**

Insol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

**Cupric dimetaphosphate,  $\text{Cu}_2(\text{P}_2\text{O}_5)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, A. 61. 62.) Insol. in most conc. acids and in alkalis, except hot  $\text{NH}_4\text{OH} + \text{Aq}$  or conc.  $\text{H}_2\text{SO}_4$ , in which it is moderately sol. Not decomp. by  $\text{H}_2\text{S}$ , but by  $(\text{NH}_4)_2\text{S} + \text{Aq}$ , less easily by  $\text{Na}_2\text{S}$ , and  $\text{K}_2\text{S} + \text{Aq}$ . (Fleitmann, Pogg. 78. 242.) +  $8\text{H}_2\text{O}$ . Completely insol. in  $\text{H}_2\text{O}$ . (Fleitmann.)

**Cupric hexametaphosphate (?).**

Sol. in  $\text{Na}_2\text{P}_6\text{O}_{18} + \text{Aq}$  or  $\text{CuCl}_2 + \text{Aq}$ . (Rose, Pogg. 76. 5.)  $\text{Cu}_2\text{P}_6\text{O}_{18}$ . Easily sol. in  $\text{H}_2\text{O}$  or acids, especially when freshly pptd. (Lüder, Z. anorg. 5. 15.)

**Cupric orthophosphate, basic,  $6\text{CuO}, \text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Min. *Phosphocalcite*.  $5\text{CuO}, \text{P}_2\text{O}_5 + 2\text{H}_2\text{O}$ . Min. *Dihydrate*. +  $3\text{H}_2\text{O}$ . Min. *Ektis*. Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  and  $\text{HNO}_3 + \text{Aq}$ .  $4\text{CuO}, \text{P}_2\text{O}_5 + \text{H}_2\text{O}$ . Slowly sol. in  $\text{NH}_4\text{OH}$  or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ ; insol. in cold  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Steinschneider, C. C. 1891, II. 51.) Sl. sol. in  $\text{CuCl}_2 + \text{Aq}$  and  $\text{CaSO}_4 + \text{Aq}$ . Decomp. by boiling  $\text{H}_2\text{O}$  and boiling  $\text{Aq}$  potash. (Caven, J. Soc. Chem. Ind. 1897, 16. 29.)

Min. *Libethenite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ . +  $2\text{H}_2\text{O}$ . Min. *Pseudolibethenite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ . +  $3\text{H}_2\text{O}$ . Min. *Tagikite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Cupric triphosphate,  $5\text{CuO}, 3\text{P}_2\text{O}_5 + 13\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . (Schwarz, Z. anorg. 1895, 9. 262.)

**Cupric dimetaphosphate,  $\text{CuP}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

Sol. in 78 pts.  $\text{H}_2\text{O}$ . Easily decomp. by hot conc.  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1890.)

**Cupric trimetaphosphate**,  $\text{Cu}_3(\text{P}_3\text{O}_9)_2 + 9\text{H}_2\text{O}$ .  
Very sl. sol. in  $\text{H}_2\text{O}$  (0.04 g. in 1 l. at  $20^\circ$ ).  
(Tammann, J. pr. 1892, (2) 45. 425.)

**Cupric tetrametaphosphate**,  $\text{Cu}_2\text{P}_4\text{O}_{12}$ .  
Insol. in  $\text{H}_2\text{O}$  and in  $\text{HCl}$ . Sl. sol. in boiling  $\text{HNO}_3$ . Very sol. in boiling conc.  $\text{H}_2\text{SO}_4$ .  
(Glatzel.)  
+  $8\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Slowly attacked by acids except conc.  $\text{H}_2\text{SO}_4$ .  
(Glatzel.)

**Cupric orthophosphate**,  $\text{Cu}_3(\text{PO}_4)_2 + 3\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids, even  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Sl. sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ .  
Sl. sol. in  $\text{Cu}$  salts +  $\text{Aq}$ . (Rose, Pogg. 76. 25.)

Sol. in cold  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ . (Steinschneider, C. C. 1891, II, 51.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 827.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Cupric hydrogen phosphate**,  $\text{CuHPO}_4 + 1\frac{1}{2}\text{H}_2\text{O} (?)$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ , and  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Insol. in  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett, Phil. Mag. (3) 10. 98.)

**Cupric pyrophosphate, basic**,  $\text{Cu}_2\text{P}_2\text{O}_7$ ,  $2\text{CuO}$ ,  $\text{H}_2\text{O} + 3\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Pahl, J. B. 1873. 229.)

**Cupric pyrophosphate**,  $\text{Cu}_2\text{P}_2\text{O}_7$ .

*Anhydrous*. Insol. in  $\text{H}_2\text{O}$ , and very sl. sol. in conc. acids. (Fleitmann, Pogg. 78. 244.)

As insol. as  $\text{Cu}$  metaphosphate, but decomp. by  $\text{H}_2\text{S}$ . (Rose, Pogg. 76. 14.)

+  $2\text{H}_2\text{O}$ . Sol. in mineral acids, and  $\text{NH}_4\text{OH} + \text{Aq}$ ; also in  $\text{Na}_2\text{F}_2\text{O}_7 + \text{Aq}$ . (Schwarzenberg, A. 65. 156.)

Sol. in cold  $\text{H}_2\text{SO}_4 + \text{Aq}$  without decomp., crystallizing out on boiling.

Decomp. by boiling  $\text{KOH} + \text{Aq}$ .

Sol. in large excess of  $\text{CuSO}_4 + \text{Aq}$ .

+  $2\frac{1}{2}\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7. 40.)

+  $5\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ .

Sol. in dil. acids. (Wiesler, Z. anorg. 1901, 28. 202.)

**Cupric iron (ferric) pyrophosphate**,  $\text{Cu}_2\text{Fe}_2(\text{P}_2\text{O}_7)_2 + 12\text{H}_2\text{O}$ .

Ppt. (Pascal, C. R. 1908, 146. 233.)

**Cupric potassium phosphate**,  $4\text{CuO}$ ,  $\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 111. 177.)

$\text{CuKPO}_4$ . As above.

**Cupric potassium tetrametaphosphate**,  $\text{K}_2\text{CuP}_4\text{O}_{12} + 4\text{H}_2\text{O}$ .

Sol. in 58 pts.  $\text{H}_2\text{O}$ . Easily attacked by acids. (Glatzel, Dissert. 1880.)

**Cupric potassium pyrophosphate**,  $\text{CuK}_2\text{P}_2\text{O}_7$ .  
Extremely easily sol. in  $\text{H}_2\text{O}$ . (Persoz, A. ch. (3) 20. 315.)

$\text{Cu}_2\text{P}_2\text{O}_7$ ,  $3\text{K}_2\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7. 44.)

**Cupric sodium phosphate**,  $\text{Cu}_2\text{Na}_6(\text{PO}_4)_4$ .

Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Sol. in conc. acids. (Wallroth, Bull. Soc. (2) 39. 316.)

**Cupric sodium triphosphate**,

$\text{CuNa}_2\text{P}_3\text{O}_{10} + 12\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; very unstable.  
Easily sol. in acids. (Stange, Z. anorg. 1896, 12. 458.)

**Cupric sodium tetrametaphosphate**,

$\text{CuNa}_2\text{P}_4\text{O}_{12}$ .

As insol. in  $\text{H}_2\text{O}$  as  $\text{Cu}$  dimetaphosphate. Difficultly decomp. by digestion with  $\text{Na}_2\text{S} + \text{Aq}$ . (Fleitmann, Pogg. 78. 355.)

+  $4\text{H}_2\text{O}$ . Sol. in 45 pts.  $\text{H}_2\text{O}$ . (Glatzel, Dissert. 1880.)

**Cupric sodium orthophosphate**,  $3\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{NaH}_2\text{PO}_4$ .

Decomp. by  $\text{H}_2\text{O}$  to  $4\text{CuO}$ ,  $\text{P}_2\text{O}_5$ . (Steinschneider, C. C. 1891, II. 52.)

$2\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{Na}_2\text{HPO}_4$ . Decomp. by  $\text{H}_2\text{O}$  into—

$3\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{Na}_2\text{HPO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (S.)

$\text{Cu}_3(\text{PO}_4)_2$ ,  $\text{NaH}_2\text{PO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (S.)

$6\text{Cu}_3(\text{PO}_4)_2$ ,  $2\text{Na}_2\text{PO}_4$ . Decomp. by  $\text{H}_2\text{O}$ . (S.)

**Cupric sodium pyrophosphate**,  $\text{CuNa}_2\text{P}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, A. 65. 387.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . (F. and H.) Much more sol. than the next salt. (Pahl.)

+  $6\text{H}_2\text{O}$ . (Persoz, A. ch. (3) 20. 315.)

$\text{Cu}_2\text{P}_2\text{O}_7$ ,  $\text{CuNa}_2\text{P}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$ . Very efflorescent; insol. in  $\text{H}_2\text{O}$ . (F. and H.)

+  $10\frac{1}{2}\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7. 42.)

$\text{CuNa}_2\text{P}_2\text{O}_7$ ,  $\text{Na}_2\text{P}_2\text{O}_7$ . Sol. in  $\text{H}_2\text{O}$ . (F. and H.)

+  $2\text{H}_2\text{O}$ . (F. and H.)

+ 12, and  $16\text{H}_2\text{O}$ . Very efflorescent, and sol. in  $\text{H}_2\text{O}$ . (Pahl.)

$\text{Cu}_2\text{Na}_2\text{P}_2\text{O}_{14} + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$  and  $\text{HNO}_3$ , even after heating. (Stange, Z. anorg. 1896, 12. 456.)

**Cupric uranyl phosphate**,  $(\text{UO}_2)_2\text{Cu}(\text{PO}_4)_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Debray.)

Min. *Chalcotite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

**Cupric orthophosphate ammonia**,  $\text{Cu}_2(\text{PO}_4)_2 \cdot 4\text{NH}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$ . (Schiff, A. 123. 41.)

$2\text{CuO}$ ,  $3\text{P}_2\text{O}_5$ ,  $20\text{NH}_3 + 21\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ , with subsequent decomp. (Metaner, A. 149. 66.)

$2\text{CuO}$ ,  $\text{P}_2\text{O}_5$ ,  $6\text{NH}_3$ . (Maumené.)

**Cupric pyrophosphate ammonia**,  $8\text{CuO}$ ,  $3\text{P}_2\text{O}_5$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Schwarzenberg, A. 65. 133.)

$\text{Cu}_2\text{P}_2\text{O}_7$ ,  $4\text{NH}_3 + \text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 123. 1.)

**Didymium metaphosphate**,  $\text{Di}(\text{PO}_3)_2$ .

Precipitate. (Smith.)

$\text{Di}_2\text{O}_3$ ,  $5\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Didymium phosphate**,  $2\text{Di}_2\text{O}_3$ ,  $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

**Didymium orthophosphate**,  $\text{DiPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in dil., easily sol. in conc. acids. (Marignac.) Insol. in  $\text{H}_2\text{O}$ . (Wallroth, Bull. Soc. (2) 39. 316.)

$+ \text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 355.)

**Didymium trihydrogen phosphate**,

$\text{Di}_2\text{H}_3(\text{PO}_4)_3$ .

Precipitate. (Frerichs and Smith.)

Existence is doubtful. (Cleve, B. 12. 910.)

**Didymium hexahydrogen phosphate**,

$\text{DiH}_6(\text{PO}_4)_3 + \text{H}_2\text{O}$ .

Precipitate. (Hermann.)

**Didymium pyrophosphate**,  $\text{Di}_4(\text{P}_2\text{O}_7)_2 + 6\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

**Didymium hydrogen pyrophosphate**,

$\text{Di}_2\text{H}_5(\text{P}_2\text{O}_7)_2$ .

Precipitate. Sol. in disodium pyrophosphate + Aq. (Frerichs and Smith, A. 191. 355.)

Does not exist. (Cleve.)

**Didymium potassium phosphate**,  $2\text{Di}_2\text{O}_3$ ,

$3\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 = 2\text{DiPO}_4$ ,  $\text{K}_4\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

**Didymium sodium orthophosphate**,  $\text{Di}_2\text{O}_3$ ,

$3\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5 = \text{DiPO}_4$ ,  $\text{Na}_2\text{PO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard.)

**Didymium sodium pyrophosphate**,  $\text{Di}_2\text{O}_3$ ,

$\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5 = \text{DiNaP}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 107. 37.)

**Dysprosium orthophosphate**,  $\text{DyPO}_4 + 5\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

Easily sol. in dil. acids or acetic acid. (Jantsch, B. 1911, 44. 1276.)

**Erbium phosphate**,  $\text{ErPO}_4 + \text{H}_2\text{O}$ .

Precipitate.

**Erbium pyrophosphate**,  $\text{ErHP}_2\text{O}_7 + 3\frac{1}{2}\text{H}_2\text{O}$ .

Scarcely sol. in boiling  $\text{H}_2\text{O}$ . Slowly sol. in acids.

**Erbium sodium pyrophosphate**,  $\text{ErNaP}_2\text{O}_7$ .

Precipitate. (Wallroth.)

**Glucinum metaphosphate**,  $\text{Gl}(\text{PO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$  and acids. (Bleyer, Z. anorg. 1912, 79. 274.)

**Glucinum orthophosphate, basic**.

$2\text{Gl}_2\text{P}_2\text{O}_5$ ,  $\text{GlO} + 13\text{H}_2\text{O}$ .

Ppt. (Bleyer, Z. anorg. 1912, 79. 268.)

**Glucinum orthophosphate**,  $\text{Gl}_2(\text{PO}_4)_2 + 6\text{H}_2\text{O}$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Atterberg, Sv. V. A. Handl. 12, 5. 33.)

1 l. 2%  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves 0.55 g. of the anhydrous salt; 1 l. 10%  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves 1.725 g. (Sestini, Gazz. ch. it. 20. 313.)

$+ 7\text{H}_2\text{O}$ . (Atterberg.)

**Glucinum hydrogen orthophosphate**,  $\text{GlHPO}_4 + 3\text{H}_2\text{O}$ .

$\text{GlH}_4(\text{PO}_4)_2$  hygroscopic. (Bleyer, Z. anorg. 1912, 79. 266.)

Precipitated by alcohol. (Atterberg.)

**Glucinum phosphate**,  $5\text{GlO}$ ,  $2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ .

Ppt. Sol. in  $\text{H}_2\text{O}$  with decomp. (Scheffer.)  $3\text{GlO}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{H}_2\text{O} + \text{H}_2\text{O}$ . (Sestini, Gazz. ch. it. 20. 313.)

**Glucinum pyrophosphate**,  $\text{Gl}_2\text{P}_2\text{O}_7 + 5\text{H}_2\text{O}$ .

Precipitate. (Scheffer.)

Sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ . (Stromeyer.)

**Glucinum potassium phosphate**,  $\text{GlKPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 110. 1333.)

**Glucinum sodium phosphate**,  $\text{GlNaPO}_4$ .

Sl. sol. in cold, easily sol. in hot acids. (Wallroth.) Insol. in acetic acid.

Min. *Beryllonite*.

$\text{GlO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 110. 1333.)

**Gold (Auric) sodium pyrophosphate (?)**,

$\text{Au}_2(\text{P}_2\text{O}_7)_2$ ,  $2\text{Na}_4\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Persoz.)

**Gold sodium pyrophosphate, ammonia,**  
 $14\text{Au}_2\text{O}_3, 6\text{P}_2\text{O}_5, 3\text{Na}_2\text{O}, 14\text{NH}_3 + 24\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17. 172.)

**Iron (ferrous) trimetaphosphate,  $\text{Fe}(\text{P}_3\text{O}_9)_2 + 12\text{H}_2\text{O}$ .**

Rather sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . After ignition sol. in  $\text{HCl} + \text{Aq}$  only after long boiling. (Lindbom, Acta Lund. 1878. 17.)

**Ferrous hexametaphosphate,  $\text{Fe}_3\text{P}_6\text{O}_{18}$ .**

When freshly pptd. is sol. in  $\text{H}_2\text{O}$ , and very sol. in least traces of acids, or  $\text{Na}_2\text{P}_6\text{O}_{18} + \text{Aq}$ . (Lüdt, Z. anorg. 5. 15.)

**Ferrous phosphate, basic,  $7\text{FeO}, 2\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$ .**

Min. *Ludlamite*. Sol. in dil.  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Decomp. by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ .

**Ferrous orthophosphate,  $\text{Fe}_3(\text{PO}_4)_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids.  
 Sol. in 1000 pts.  $\text{H}_2\text{O}$  containing more than 1 vol.  $\text{CO}_2$ . (Pierre.)

Sol. in an excess of ferrous salts +  $\text{Aq}$ .  
 Sol. in 560 pts.  $\text{H}_2\text{O}$  containing  $\frac{1}{100}$  pt.  $\text{HC}_2\text{H}_3\text{O}_2$ . Sol. in 1666 pts.  $\text{H}_2\text{O}$  containing 150 pts.  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ . (Pierre, A. ch. (3) 36. 78.)

Sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ .  
 Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Not pptd. in presence of  $\text{Na}$  citrate.

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+  $\text{H}_2\text{O}$ . (Debray, A. ch. (3) 61. 437.)  
 +  $8\text{H}_2\text{O}$ . Min. *Vivianite*. Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Boiling  $\text{KOH} + \text{Aq}$  dissolves out phosphoric acid. Sol. in cold citric acid +  $\text{Aq}$ . (Bolton, C. N. 37. 14.)

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Evans, C. C. 1897, I. 580.)

**Ferrous hydrogen orthophosphate,  $\text{FeHPO}_4 + \text{H}_2\text{O}$ .**

Ppt. (Debray, A. ch. (3) 61. 437.)  
 Is impure  $\text{Fe}_3(\text{PO}_4)_2$ . (Erlenmeyer and Heinrichs, A. 194. 176.)

**Ferrous tetrahydrogen orthophosphate,  $\text{FeH}_4(\text{PO}_4)_3 + \text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Not changed by alcohol. (Erlenmeyer and Heinrichs, A. 194. 176.)

**Ferrous pyrophosphate.**

Ppt. Sol. in an excess of  $\text{Na}_2\text{P}_2\text{O}_7$  or  $\text{FeSO}_4 + \text{Aq}$ . (Schwarzenberg, A. 65. 153.)

**Ferric metaphosphate,  $\text{Fe}_3(\text{PO}_3)_3$  or  $\text{Fe}(\text{PO}_3)_3$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, Phil. Mag. (3) 30. 322.)

**Iron (ferric) orthophosphate, basic,  $2\text{Fe}_2\text{O}_3, \text{P}_2\text{O}_5 + x\text{H}_2\text{O}$ .**

Insol. in  $\text{NH}_4$  citrate, sol. in  $\text{NH}_4$  tartrate +  $\text{Aq}$ . (Wittstein.)

+  $3\text{H}_2\text{O}$ . Min. *Krawietzite*. Easily sol. in  $\text{HCl} + \text{Aq}$ .

+  $4\text{H}_2\text{O}$ . Ppt. (Millot, C. R. 82. 89.)

+  $5\text{H}_2\text{O}$ . Min. *Dufrenoyite*.  
 +  $12\text{H}_2\text{O}$ . Min. *Cacoxene*. Sol. in  $\text{HCl} + \text{Aq}$ .

+ 18, or  $24\text{H}_2\text{O}$ . Min. *Delvauxite*.  
 $5\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 14\text{H}_2\text{O}$ . Min. *Beraunite*.

Sol. in  $\text{HCl} + \text{Aq}$ .

$3\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Min. *Eleonorite*.  
 Sol. in  $\text{HCl} + \text{Aq}$ .

**Ferric orthophosphate,  $\text{Fe}_3(\text{PO}_4)_3 + x\text{H}_2\text{O}$ , or  $2\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + x\text{H}_2\text{O}$ .**

+ 4, or  $8\text{H}_2\text{O}$ . (Pptd. ferric phosphate.)  
 Insol. in  $\text{H}_2\text{O}$ . Sol. in 1500 pts. boiling  $\text{H}_2\text{O}$ .

(Bergmann, 1815.) Sol. in pure  $\text{H}_2\text{O}$  when all traces of soluble salts are absent. (Frese-nius.) Very sl. sol. in, but decomp. by  $\text{H}_2\text{O}$ . (Lachowicz, W. A. B. 101, 2b. 374.) For an extended discussion of solubility in and decomposition by  $\text{H}_2\text{O}$  and effect of salts see Cameron and Hurst, (J. Am. Chem. Soc. 1904, 26. 888.)

Easily sol. in dil. mineral acids, excepting  $\text{H}_3\text{PO}_4 + \text{Aq}$ . Insol. in cold  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Wittstein.) 100 ccm. cold  $\text{H}_2\text{O}$  containing 10%  $\text{HC}_2\text{H}_3\text{O}_2$  dissolve 0.007 g. salt. (Seetini, Gazz. ch. it. 5. 252.) When freshly pptd. easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Berthier.) Easily sol. in tartaric or citric acid +  $\text{Aq}$ , also in  $\text{NH}_4$  salts of those acids, and  $\text{Na}$  citrate +  $\text{Aq}$ . (Heydenreich, C. N. 4. 158.) See below.

Sol. in 12,500 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$ . (Pierre, A. ch. (3) 36. 78.)

Insol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Wittstein.)  
 Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  in presence of  $\text{Na}_2\text{HPO}_4$ ; insol. in hot  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ ; sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  (Berzelius).  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$ , or  $\text{NaOH} + \text{Aq}$  dissolve out  $\text{H}_3\text{PO}_4$ .

Sol. in ferric salts +  $\text{Aq}$ , even ferric acetate, but insol. in ferrous acetate +  $\text{Aq}$ .

Partially sol. in large amt. of  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Not pptd. in presence of  $\text{Na}$  citrate. (Spiller.)

Arth (Bull. Soc. (3) 2. 324) obtained a modification of  $\text{Fe}_3(\text{PO}_4)_3$ , insol. in  $\text{HNO}_3 + \text{Aq}$ , but sol. in hot conc.  $\text{HCl} + \text{Aq}$ .

+  $4\text{H}_2\text{O}$ . Min. *Strengite*. Easily sol. in  $\text{HCl} + \text{Aq}$ ; insol. in  $\text{HNO}_3 + \text{Aq}$ .

+  $5\text{H}_2\text{O}$ . Only sl. sol. in  $\text{H}_2\text{O}$ . Slowly sol. in  $\text{HNO}_3$ , easily sol. in  $\text{HCl}$ . (Weinland, Z. anorg. 1913, 84. 361.)

Diammonium citrate +  $\text{Aq}$  dissolves 4.8% of the  $\text{P}_2\text{O}_5$ ; triammonium citrate, 5.8%  $\text{P}_2\text{O}_5$ ; and with an excess of  $\text{NH}_4\text{OH}$ , 21.2%  $\text{P}_2\text{O}_5$  is dissolved. (Erlenmeyer, B. 14. 1253.)

+  $9\text{H}_2\text{O}$ . Dissolves in 35 min. in diammonium citrate +  $\text{Aq}$  (sp. gr. 1.09); in 55 min. in triammonium citrate +  $\text{Aq}$  (sp. gr. 1.09); citric acid +  $\text{Aq}$  ( $\frac{1}{4}\%$  citric acid) dissolves 17.5% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, l. c.)

**Iron (ferric) phosphate, acid,  $8\text{Fe}_2\text{O}_3, 9\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rümpler, Z. anal. 12. 151.)  
 $6\text{Fe}_2\text{O}_3, 7\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .  
 $4\text{Fe}_2\text{O}_3, 5\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

$2\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$  finally into  $\text{Fe}_3(\text{PO}_4)_2$ . (Erlenmeyer and Heinrich, A. 194. 176.)

$8\text{Fe}_2\text{O}_3, 11\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$ . As above. (E. and H.)

$4\text{Fe}_2\text{O}_3, 7\text{P}_2\text{O}_5 + 9\text{H}_2\text{O}$ . As above. (E. and H.)

$\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$ ;  $\text{H}_2\text{O}_2 + \text{Aq}$ ; sol. in  $\text{NH}_4$  citrate, alkali hydrates, or carbonates +  $\text{Aq}$ . (Winkler.)

Slowly decomp. by  $\text{H}_2\text{O}$ . (E. and H.)

+  $10\text{H}_2\text{O}$ . (Waine, C. N. 36. 132.)

$2\text{Fe}_2\text{O}_3, 5\text{P}_2\text{O}_5 + 17\text{H}_2\text{O}$ .

$\text{Fe}_2\text{O}_3, 3\text{P}_2\text{O}_5 + 6\text{H}_2\text{O} = \text{FeH}_2(\text{PO}_4)_2$ . Deliquescent. Insol. in  $\text{H}_2\text{O}$ , but decomp. into  $\text{Fe}_3(\text{PO}_4)_2$ . (E. and H.)

+  $4\text{H}_2\text{O}$ . (Hautefeuille and Margottet, C. R. 106. 135.)

**Ferric pyrophosphate,  $\text{Fe}_4(\text{P}_2\text{O}_7)_2$ .**

*Two modifications.*—(a) Sol. in acids,  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ ,  $\text{FeCl}_3 + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , and in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ .

Insol. in acetic, sulphurous acid, or  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in  $\text{NH}_4$  citrate +  $\text{Aq}$ . (Schwarzenberg, A. 65. 153.)

(b) Insol. in dil. acids,  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ ,  $\text{FeCl}_3 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gladstone, Chem. Soc. (2) 5. 435.)

Solubility of  $\text{Fe}_4(\text{P}_2\text{O}_7)_2$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $0^\circ$ .

100 g. sat. solution contain		100 g. sat. solution contain	
G. $\text{NH}_3$	G. $\text{Fe}_4(\text{P}_2\text{O}_7)_2$	G. $\text{NH}_3$	G. $\text{Fe}_4(\text{P}_2\text{O}_7)_2$
0.884	5.606	5.92	14.71
1.59	9.75	8.26	13.89
3.71	14.85	10.55	7.40
4.72	15.94	15.96	2.52
5.93	13.92	18.83	0.445
7.91	14.61		

(Pascal, A. ch. 1909, (8) 16. 374.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Appl. Ch. 6. 184.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

**Ferroferric orthophosphate,  $2\text{Fe}_3(\text{PO}_4)_2, 3(\text{Fe}_2\text{O}_3, 2\text{P}_2\text{O}_5) + 16\text{H}_2\text{O}$ .**

Ppt. Sol. in  $\text{HCl} + \text{Aq}$ . (Rammelsberg.)

$4\text{Fe}_2\text{O}_3, 6\text{FeO}, 5\text{P}_2\text{O}_5 + 40\text{H}_2\text{O}$ . Sol. in 40 min. in diammonium citrate +  $\text{Aq}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq}$  (sp. gr. = 1.09) dissolves 55.7% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

**Ferrous lithium phosphate,  $\text{Li}_3\text{PO}_4, \text{Fe}_3(\text{PO}_4)_2$ .**

Min. *Triphylite*. Easily sol. in acids; not wholly decomp. by  $\text{KOH} + \text{Aq}$ .

**Iron (ferrous) manganous phosphate,  $\text{Fe}_2(\text{PO}_4)_2, \text{Mn}_2(\text{PO}_4)_2$ .**

Min. *Triphite*. Easily sol. in  $\text{HCl} + \text{Aq}$ .  
 $5(\text{Mn}, \text{Fe})\text{O}, 2\text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$ . Min. *Huraulite*. Sol. in acids.

**Ferric manganous sodium phosphate,  $\text{FePO}_4, (\text{Na}_2, \text{Mn})_2\text{PO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .**

Min.—(?).

**Ferrous manganous phosphate chloride,  $3(\text{Mn}, \text{Fe})_2(\text{PO}_4)_2, \text{MnCl}_2$ .**

(Deville and Caron.)

**Ferrous manganous phosphate fluoride,  $(\text{Mn}, \text{Fe})_2(\text{PO}_4)_2, (\text{Mn}, \text{Fe})\text{F}_3$ .**

Min. *Triphite, Zwieselite*. Sol. in  $\text{HCl} + \text{Aq}$ .  
 $3(\text{Mn}, \text{Fe})_2(\text{PO}_4)_2, \text{MnF}_3$ . (Deville and Caron, C. R. 47. 985.)

**Ferric potassium phosphate,  $2\text{Fe}_2\text{O}_3, 3\text{K}_2\text{O}, 3\text{P}_2\text{O}_5$ .**

Not attacked by boiling  $\text{H}_2\text{O}$ . (Ouvrard, A. ch. (6) 16. 289.)

$\text{Fe}_2\text{O}_3, \text{K}_2\text{O}, 2\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ ; very sl. attacked by acids. (Ouvrard.)

**Ferric silver metaphosphate,  $2\text{Fe}_2\text{O}_3, 2\text{Ag}_2\text{O}, 5\text{P}_2\text{O}_5$ .**

(Hautefeuille and Margottet, C. R. 96. 1142.)

**Ferric silver pyrophosphate,  $\text{Fe}_2\text{Ag}_2(\text{P}_2\text{O}_7)_2 + 4\text{H}_2\text{O}$ .**

Ppt. (Pascal, C. R. 1908, 146. 232.)

**Ferric sodium phosphate,  $2\text{Fe}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{P}_2\text{O}_5$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Ouvrard.)

**Ferrous sodium triphosphate,  $\text{FeNa}_2\text{P}_3\text{O}_{10} + 11\frac{1}{2}\text{H}_2\text{O}$ .**

Stable dry; sol. in  $\text{HNO}_3$ ; decomp. in contact with  $\text{H}_2\text{O}$ . (Stange, Z. anorg. 1896, 12. 451.)

**Ferric sodium hydrogen orthophosphate,  $\text{Fe}(\text{PO}_4)_2\text{H}_2\text{Na} + \text{H}_2\text{O}$ .**

Difficultly sol. in  $\text{H}_2\text{O}$ . Slowly decomp. by boiling with  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and dil.  $\text{HNO}_3$ . Decomp. by alkalis and alkali carbonates. (Weinland, Z. anorg. 1913, 84. 354.)

$\text{Fe}(\text{PO}_4)_2\text{H}_2\text{Na} + \text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and in dil.  $\text{HNO}_3$ . Decomp. by alkalis and alkali carbonates. (Weinland, Z. anorg. 1913, 84. 358.)

**Ferric sodium pyrophosphate,  $\text{Fe}_2(\text{P}_2\text{O}_7)_2, 2\text{Na}_4\text{P}_2\text{O}_7 + 7\text{H}_2\text{O}$ .**

Slowly but completely sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Milek, J. B. 1865. 263.)

Very sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg.)

+5, and 6H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O, especially if warm. (Pahl, J. B. 1873. 229.)

FeNaP<sub>2</sub>O<sub>7</sub>. Insol. in H<sub>2</sub>O, dil. HCl, or HNO<sub>3</sub>+Aq; sl. sol. in conc. HCl+Aq; decomp. by conc. hot H<sub>2</sub>SO<sub>4</sub> without solution. (Jørgensen, J. pr. (2) 16. 342.)

Insol. in acetone. (Naumann, B. 1904. 37. 4329.)

Na<sub>2</sub>Fe<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>+9H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Rosenheim, B. 1915. 48. 586.)

Fe<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>, 5Na<sub>4</sub>P<sub>2</sub>O<sub>7</sub>+7H<sub>2</sub>O. (Pahl, J. B. 1873. 229.)

Iron (ferric) phosphate sulphate, 3Fe<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>, 2Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2Fe<sub>2</sub>O<sub>3</sub>.H<sub>2</sub>.

Min. *Diaochile*.

Lanthanum metaphosphate, La<sub>2</sub>(PO<sub>3</sub>)<sub>6</sub>.

Precipitate. (Frerichs and Smith.)

La<sub>2</sub>O<sub>3</sub>, 5P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O, dil., or conc. acids. (Johnsson, B. 22. 976.)

Lanthanum orthophosphate, LaPO<sub>4</sub>.

Precipitate. (Hermann.)

Insol. in H<sub>2</sub>O and acids. (Ouvrard, C. R. 107. 37.)

Lanthanum hydrogen phosphate,

La<sub>2</sub>H<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>.

Precipitate. (Frerichs, B. 7. 799.)

Existence is doubtful. (Cleve, B. 11. 910.)

Lanthanum phosphate, acid, La<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>.

Precipitate. (Hermann.)

Lanthanum pyrophosphate, LaHP<sub>2</sub>O<sub>7</sub>+3H<sub>2</sub>O. (Cleve.)

La<sub>2</sub>H<sub>2</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>. Precipitate. (Frerichs and Smith.)

Does not exist. (Cleve.)

Lanthanum potassium orthophosphate, 2La<sub>2</sub>O<sub>3</sub>, 3K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub>=2LaPO<sub>4</sub>, K<sub>2</sub>PO<sub>4</sub>.

Insol. in H<sub>2</sub>O. (Ouvrard, C. R. 107. 37.)

Lanthanum sodium orthophosphate, La<sub>2</sub>O<sub>3</sub>, 3Na<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>.

Insol. in H<sub>2</sub>O. (Ouvrard.)

Lanthanum sodium pyrophosphate,

LaNaP<sub>2</sub>O<sub>7</sub>.

Insol. in acetic, and dil. cold mineral acids. Sol. in warm dil. acids. (Wallroth.)

Lead dimetaphosphate, PbP<sub>2</sub>O<sub>6</sub>.

Ppt. Almost insol. in H<sub>2</sub>O. Sol. in HNO<sub>3</sub>+Aq. (Fleitmann, Pogg. 78. 253.)

Lead trimetaphosphate, Pb<sub>3</sub>(P<sub>3</sub>O<sub>9</sub>)<sub>2</sub>+3H<sub>2</sub>O.

Nearly insol. in H<sub>2</sub>O. Less sol. in H<sub>2</sub>O than the corresponding Ag salt. (Fleitmann and Henneberg, A. 65. 304.)

Most insol. of the trimetaphosphates. (Lindbom, Acta Lund. 1873. 12.)

Anhydrous salt is insol. in H<sub>2</sub>O; easily sol. in HNO<sub>3</sub>+Aq. (Lindbom.)

Lead tetrametaphosphate, Pb<sub>2</sub>P<sub>4</sub>O<sub>12</sub>.

Insol. in H<sub>2</sub>O.

More easily decomp. by acids than the other insol. metaphosphates. Easily decomp. by alkali hydrosulphides+Aq in the cold. (Fleitmann, Pogg. 78. 353.)

Lead hexametaphosphate, Pb<sub>3</sub>P<sub>6</sub>O<sub>18</sub>.

Nearly insol. in H<sub>2</sub>O; sol. in acids. (Lüder, Z. anorg. 5. 15.)

Lead orthophosphate, basic, 4PbO, P<sub>2</sub>O<sub>5</sub>.

(Gerhardt, A. 72. 85.)

Lead orthophosphate, Pb<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>.

Insol. in H<sub>2</sub>O; sol. in HNO<sub>3</sub>+Aq. Insol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq.

Sl. sol. in H<sub>2</sub>O. 1.35×10<sup>-4</sup> g. is contained in 1 litre of sat. solution at 20°. (Böttger, Z. phys. Ch. 1903. 46. 604.)

Not hydrolyzed by boiling H<sub>2</sub>O. Sol. in boiling KOH+Aq; insol. in NH<sub>4</sub>OH+Aq. Insol. in Pb(NO<sub>3</sub>)<sub>2</sub>+Aq. (Caven, J. Soc. Chem. Ind. 1897. 16. 30.)

Sol. in 782.9 pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq containing 38.94 pts. pure HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Bertrand, Monit. Scient. (3) 10. 477.)

Insol. in methyl acetate. (Naumann, B. 1909. 42. 3790); ethyl acetate. (Naumann, B. 1910. 43. 314.)

Lead hydrogen phosphate, PbHPO<sub>4</sub>.

Insol. in H<sub>2</sub>O. Decomp. by H<sub>2</sub>SO<sub>4</sub>, or HCl+Aq. Sol. in HNO<sub>3</sub>, or in KOH or NaOH+Aq. Insol. in HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. Sol. in cold NH<sub>4</sub>Cl+Aq (Brett), from which it can be completely precipitated by a great excess of NH<sub>4</sub>OH+Aq.

More sol. in NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq at 18.8–25° than in pure H<sub>2</sub>O. (Wappen.)

Sol. in sat. NaCl+Aq, but less than PbSO<sub>4</sub>. (Becquerel, C. R. 20. 1524.)

Insol. in Pb salts+Aq.

Not pptd. in presence of Na citrate (Spiller.)

Lead pyrophosphate, Pb<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. Sol. in HNO<sub>3</sub>, or KOH+Aq. Insol. in NH<sub>4</sub>OH+Aq, HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, or SO<sub>2</sub>+Aq. (Schwarzenberg, A. 65. 133.) Sol. in Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Aq. (Stromeyer.)

Insol. in acetone. (Naumann, B. 1904. 37. 4329.)

Lead potassium phosphate, PbKPO<sub>4</sub>.

Decomp. by hot H<sub>2</sub>O. (Ouvrard, C. R. 110. 1333.)

Lead sodium phosphate, PbNaPO<sub>4</sub>.

Very sol. in dil. acids. (Ouvrard, C. R. 110. 1333.)

10PbO, 8Na<sub>2</sub>O, 9P<sub>2</sub>O<sub>5</sub>. (Ouvrard.)

**Lead sodium pyrophosphate,  $\text{PbNa}_2\text{P}_2\text{O}_7$ .**

Insol. in hot  $\text{H}_2\text{O}$ . (Gerhardt, A. ch. (3) 22. 506.)

**Lead triphosphate sodium pyrophosphate,  $\text{Pb}_3\text{Na}_4\text{P}_5\text{O}_{17} + 10\text{H}_2\text{O}$ .**

Sol. in  $\text{HNO}_3$  after melting. (Stange, Z. anorg. 1896, 12. 459.)

**Lead phosphate chloride,  $2\text{PbHPO}_4$ ,  $\text{PbCl}_2$ .**

Insol. in boiling  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3$  + Aq. (Gerhardt, A. ch. (3) 22. 505.)

$2\text{Pb}_3(\text{PO}_4)_2$ ,  $\text{PbCl}_2$ . Ppt. (Heintz, Pogg. 73. 119.)

$3\text{Pb}_3(\text{PO}_4)_2$ ,  $\text{PbCl}_2$ . Min. *Pyromorphite*.

Sol. in  $\text{HNO}_3$ , and  $\text{KOH}$  + Aq.

Sl. sol. in cold citric acid + Aq. (Bolton, C. N. 37. 14.)

+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3$  + Aq. (Heintz.)

**Lithium metaphosphate,  $\text{LiPO}_3$ .**

Insol. in boiling  $\text{H}_2\text{O}$ . Scarcely sol. in acetic acid. Easily sol. in mineral acids. (Merling, Z. anal. 1879, 18. 565.)

**Lithium tetrametaphosphate,  $\text{Li}_4\text{P}_4\text{O}_{13} + 4\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Warschauer, Z. anorg. 1903, 36. 180.)

**Lithium orthophosphate,  $\text{Li}_3\text{PO}_4$ .**

Very slightly sol. in  $\text{H}_2\text{O}$ .

Sol. in 2539 pts. pure  $\text{H}_2\text{O}$  and 3920 pts. ammoniacal  $\text{H}_2\text{O}$ ; much more readily in  $\text{H}_2\text{O}$  containing  $\text{NH}_4$  salts. Easily sol. in  $\text{HCl}$  + Aq or  $\text{HNO}_3$  + Aq. (Mayer, A. 98. 193.) Easily sol. in carbonic acid water. (Troost.) Sol. in dil. acids or acetic acid. (de Schulten, Bull. Soc. (3) 1. 479.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

+  $\frac{1}{2}\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$ .

**Lithium hydrogen phosphate,  $\text{Li}_2\text{HPO}_4$ .**

Nearly insol. in  $\text{H}_2\text{O}$ . (Gmelin.) Sol. in 833 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Rammelsberg.)

$\text{Li}_3\text{H}(\text{PO}_4)_2 + \text{H}_2\text{O}$ . Sol. in 200 pts.  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Lithium dihydrogen phosphate,  $\text{LiH}_2\text{PO}_4$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Heptalithium dihydrogen phosphate,**

$\text{Li}_7\text{H}_2(\text{PO}_4)_2$ .

+  $\text{H}_2\text{O}$ , or  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Lithium pentahydrogen phosphate,**

$\text{LiH}_4(\text{PO}_4)_2 + \text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Lithium pyrophosphate,  $\text{Li}_4\text{P}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

(Rammelsberg, B. A. B. 1883. 21.)

**Lithium manganous phosphate,  $\text{Li}_2\text{PO}_4$ ,  $\text{Mn}_2(\text{PO}_4)_2$ .**

Min. *Lithiophilite*.

**Lithium potassium metaphosphate,  $\text{Li}_2\text{O}$ ,  $2\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

As  $\text{NH}_4$  comp. (Tammann, J. pr. 1892, (2) 45. 443.)

**Lithium potassium pyrophosphate,  $\text{Li}_2\text{KP}_2\text{O}_7$ .**

(Kraut, A. 1876, 182. 170.)

**Lithium sodium phosphate,  $3\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Ouvrard, C. R. 110. 1333.)

$2\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ . As above (Ouvrard.)

**Lithium sodium pyrophosphate,  $\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ .**

$5\text{Li}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .

$4\text{Li}_2\text{O}$ ,  $6\text{Na}_2\text{O}$ ,  $5\text{P}_2\text{O}_5$ . (Kraut, A. 1876, 182. 168.)

**Magnesium metaphosphate,  $\text{Mg}(\text{PO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids, but sol. in  $\text{H}_2\text{SO}_4$  + Aq. (Maddrell, A. 61. 62.)

Not decomp. by very long digestion with alkali carbonates, or orthophosphates + Aq. (Fleitmann.)

**Magnesium dimetaphosphate,  $\text{Mg}_2(\text{P}_2\text{O}_5)_2 + 9\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Fleitmann, Pogg. 78. 259.)

**Magnesium trimetaphosphate,  $\text{Mg}_3(\text{P}_3\text{O}_9)_2$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ , more easily in hot  $\text{H}_2\text{O}$ . When ignited, insol. in boiling  $\text{HCl}$  + Aq. (Lindbom.)

Cryst. with 12, or  $15\text{H}_2\text{O}$ .

**Magnesium tetrametaphosphate,  $\text{Mg}_4\text{P}_4\text{O}_{13}$ .**

Insol. in  $\text{H}_2\text{O}$ , somewhat sol. in  $\text{HCl}$  + Aq. More easily sol. in  $\text{HNO}_3$  + Aq, especially easily sol. in conc.  $\text{H}_2\text{SO}_4$ . (Glatzel, Dissert. 1880.)

+  $10\text{H}_2\text{O}$ . Sol. in 70 pts.  $\text{H}_2\text{O}$ . (Glatzel.)

**Magnesium orthophosphate,  $\text{Mg}_3(\text{PO}_4)_2$ , and +5, or  $7\text{H}_2\text{O}$ .**

1 litre  $\text{H}_2\text{O}$  dissolves 0.1 g. ignited  $\text{Mg}_3(\text{PO}_4)_2$  in 7 days, but 0.205 g. if freshly precipitated. (Vöcker, J. B. 1862. 131.)

1 l.  $\text{H}_2\text{O}$  with 2 g.  $\text{NaCl}$  dissolves 75.8 mg.; 1 l.  $\text{H}_2\text{O}$  with 3 g.  $\text{NaNO}_3$  dissolves 61.9 mg.  $\text{Mg}_3(\text{PO}_4)_2$ . (Liebig, A. 106. 185.)

Easily sol. in acids, except in acetic acid. (Schaffner, A. 50. 145.)

Easily sol. in  $\text{H}_2\text{O}$  in presence of alkali salts.

+6½H<sub>2</sub>O. Sol. in 30 min. in diammonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq (sp. gr. = 1.09) dissolves 37.5% of the P<sub>2</sub>O<sub>5</sub>. (Erlenmeyer, R. 14. 1253.)

+20H<sub>2</sub>O. Sol. in 10 min. in diammonium citrate+Aq (sp. gr. = 1.09); triammonium citrate+Aq (sp. gr. = 1.09) dissolves 23.2% of the P<sub>2</sub>O<sub>5</sub>; sol. in 15 min. in ¼% citric acid +Aq. (Erlenmeyer, l. c.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)

#### **Magnesium hydrogen phosphate, MgHPO<sub>4</sub> + 7H<sub>2</sub>O.**

Sol. in 322 pts. cold H<sub>2</sub>O in several days. If heated to 40° becomes milky, and separates a precipitate out at 100° of same salt, so that solution at 100° contains only 1 pt. salt in 498 pts. H<sub>2</sub>O. Much more sol. in H<sub>2</sub>O containing traces of acids, even dil. oxalic or acetic acids. (Graham, Phil. Mag. Ann. 2. 20.) Easily sol. in H<sub>2</sub>SO<sub>4</sub>+Aq. (Gerland, J. pr. (2) 4. 127.)

Sol. in aqueous solution of Mg salts, but insol. in Na<sub>2</sub>HPO<sub>4</sub>+Aq. (Rose.) Sol. in sodium citrate+Aq. (Spiller.) When freshly precipitated it is sol. in hot NH<sub>4</sub>Cl+Aq, and NH<sub>4</sub>OH+Aq does not completely reprecipitate it; less sol. in NH<sub>4</sub>NO<sub>3</sub>+Aq. (Brett, Phil. Mag. (3) 10. 96.) Insol. in alcohol. (Berzelius.)

For solubility in H<sub>3</sub>PO<sub>4</sub>, see under MgO.

+½H<sub>2</sub>O. (Debray.)

+H<sub>2</sub>O. Easily sol. in dil. acids. (de Schulten, C. R. 100. 263.)

+3H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O, easily in acids. (Stoklasa, Z. anorg. 3. 67.)

+4½H<sub>2</sub>O. (Bergmann.)

+6H<sub>2</sub>O. (Debray.)

#### **Magnesium tetrahydrogen phosphate, MgH<sub>4</sub>(PO<sub>4</sub>)<sub>2</sub>.**

Not hygroscopic. Sol. in 5 pts. H<sub>2</sub>O without decomp. (Stoklasa, Z. anorg. 3. 67.)

+2H<sub>2</sub>O. Not hygroscopic. Sol. in H<sub>2</sub>O without decomp. (Stoklasa, Z. anorg. 1. 307.)

Decomp. by alcohol into MgHPO<sub>4</sub>+3H<sub>2</sub>O.

#### **Magnesium pyrophosphate, Mg<sub>2</sub>P<sub>2</sub>O<sub>7</sub>.**

Nearly insol. in H<sub>2</sub>O; readily sol. in HCl or HNO<sub>3</sub>+Aq. (Fresenius.)

+3H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O, easily in HCl or HNO<sub>3</sub>+Aq; sol. in H<sub>2</sub>SO<sub>4</sub>+Aq, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Aq. (Schwarzenberg.)

Sol. in MgSO<sub>4</sub>+Aq, and (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq.

#### **Magnesium tetraphosphate, Mg<sub>3</sub>P<sub>4</sub>O<sub>13</sub>.**

Insol. in H<sub>2</sub>O. (Fleitmann and Henneberg, A. 65. 331.)

#### **Magnesium potassium dimetaphosphate, K<sub>2</sub>Mg<sub>2</sub>(P<sub>2</sub>O<sub>5</sub>)<sub>2</sub>.**

Very sol. in dil. acids. (Ouvrard, C. R. 1888, 106. 1729.)

+4H<sub>2</sub>O. Sol. in 10.2 pts. H<sub>2</sub>O. (Glatzel.)

#### **Magnesium potassium orthophosphate, MgKPO<sub>4</sub>.**

Sl. sol. in H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. Easily sol. in acids.

+6H<sub>2</sub>O.

2MgO, K<sub>2</sub>O, 3P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O; sol. in dil. HCl+Aq. (Ouvrard, C. R. 106. 1729.)

Mg<sub>2</sub>HK(PO<sub>4</sub>)<sub>2</sub>+15H<sub>2</sub>O. (Haushofer.)

#### **Magnesium rubidium orthophosphate, RbMgPO<sub>4</sub>+6H<sub>2</sub>O.**

Easily sol. in warm dil. HCl+Aq.

Not decomp. by boiling H<sub>2</sub>O. (Erdmann, A. 1897, 294. 73.)

#### **Magnesium sodium triphosphate, MgNa<sub>2</sub>P<sub>3</sub>O<sub>10</sub>+13H<sub>2</sub>O.**

Decomp. in the air. (Stange, Z. anorg. 1896, 12. 454.)

#### **Magnesium sodium metaphosphate, 3MgO, Na<sub>2</sub>O, 4P<sub>2</sub>O<sub>5</sub>.**

Insol. in H<sub>2</sub>O or H<sub>3</sub>PO<sub>4</sub>+Aq. Scarcely sol. in HCl+Aq, or aqua regia. Not decomp. by (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Maddrell, A. 61. 53.)

#### **Magnesium sodium dimetaphosphate, MgNa<sub>2</sub>(P<sub>2</sub>O<sub>5</sub>)<sub>2</sub>+4H<sub>2</sub>O.**

Sol. in 25 pts. H<sub>2</sub>O. (Glatzel, Dissert. 1880.)

#### **Magnesium sodium trimetaphosphate, MgNa<sub>3</sub>(P<sub>3</sub>O<sub>9</sub>)<sub>2</sub>+5H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O. After ignition is insol. in H<sub>2</sub>O. (Lindbom.)

#### **Magnesium sodium phosphate, 10MgO, 8Na<sub>2</sub>O, 9P<sub>2</sub>O<sub>5</sub>.**

Insol. in H<sub>2</sub>O; easily sol. in dil. acids. (Ouvrard, C. R. 106. 1729.)

#### **Magnesium sodium orthophosphate, MgNaPO<sub>4</sub>.**

Insol. in H<sub>2</sub>O. (Rose.)

+9H<sub>2</sub>O. (Schoecker and Violet, A. 140. 232.)

MgO, 2Na<sub>2</sub>O, P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O. (Ouvrard.)

3MgO, 3Na<sub>2</sub>O, 2P<sub>2</sub>O<sub>5</sub>. Insol. in H<sub>2</sub>O. (Ouvrard.)

#### **Magnesium sodium pyrophosphate, basic (?).**

Precipitate; sl. sol. in H<sub>2</sub>O. Easily in HCl+Aq, HNO<sub>3</sub>+Aq, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Aq. (Baer, Pogg. 75. 168.)

Sol. in (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq, and in MgSO<sub>4</sub>+Aq.

Insol. in alcohol.

#### **Magnesium phosphate chloride, Mg<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>, MgCl<sub>2</sub>.**

(Deville and Caron, A. ch. (3) 67. 455.)



**Magnesium pyrophosphate nitrogen dioxide,**  $\text{Mg}_2\text{P}_2\text{O}_7, \text{H}_2\text{O}, \text{NO}_2$ .

Scarcely sol. in water. (Luck, Z. anal. 13. 255.)

**Magnesium phosphate fluoride,**  $\text{Mg}_3(\text{PO}_4)_2, \text{MgF}_2$ .

Min. *Wagnerite*. Slowly sol. in hot  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$ .

**Magnesium phosphate calcium fluoride,**  $2\text{Mg}_3(\text{PO}_4)_2, \text{CaF}_2$ .

Min. *Kjerulfite*.

**Manganous dimetaphosphate,**  $\text{Mn}_2(\text{P}_2\text{O}_6)_2$ .

*Anhydrous*. Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Fleitmann.) Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Madrell.) Scarcely attacked by warm  $\text{Na}_2\text{S} + \text{Aq.}$  and not much more by  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  Decomp. by  $\text{Na}_2\text{CO}_3 + \text{Aq.}$

+  $8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Fleitmann, Pogg. 78. 257.)

**Manganous trimetaphosphate,**  $\text{Mn}_3(\text{P}_3\text{O}_{10})_2 + 11\text{H}_2\text{O}$ .

Difficultly sol. in cold or warm  $\text{H}_2\text{O}$ . More easily sol. in cold, very easily in warm  $\text{HCl} + \text{Aq.}$  When ignited, is insol. in acids, even aqua regia. (Lindbom.)

**Manganous hexametaphosphate.**

Sol. in sodium hexametaphosphate +  $\text{Aq.}$  (Rose, Pogg. 76. 4.)

$\text{Mn}_2\text{P}_6\text{O}_{18}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Lüder, Z. anorg. 5. 15.)

**Manganic metaposphate,**  $\text{Mn}(\text{PO}_3)_2$ .

Insol. in  $\text{H}_2\text{O}$  or acids; decomp. by alkalis. (Schjerning, J. pr. (2) 45. 515.)

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$ ; decomp. by alkalis +  $\text{Aq.}$  (Barbier, C. R. 1902, 135. 1055.)

+  $\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or acids, except  $\text{HCl} + \text{Aq.}$  Sl. decomp. by boiling with  $\text{H}_2\text{SO}_4$ . (Hermann, Pogg. 74. 303.)

**Manganous tetrametaphosphate,**  $\text{Mn}_2(\text{PO}_3)_4$ .

Not attacked by acids. (Glatzel, Dissert. 1890.)

+  $10\text{H}_2\text{O}$ . Sol. only in boiling conc.  $\text{H}_2\text{SO}_4$ . (Glatzel.)

**Manganous dekametaphosphate,**  $5\text{MnO}, 5\text{P}_2\text{O}_5 + 12\text{H}_2\text{O}$ .

Ppt. (Tammann, J. pr. 1892, (2) 45. 450.)

**Manganous orthophosphate,**  $\text{Mn}_2(\text{PO}_4)_2$ .

+  $\text{H}_2\text{O}$ . (Debray.)

+  $3\text{H}_2\text{O}$ . Sol. in 20 min. in diammonium citrate +  $\text{Aq.}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq.}$  (sp. gr. = 1.09) dissolves 30.2% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

+  $4\frac{1}{2}$ – $5\frac{1}{2}\text{H}_2\text{O}$ . Efflorescent. (Erlenmeyer and Heinrich, A. 190. 208.)

+  $7\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.) Easily sol. in mineral acids; sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$

Easily sol. in  $\text{SO}_2 + \text{Aq.}$  (Gerland, J. pr. (2) 4. 97.)

Somewhat sol. in boiling  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  but deposited on cooling. (Berzelius.)

Partly sol. in cold  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  (Brett.)

Sol. in cold or hot solutions of ammonium sulphate or succinate. (Wittstein.)

Sl. sol. in Mn salts +  $\text{Aq.}$  (Rose, Pogg. 76. 25.)

Insol. in alcohol.

Sol. in 10 min. in diammonium citrate +  $\text{Aq.}$  (sp. gr. = 1.09); triammonium citrate +  $\text{Aq.}$  (sp. gr. = 1.00) dissolves 53% of the  $\text{P}_2\text{O}_5$ . (Erlenmeyer, B. 14. 1253.)

**Manganous dihydrogen orthophosphate,**  $\text{MnHPO}_4 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Solution decomp. at  $100^\circ$ . (Debray.) Slowly decomp. by cold  $\text{H}_2\text{O}$  into  $\text{Mn}_2(\text{PO}_4)_2$ . (Erlenmeyer and Heinrich, A. 190. 203.)

Easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Gerland.)

Sl. sol. in  $\text{HC}_2\text{H}_3\text{O}_2$ , easily in conc. mineral acids. (Heintz.) Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  from which it is reprecip. on boiling. Decomp. by boiling  $\text{KOH} + \text{Aq.}$

Insol. in alcohol.

$\text{Mn}_2(\text{PO}_4)_2, 2\text{MnHPO}_4 + 4\text{H}_2\text{O}$ . (de Schulzen, C. C. 1905, I. 188.)

**Manganous tetrahydrogen phosphate,**  $\text{MnH}_2(\text{PO}_4)_2 + 2\text{H}_2\text{O}$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , with decomp. to  $\text{MnHPO}_4$ . (Erlenmeyer and Heinrich, A. 190. 208.)

Not decomp. by  $\text{H}_2\text{O}$ . (Otto, C. C. 1887. 1563.)

$\text{H}_2\text{O}$  decomp. it into  $\text{MnHPO}_4$  and  $\text{H}_3\text{PO}_4$ , containing some dissolved salt. The less  $\text{H}_2\text{O}$  used, the more  $\text{MnHPO}_4$  separates. The acid filtrate separates  $\text{MnHPO}_4$  on boiling. At  $0^\circ$  the decomp. increases in proportion to the amt. of salt, but 1 g. of the salt is unchanged in 100 g.  $\text{H}_2\text{O}$ . With less than 20 g. of salt to 100 g.  $\text{H}_2\text{O}$  the decomp. is analogous to that of  $\text{CaH}_2(\text{PO}_4)_2$ , but with larger amts. of salt it is the opposite, becoming less with increasing amts. of the salt. (Viard, C. R. 1899, 129. 412.)

Alcohol dissolves out  $\text{H}_2\text{PO}_4$ . (Heintz.)

**Pentamanganous dihydrogen phosphate,**  $\text{Mn}_5\text{H}_2(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ .

Not decomp. by boiling  $\text{H}_2\text{O}$ . (Erlenmeyer and Heinrich, A. 190. 208.)

**Manganic orthophosphate, basic,**  $\text{Mn}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Digitized by Google

**Manganic orthophosphate,  $\text{MnPO}_4 \cdot \text{H}_2\text{O}$ .**

Sol. in acids. (Christensen, J. pr. (2) 23. 1.)

**Manganous pyrophosphate,  $\text{Mn}_2\text{P}_2\text{O}_7$ .**

*Anhydrous.* (Lewis, Sill. Am. J. (3) 14. 281.)

+ $\text{H}_2\text{O}$ .

+ $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{MnSO}_4$  + Aq. but sol. in  $\text{Na}_4\text{P}_2\text{O}_7$  + Aq. (Rose.)

Difficultly sol. in  $\text{Na}_4\text{P}_2\text{O}_7$  + Aq. but easily sol. in  $\text{K}_4\text{P}_2\text{O}_7$  + Aq. (Pahl.) Decomp. by  $\text{KOH}$  + Aq. Sol. in  $\text{H}_2\text{SO}_4$  + Aq. (Schwarzenberg.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Manganous hydrogen pyrophosphate,**

$\text{MnH}_2\text{P}_2\text{O}_7 \cdot 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Pahl.)

**Manganic pyrophosphate,**

$\text{Mn}_2\text{P}_2\text{O}_{11} \cdot 14\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{SO}_4$ , and  $\text{H}_3\text{PO}_4$ . (Auger, C. R. 1901, 133. 95.)

$\text{MnHP}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; very sl. attacked by dil.  $\text{HCl}$  + Aq. easily by conc. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Schjerning, J. pr. (2) 45. 515.)

**Manganous potassium dimetaphosphate,**

$\text{K}_2\text{Mn}(\text{PO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

Sol. in 95 pts.  $\text{H}_2\text{O}$ . When ignited is not attacked by acids. (Glatzel, Dissert. 1880.)

**Manganous potassium orthophosphate,**

$\text{MnKPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Ouvrard.)

**Manganous potassium pyrophosphate,**

$\text{MnKP}_2\text{O}_7$ .

+ $5\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ .

+ $3\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 584.)

**Manganous potassium phosphate,  $\text{MnK}_2\text{P}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ouvrard, C. R. 106. 1729.)

+ $8\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Pahl.)

$\text{Mn}_2\text{P}_2\text{O}_7$ ,  $2\text{K}_4\text{P}_2\text{O}_7$  +  $10\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . (Pahl.)

**Manganic potassium pyrophosphate,**

$\text{MnKP}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids and bases. (Schjerning.)

**Manganic silver pyrophosphate,**

$\text{AgMn}_2\text{P}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$ .

Almost insol. in  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 585.)

**Manganous sodium triphosphate,**

$\text{MnNa}_3\text{P}_3\text{O}_{10} \cdot 12\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; the melt obtained by heating the salt is readily sol. in  $\text{H}_2\text{SO}_4$ . (Stange, Z. anorg. 1896, 12. 455.)

**Manganous sodium dimetaphosphate,**

$\text{MnNa}_2(\text{PO}_3)_2 \cdot 6\text{H}_2\text{O}$ .

Easily sol. in boiling  $\text{H}_2\text{SO}_4$ , but not attacked by acids after boiling. (Glatzel, Dissert. 1880.)

**Manganous sodium trimetaphosphate,**

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg.)

$\text{MnNa}(\text{PO}_3)_3$ . Insol. in  $\text{H}_2\text{O}$ , dil. acids, or alkalis. (Schjerning, J. pr. (2) 45. 515.)

**Manganous sodium octametaphosphate,**

$\text{Mn}_2\text{Na}_7(\text{PO}_3)_8$ .

Insol. in acids except conc.  $\text{H}_2\text{SO}_4$ . (Tammann, J. pr. 1892, (2) 45. 469.)

+ $5\text{H}_2\text{O}$ . Almost insol. in cold  $\text{H}_2\text{O}$ .

Decomp. by boiling  $\text{H}_2\text{O}$  with separation of  $\text{Mn}_2\text{O}_3$ . (Rosenheim, B. 1915, 48. 584.)

**Manganous sodium orthophosphate,**

$\text{MnNaPO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Ouvrard, C. R. 106. 1729.)

$\text{MnO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ . As above.

**Manganous sodium pyrophosphate,**

$\text{MnNa}_2\text{P}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Wallroth.)

+ $4\frac{1}{2}\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Pahl.)

$3\text{Mn}_2\text{P}_2\text{O}_7$ ,  $2\text{Na}_4\text{P}_2\text{O}_7$  +  $24\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Pahl.)

**Manganic sodium pyrophosphate,  $\text{MnNaP}_2\text{O}_7$  +  $\text{H}_2\text{O}$ .**

(Christensen, J. pr. (2) 23. 1.)

**Manganic dipyrophosphate ammonia,**

$\text{Mn}_2\text{P}_2\text{O}_{11} \cdot 2\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$ .

Decomp. by  $\text{HCl}$  and by alkalis. (Barbier, C. R. 1902, 135. 1109.)

**Manganous phosphate chloride,  $\text{Mn}_2(\text{PO}_4)_2$ ,  $\text{MnCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Deville and Caron, A. ch. (3) 67. 459.)

$3\text{Mn}_2(\text{PO}_4)_2$ ,  $\text{MnCl}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Deville and Caron.)

**Mercurous hexametaphosphate (?).**

Ppt. Sol. in sodium hexametaphosphate + Aq. (Rose.)

$\text{Hg}_2\text{P}_6\text{O}_{18}$ . Insol. in  $\text{H}_2\text{O}$ ; very sl. sol. in acids. (Lüdt, Z. anorg. 5. 15.)

Moderately sol. in  $\text{H}_2\text{O}$  when freshly pptd. More sol. in acids than the mercurous salt. (Lüdt.)

**Mercurous orthophosphate,  $(\text{Hg}_2)_3(\text{PO}_4)_2$ .**

Ppt. Decomp. by boiling with  $\text{H}_2\text{O}$ . (Gerhardt.)

Sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ . Insol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ .

**Mercuric orthophosphate,  $\text{Hg}_3(\text{PO}_4)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in hot  $\text{H}_2\text{O}$ , crystallizing out on cooling. (Haack, A. 262. 185. Slowly sol. in cold dil., quickly in hot dil. or cold conc.  $\text{HCl} + \text{Aq}$ . Less easily sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Berzelius.) Insol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Haack.) Decomp. by  $\text{NaCl} + \text{Aq}$  into insol.  $\text{HgCl}_2$ ,  $3\text{HgO}$ , but sol. in  $\text{NaCl} + \text{Aq}$ , containing  $\text{HNO}_3$ . (Haack.)

Sol. in 6 pts.  $\text{NH}_4\text{Cl}$  in aqueous solution by heating. (Trommsdorff.)

Sol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Wittstein.)

Insol. in alcohol.

**Mercuriomercuric orthophosphate,  $7\text{Hg}_2\text{O}$ ,  $14\text{HgO}$ ,  $2\text{P}_2\text{O}_5 + 20\text{H}_2\text{O}$ .**

(Brooks, Pogg. 66. 63.)

**Mercurous pyrophosphate,  $\text{Hg}_4\text{P}_2\text{O}_7 + \text{H}_2\text{O}$ .**

Sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , when recently pptd. Insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , when heated to  $100^\circ$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . Decomp. by  $\text{HCl} + \text{Aq}$ . (Schwarzenberg, A. 65. 133.)

**Mercuric pyrophosphate,  $\text{Hg}_3\text{P}_2\text{O}_7$ .**

Sol. in acids; insol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}$ , after being heated to  $100^\circ$ . Sol. in  $\text{NaCl} + \text{Aq}$ ; quickly decomp. by  $\text{NaOH} + \text{Aq}$ , and  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ .

Sol. in 6 pts.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Trommsdorff.) Sol. in  $\text{NH}_4\text{NO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ ; also in  $\text{KI} + \text{Aq}$ .

**Mercurous silver orthophosphate,  $\text{AgHg}_2\text{PO}_4$ .**

Sol. in  $\text{HNO}_3$ . (Jacobsen, Bull. Soc. 1909, (4) 5. 949.)

**Molybdenum phosphate,  $\text{Mo}_2(\text{PO}_4)_2$  (?).**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{MoCl}_3 + \text{Aq}$ .

**Molybdenum sodium pyrophosphate,  $\text{Na}(\text{MoP}_2\text{O}_7) + 12\text{H}_2\text{O}$ .**

Ppt. (Rosenheim, B. 1915, 48. 589.)

**Nickel dimetaphosphate,  $\text{NiP}_2\text{O}_5$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . Not decomp. by boiling alkali carbonates or sulphides +  $\text{Aq}$ . (Maddrell, A. 61. 58.)

+  $4\text{H}_2\text{O}$ . Sol. in cold acids. (Glatzel, Dissert. 1880.)

**Nickel tetrametaphosphate,  $\text{Ni}_2\text{P}_4\text{O}_{12}$ .**

Insol. in  $\text{HCl}$ . Sol. in conc.  $\text{HNO}_3$  and especially sol. in  $\text{H}_2\text{SO}_4$  on boiling. (Glatzel.)

**Nickel tetrametaphosphate,  $\text{Ni}_2\text{P}_4\text{O}_{12} + 12\text{H}_2\text{O}$ .**

Easily sol. in acids. (Glatzel.)

**Nickel orthophosphate,  $\text{Ni}_3(\text{PO}_4)_2 + 7\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Rammelsberg, Pogg. 68. 383.)

Sol. in  $\text{Ni}$  salts +  $\text{Aq}$ . (Rose, Pogg. 76. 25.)

Insol. in  $\text{Na}_2\text{HPO}_4 + \text{Aq}$ . (Tupputi, 1811.)

Very sl. sol. in hot  $(\text{NH}_4)_2\text{HPO}_4 + \text{Aq}$ .

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethylacetate. (Naumann, B. 1910, 43. 314.)

**Nickel pyrophosphate,  $\text{Ni}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in mineral acids,  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ . Not pptd. from  $\text{Ni}_3\text{P}_2\text{O}_7 + \text{Aq}$  by alcohol. (Schwarzenberg, A. 65. 158.)

**Nickel potassium dimetaphosphate,  $\text{NiK}_2\text{P}_2\text{O}_5 + 6\text{H}_2\text{O}$ .**

Sol. in 130 pts.  $\text{H}_2\text{O}$ . (Glatzel.)

**Nickel potassium orthophosphate,  $\text{NiKPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ouvrard, R. 106. 1729.)

$3\text{NiO}$ ,  $3\text{K}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ . As above.

**Nickel sodium triphosphate,  $\text{Na}_2\text{NiP}_3\text{O}_{11} + 12\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; decomp. in  $\text{Aq}$  solution. (Schwarz, Z. anorg. 1895, 9. 261.)

**Nickel sodium metaphosphate,  $3\text{Ni}(\text{PO}_3)_2$ ,  $\text{Na}_3\text{PO}_3$ .**

Insol. in  $\text{H}_2\text{O}$  and dil. acids. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Maddrell, A. 61. 56.)

$\text{NiNa}_2(\text{PO}_3)_2 + 8\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Lindbom.)

**Nickel sodium dimetaphosphate,  $\text{NiNa}_2\text{P}_2\text{O}_5 + 6\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Moderately sol. in acids. (Glatzel, Dissert. 1880.)

**Nickel sodium trimetaphosphate,  $\text{Ni}_2\text{Na}_2(\text{P}_3\text{O}_9)_2 + 9\text{H}_2\text{O}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves 60.6 g. at  $20^\circ$ . (Tammann, J. pr. 1892, (2) 45. 426.)

$\text{Na}_2\text{NiP}_3\text{O}_{10} + 12\text{H}_2\text{O}$ . Insol. and not decomp. by  $\text{H}_2\text{O}$ . Sol. in acids. (Schwarz, Z. anorg. 1895, 9. 261.)

**Nickel sodium octometaphosphate,  $\text{Na}_2\text{Ni}_2(\text{PO}_3)_8$ .**

(Tammann, J. pr. 1892, (2) 45. 469.)

**Nickel sodium orthophosphate,  $\text{NiNaPO}_4 + 7\text{H}_2\text{O}$ .**

Ppt. (Debray, C. R. 59. 40.)

$\text{NiO}$ ,  $2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids. (Ouvrard.)

**Nickel sodium pyrophosphate,**  
 $\text{Ni}_{12}\text{Na}_{18}(\text{P}_2\text{O}_7)_4$ .

Insol. in  $\text{H}_2\text{O}$ . Moderately sol. in acids.  
 (Wallroth.)

**Osmium phosphate (?)**.

Sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)

**Palladium orthophosphate (?)**.

Ppt.

**Phosphorus phosphate,  $4\text{P}_2\text{O}_5, 3\text{P}_2\text{O}_3$  (?)**.

Decomp. spontaneously. Sol. in  $\text{H}_2\text{O}$  and alcohol when fresh; insol. in ether. (le Verrier, A. 27. 167; Reinitzer, B. 14. 1884.)

**Platinum phosphate,  $\text{PtP}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ , acids and alkalis. Decomp. by fusing with potassium carbonate. (Barnett, C. N. 1895, 71. 256.)

**Potassium monometaphosphate,  $\text{KPO}_3$ .**

Nearly insol. in  $\text{H}_2\text{O}$ ; sol. in weak acids, even in acetic acid. (Maddrell, A. 61. 62.)

Insol. in  $\text{H}_2\text{O}$  and weak acids. (Fleitmann, Pogg. 78. 250.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

**Potassium dimetaphosphate,  $\text{K}_2\text{P}_2\text{O}_5 + \text{H}_2\text{O}$ .**

Sol. in 1.2 pts. cold  $\text{H}_2\text{O}$ , but not more in hot  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. 78. 250.)

**Potassium trimetaphosphate,  $\text{K}_3\text{P}_3\text{O}_9$ .**

Very sol. in cold  $\text{H}_2\text{O}$  before it is fused. (Lindbom, Acta Lund. 1873. 14.)

**Potassium orthophosphate,  $\text{K}_3\text{PO}_4$ .**

Not deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Graham, Pogg. 32. 47.)

Very al. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Darracq.)

Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution, mols.	
K	$\text{PO}_4$
9.14	3.13
8.84	3.22
8.42	3.44
7.52	3.78
6.90	4.15
6.88	4.12

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 103.)

Insol. in alcohol.

**Potassium hydrogen orthophosphate,**  
 $2\text{K}_2\text{HPO}_4, \text{KH}_2\text{PO}_4 + \text{H}_2\text{O}$ .

Very unstable; very sol. in  $\text{H}_2\text{O}$  with decomp. Identical with the substance de-

scribed as dipotassium phosphate by Berzelius. (Staudenmaier, Z. anorg. 1894, 5. 389.)

$3\text{K}_2\text{HPO}_4, \text{KH}_2\text{PO}_4 + 2\text{H}_2\text{O}$ . Very unstable; very sol. in  $\text{H}_2\text{O}$  with decomp. (Staudenmaier.)

**Potassium hydrogen orthophosphate,**  
 $\text{K}_2\text{HPO}_4$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol.

Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution, mols.	
K	$\text{PO}_4$
6.80	4.08
6.80	4.05
6.76	3.96
6.50	3.81
6.16	3.61
5.24	3.25
4.42	2.94

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 103.)

**Potassium dihydrogen phosphate,  $\text{KH}_2\text{PO}_4$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Vauquelin, A. ch. 74. 96.)

1 l. sat. aq. solution at  $7^\circ$  contains 249.9 g.  $\text{KH}_2\text{PO}_4$ . (Muthmann and Kuntze, Z. Kryst. Min. 1894, 23. 308.)

Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution, mols.	
K	$\text{PO}_4$
2.90	2.36
1.70	1.71
1.60	1.67
1.48	1.46
1.78	3.15
2.18	4.65
2.54	6.32
2.66	6.76
2.98	8.03
3.32	8.80

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 103.)

Sp. gr. of  $\text{KH}_2\text{PO}_4 + \text{Aq}$  at  $18^\circ$  containing:  
 5 10 15%  $\text{KH}_2\text{PO}_4$ .

1.0341 1.0691 1.1092

(Kohlrausch, W. Ann. 1879. 1.)

Sol. in 20%  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Strömeyer.)  
 For solubility in  $\text{H}_2\text{O}$ , see  $\text{K}_2\text{HPO}_4, \text{H}_3\text{PO}_4$ .  
 Insol. in alcohol.

**Potassium orthophosphate, acid,  $\text{KH}_2\text{PO}_4$ ,  $\text{H}_2\text{PO}_4$ .**

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{KH}_2\text{PO}_4$ , $\text{H}_2\text{PO}_4$	Solid phase
- 0.6	3.337	Ice
- 2.5	12.13	"
- 6.7	29.43	"
- 9.2	36.98	"
- 13	44	Ice + $\text{KH}_2\text{PO}_4$
0 (?)	45.8	$\text{KH}_2\text{PO}_4$
+ 10.9	50.3	"
65.2	68.44	"
78	72.43	"
87.5	77.6	"
105.5	85.9	"
120	92.1	" + $\text{KH}_2\text{PO}_4$ , $\text{H}_2\text{PO}_4$
135	96.1	$\text{KH}_2\text{PO}_4$ , $\text{H}_2\text{PO}_4$
139	100	"

(Parravano and Mieli, *Gazz. ch. it.* **33**, II, 536.)

Solubility in anhydrous  $\text{H}_2\text{PO}_4$  at  $t^\circ$ .

$t^\circ$	% $\text{KH}_2\text{PO}_4$ , $\text{H}_2\text{PO}_4$
38.5	18.17
84	58.42
110	77.53
126.5	92.26

(Parravano and Mieli.)

**Potassium pyrophosphate,  $\text{K}_2\text{P}_2\text{O}_7 + 3\text{H}_2\text{O}$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Precipitated from aqueous solution by alcohol. (Schwarzenberg, A. **66**, 136.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

**Potassium hydrogen pyrophosphate,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_7$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Schwarzenberg.)

**Potassium silver metaphosphate,  $\text{K}_2\text{Ag}_2(\text{PO}_3)_2 + \text{H}_2\text{O}$ .**

(Tammann, J. pr. 1892, (2) **45**, 417.)

**Potassium sodium dimetaphosphate,  $\text{KNaP}_2\text{O}_6 + \text{H}_2\text{O}$ .**

Sol. in 24 pts.  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. **78**, 339.)

**Potassium sodium phosphate,  $\text{KNaHPO}_4 + 7\text{H}_2\text{O}$ .**

Not efflorescent. Sol. in  $\text{H}_2\text{O}$ .

**Tripotassium trisodium hexahydrogen phosphate,  $\text{H}_4\text{Na}_3\text{K}_3(\text{PO}_3)_6 + 22\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Filhol and Senderens, C. R. **93**, 388.)

**Potassium sodium pyrophosphate,  $\text{K}_2\text{Na}_2\text{P}_2\text{O}_7 + 12\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schwarzenberg, A. **65**, 140.)

**Potassium strontium dimetaphosphate,  $\text{K}_2\text{Sr}(\text{P}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$ .**

As the  $\text{KBa}$  comp. (Glatzel, Dissert. 1880.)

**Potassium strontium hexametaphosphate,  $\text{K}_2\text{Sr}_2\text{P}_6\text{O}_{18}$ .**

(Tammann, J. pr. 1892, (2) **45**, 435.)

**Potassium strontium orthophosphate,  $\text{KSrPO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Grandeau, A. ch. (6) **8**, 193.)

**Potassium strontium pyrophosphate,  $\text{K}_2\text{SrP}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ouvrard, C. R. **106**, 1599.)

**Potassium thorium phosphate,  $\text{K}_2\text{O}$ ,  $4\text{ThO}_3$ ,  $3\text{P}_2\text{O}_5$ .**

Insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia. (Troost and Ouvrard, C. R. **102**, 1422.)

$\text{K}_2\text{O}$ ,  $\text{ThO}_3$ ,  $\text{P}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3$  + Aq. (Troost and Ouvrard.)

$6\text{K}_2\text{O}$ ,  $3\text{ThO}_3$ ,  $4\text{P}_2\text{O}_5$ . Sol. in acids. (Troost and Ouvrard.)

**Potassium tin (stannic) phosphate,  $\text{K}_2\text{O}$ ,  $4\text{SnO}_2$ ,  $3\text{P}_2\text{O}_5$ .**

(Ouvrard, C. R. **111**, 177.)

$\text{K}_2\text{O}$ ,  $2\text{SnO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

**Potassium titanium phosphate,  $\text{K}_2\text{O}$ ,  $4\text{TiO}_2$ ,  $3\text{P}_2\text{O}_5$ .**

(Ouvrard, C. R. **111**, 177.)

$\text{K}_2\text{O}$ ,  $2\text{TiO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

**Potassium uranous phosphate,  $4\text{UO}_2$ ,  $\text{K}_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ .**

Practically insol. in conc.  $\text{HNO}_3$  and  $\text{HCl}$ , even when the acids are boiling. Attacked by  $\text{HF} + \text{HNO}_3$ . (Colani, A. ch. 1907, (8) **12**, 133.)

**Potassium uranous metaphosphate,  $\text{UO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ .**

Easily sol. in  $\text{HNO}_3$ . Sol. in conc.  $\text{HCl}$ . (Colani.)

**Potassium uranous pyrophosphate,  $3\text{UO}_2$ ,  $6\text{K}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$ .**

Sol. in acids. (Colani.)

**Potassium uranyl phosphate,  $\text{K}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ .**

(Ouvrard, C. R. **110**, 1333.)

$2\text{K}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

$\text{K}_2\text{O}$ ,  $2\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)

**Potassium uranyl orthophosphate**,  
 $K(UO_2)PO_4 + 3H_2O$ .  
 As  $NH_4$  comp. (Lienau, Dissert. 1898.)

**Potassium vanadium phosphate**.  
 See Phosphovanadate, potassium.

**Potassium yttrium phosphate**,  $3K_2O, Y_2O_3, 2P_2O_5$ .  
 $K_2O, Y_2O_3, 2P_2O_5$ .  
 $3K_2O, 5Y_2O_3, 6P_2O_5$ . (Duboin, C. R. 107. 622.)

**Potassium zinc tetrametaphosphate**,  
 $K_2Zn(PO_3)_4 + 6H_2O$ .  
 Sol. in 70 pts.  $H_2O$ . (Glatzel, Dissert. 1880.)

**Potassium zinc phosphate**,  $KZnPO_4$ .  
 Insol. in  $H_2O$ . Sol. in dil. acids. (Ouvrard, C. R. 106. 1729.)  
 $K_2ZnP_2O_7$ . As above.

**Potassium zirconium phosphate**,  $K_2O, 4ZrO_2, 3P_2O_5$ .  
 Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. 102. 1422.)  
 $K_2O, ZrO_2, P_2O_5$ . Insol. in  $H_2O, HNO_3, HCl$ , or aqua regia. Sol. in hot conc.  $H_2SO_4$ . (Troost and Ouvrard.)

**Potassium phosphate selenate**.  
 See Selenophosphate, potassium.

**Potassium hydrogen phosphate sulphate**,  
 $KH_2PO_4, KHSO_4$ .  
 Decomp. by  $H_2O$  and alcohol. (Jacquelin.)

**Rhodium phosphate, basic**,  $4Rh_2O_3, 3P_2O_5 + 32H_2O$ .  
 Insol. in  $H_2O$  or acids. (Claus.)  
 $Rh_2O_3, P_2O_5 + 6H_2O = RhPO_4 + 3H_2O$ . Sol. in  $H_2O$ . (Claus.)

**Rubidium metaphosphate**,  $RbPO_3$ .  
 Sol. in  $H_2O$ . (von Berg, B. 1901, 34. 4183.)

**Rubidium orthophosphate**,  $Rb_3PO_4 + 4H_2O$ .  
 Hygroscopic; sol. in  $H_2O$ ; pptd. by alcohol. (von Berg, B. 1901, 34. 4183.)

**Rubidium hydrogen orthophosphate**,  
 $Rb_2HPO_4 + H_2O$ .  
 Sol. in  $H_2O$ ; insol. in conc.  $NH_4OH + Aq$ ; insol. in alcohol. (von Berg.)

**Rubidium dihydrogen orthophosphate**,  
 $RbH_2PO_4$ .  
 Very sol. in  $H_2O$ ; pptd. by alcohol. (von Berg.)

**Rubidium pyrophosphate**,  $Rb_2P_2O_7$ .  
 Hygroscopic; sol. in  $H_2O$ . (von Berg.)

**Samarium anhydrometaphosphate**,  $Sm_2O_3, 5P_2O_5$ .  
 Insol. in  $H_2O$  or  $HNO_3 + Aq$ . (Cleve.)

**Samarium orthophosphate**,  $SmPO_4$ .  
 Scarcely attacked by boiling  $HNO_3 + Aq$ . (Cleve.)  
 $+ 2H_2O$ .

**Samarium pyrophosphate**,  $SmHP_2O_7 + 1\frac{1}{2}H_2O$ .  
 (Cleve.)

**Silicon phosphate**.  
 See Silicophosphoric acid.

**Silver metaphosphate**,  $Ag_2O, 2P_2O_5 + H_2O$ .  
 (Kroll, Z. anorg. 1912, 76. 408.)

**Silver dimetaphosphate**,  $Ag_2P_2O_5$ .  
 Very sl. sol. in  $H_2O$ . (Fleitmann, Pogg. 78. 253.)  
 Sol. in cold aniline metaphosphate + Aq. (Nicholson.)

Very sl. sol. in  $H_2O$ . (Warschauer, Dissert. 1903.)  
 $+ H_2O$ . Very sol. in  $H_2O$ . (Langheld, B. 1912, 45. 3760.)

**Silver trimetaphosphate**,  $Ag_3P_3O_9$ .  
 Sol. in 60 pts. cold  $H_2O$ . Can be crystallized from conc.  $HNO_3 + Aq$ . (Fleitmann and Henneberg.)  
 $+ H_2O$ . (Lindbom.)

**Silver hexametaphosphate**,  $Ag_6P_6O_{18}$ .  
 Insol. in  $H_2O$ . Sol. in  $HNO_3$  or  $NH_4OH + Aq$ , and in a large excess of sodium hexametaphosphate + Aq. (Rose.)  
 Easily decomp. by  $Na_2S + Aq$ .  
 Decomp. gradually by hot  $H_2O$  into  $Ag_3P_3O_9$ .  
 When freshly pptd., easily sol. in  $H_2O$ . Easily sol. in dil. acids. (Lüder, Z. anorg. 5. 15.)

**Silver orthophosphate**,  $Ag_3PO_4$ .  
 Very sl. sol. in  $H_2O$ . 1 l.  $H_2O$  dissolves  $6.5 \times 10^{-2}$  g.  $Ag_3PO_4$  at  $19.46^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)  
 Sol. in  $H_2PO_4, HNO_3$ , or  $HC_2H_3O_2 + Aq$ , in  $NH_4OH$  or  $(NH_4)_2CO_3 + Aq$ . Less easily in ammonium nitrate or succinate, and incompletely in  $(NH_4)_2SO_4 + Aq$ . (Lassaigne, J. Pharm. (3) 16. 289.)

Insol. in  $Na_2HPO_4 + Aq$ . (Stromeyer.)  
 Not pptd. in presence of Na citrate. (Spiller.)

If 1 mol.  $Ag_3PO_4$  is boiled with 1 mol.  $Na_2CO_3$ , 44% of it is decomp. (Malaguti.)  
 Readily sol. in soluble hyposulphites + Aq with decomp. (Herschel.)

Insol. in Ag salts + Aq. (Rose.)  
 Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Silver hydrogen orthophosphate,  $\text{Ag}_2\text{HPO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  or alcohol into  $\text{H}_3\text{PO}_4$  and  $\text{Ag}_2\text{PO}_4$ . (Joly, C. R. 103. 1071.)

Sol. in  $\text{H}_2\text{PO}_4 + \text{Aq}$ ; insol. in ether. (Schwarzenberg, A. 65. 162.)

**Silver pyrophosphate,  $\text{Ag}_2\text{P}_2\text{O}_7$ .**

Insol. in hot or cold  $\text{H}_2\text{O}$ . Sol. in cold  $\text{HNO}_3 + \text{Aq}$  without decomp. Decomp. by hot  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$  into orthophosphate. Decomp. by  $\text{HCl} + \text{Aq}$  into  $\text{AgCl}$  and  $\text{H}_3\text{PO}_4$ . Insol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. (Stromeyer, Schw. J. 58. 126.)

Insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . Very al. sol. in  $\text{AgNO}_3 + \text{Aq}$ . (Schwarzenberg, A. 65. 161.)

Not completely insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Rose.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Silver hydrogen pyrophosphate,  $\text{Ag}_2\text{H}_2\text{P}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{Ag}_2\text{P}_2\text{O}_7$ . (Hurtzig and Geuther, A. 111. 160.)

Decomp. by cold  $\text{H}_2\text{O}$ . (Cavalier, C. R. 1904, 139. 285.)

**Silver hydrogen pyrophosphate metaphosphate,  $2\text{Ag}_2\text{HF}_2\text{O}_7, \text{HPO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (H. and G.)

**Silver tetraphosphate,  $6\text{Ag}_2\text{O}, 4\text{P}_2\text{O}_5 = \text{Ag}_4\text{P}_4\text{O}_{13}$ .**

Insol. in, but gradually decomp. by boiling  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in large excess of the corresponding Na salt + Aq.

**Silver dekaphosphate,  $\text{Ag}_{12}\text{P}_{10}\text{O}_{31}$ .**

Easily sol. in sodium dekaphosphate + Aq. (Fleitmann and Henneberg, A. 65. 330.)

**Silver ultraphosphate,  $\text{Ag}_2\text{O}, 3\text{P}_2\text{O}_5$ .**

(Kroll, Z. anorg. 1912, 76. 407.)

**Silver sodium dimetaphosphate,  $\text{AgNaP}_2\text{O}_6$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, Pogg. 65. 310.)

**Silver sodium pyrophosphate,  $6\text{Ag}_2\text{P}_2\text{O}_7, \text{Na}_4\text{P}_2\text{O}_7 + 4\text{H}_2\text{O}$ .**

Not completely sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Baer, Pogg. 75. 152.)

Easily sol. in  $\text{H}_2\text{O}$ . (Stromeyer.)

$\text{Ag}_2\text{NaP}_2\text{O}_7 + \frac{1}{2}\text{H}_2\text{O}$ . Ppt. (Stange, Z. anorg. 1896, 12. 460.)

**Silver uranyl phosphate,  $2\text{Ag}_2\text{O}, 6\text{UO}_3, 3\text{P}_2\text{O}_5, + 30\text{H}_2\text{O}$ .**

(Blinkoff, Dissert. 1900.)

**Silver phosphate ammonia,  $\text{Ag}_3\text{PO}_4, 4\text{NH}_3$ .**  
(Widmann, B. 17. 2284.)

**Sodium triphosphate,  $\text{Na}_3\text{P}_3\text{O}_{10}$ .**

Very sol. in  $\text{H}_2\text{O}$ ; decomp. easily in aq. solution at  $100^\circ$ . (Schwarz, Z. anorg. 1895, 9. 253.)

**Sodium monometaphosphate,  $\text{NaPO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. and conc. acids. (Maddrell, A. 61. 63.)

Insol. in acids. (Graham.)

Gradually decomp. by alkalis.

**Sodium dimetaphosphate,  $\text{Na}_2\text{P}_2\text{O}_6 + 2\text{H}_2\text{O}$ .**

Deliquescent. Sol. in 7.2 pts. of cold or hot  $\text{H}_2\text{O}$ . Very sol. in conc.  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{NaOH} + \text{Aq}$ . Insol. in strong, very al. sol. in dilute alcohol. (Fleitmann, Pogg. 78. 246.)

**Sodium trimetaphosphate,  $\text{Na}_3\text{P}_3\text{O}_9 + 6\text{H}_2\text{O}$ .**

Sol. in 4.5 pts. cold  $\text{H}_2\text{O}$ . Insol. in strong, very al. sol. in dil. alcohol. (Fleitmann and Henneberg, A. 65. 307.)

Decomp. by boiling  $\text{H}_2\text{O}$ . (Lindbom.)

**Sodium tetrametaphosphate,  $\text{Na}_4\text{P}_4\text{O}_{12}$ .**

Sol. in  $\text{H}_2\text{O}$ ; cryst. with about  $4\text{H}_2\text{O}$ . Less sol. in alcohol than in  $\text{H}_2\text{O}$ . (Fleitmann, Pogg. 78. 854.)

**Sodium hexametaphosphate,  $\text{Na}_6\text{P}_6\text{O}_{18}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Graham, Pogg. 32. 56.)

**Sodium orthophosphate,  $\text{Na}_2\text{PO}_4 + 12\text{H}_2\text{O}$ .**

Not deliquescent in dry air.

100 pts.  $\text{H}_2\text{O}$  dissolve 19.6 pts. crystals at  $15.5^\circ$ . (Graham.)

100 pts.  $\text{H}_2\text{O}$  dissolve 28.3 pts.  $\text{Na}_2\text{PO}_4 + 12\text{H}_2\text{O}$  at  $15^\circ$ . (Schiff.)

**Solubility in  $\text{H}_2\text{PO}_4 + \text{Aq}$  at  $25^\circ$ .**

In 1000 g. of the solution, mols.	
Na	$\text{PO}_4$
4.28	0.040
3.24	0.183
2.24	0.752
2.73	1.06

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 101.)

**Sp. gr. of  $\text{Na}_2\text{PO}_4 + \text{Aq}$  at  $15^\circ$ .**

$\% = \% \text{Na}_2\text{PO}_4 + 12\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0043	9	1.0399	17	1.0778
2	1.0066	10	1.0455	18	1.0827
3	1.0130	11	1.0492	19	1.0876
4	1.0174	12	1.0539	20	1.0925
5	1.0218	13	1.0586	21	1.0975
6	1.0263	14	1.0633	22	1.1025
7	1.0308	15	1.0681	23	1.1076
8	1.0353	16	1.0729	24	1.1127

(Schiff, calculated by Gerlach, Z. anal. 8. 280.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+ $10\text{H}_2\text{O}$ . (Rammelsberg.)

Could not be obtained. (Hall, J. pr. 94. 237.)

+ $7\text{H}_2\text{O}$ . (Hall.)

Melts in crystal water at  $76.6^\circ$ . (Graham.)

Sodium hydrogen phosphate,  $\text{Na}_2\text{HPO}_4$ .

Sol. in  $\text{H}_2\text{O}$  with evolution of heat.

100 pts.  $\text{H}_2\text{O}$  dissolve at  $t^\circ$ .

$t^\circ$	Pts. $\text{Na}_2\text{HPO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{HPO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{HPO}_4$
0	1.55	40	30.88	80	81.29
10	4.10	50	43.31	90	95.02
20	11.08	60	55.29	100	108.20
30	19.95	70	68.72	106.2	114.43

(Poggiale, J. Pharm. (3) 44. 273.)

100 pts.  $\text{H}_2\text{O}$  at  $13^\circ$  dissolve 3.4 pts.  $\text{Na}_2\text{HPO}_4$ ; (Ferein, Ph. Viertelj. 7. 244); at  $15^\circ$ , 5.9 pts. (Neesse); at  $18^\circ$ , 6.3 pts. (Mulder); at  $16^\circ$ , 8.4 pts. (Müller, J. pr. 98. 52); at  $20^\circ$ , 6.8 pts. (Neesse, Russ. Z. Pharm. 1. 101); at  $25^\circ$ , 12.6 pts. (*ibid.*).

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Na}_2\text{HPO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{HPO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{HPO}_4$
0	2.5	35	39.3	69	94.8
1	2.6	36	43.6	70	95.0
2	2.6	37	49.5	71	95.1
3	2.7	38	55.5	72	95.2
4	2.7	39	60.6	73	95.4
5	2.8	40	63.9	74	95.6
6	3.0	41	66.2	75	95.8
7	3.2	42	68.6	76	96.0
8	3.4	43	70.8	77	96.1
9	3.6	44	72.9	78	96.3
10	3.9	45	74.8	79	96.5
11	4.2	46	76.5	80	96.6
12	4.5	47	78.2	81	96.8
13	4.9	48	79.7	82	96.9
14	5.3	49	81.2	83	97.0
15	5.8	50	82.5	84	97.1
16	6.3	51	83.7	85	97.2
17	6.9	52	84.8	86	97.4
18	7.6	53	85.8	87	97.5
19	8.4	54	86.7	88	97.6
20	9.3	55	87.7	89	97.7
21	10.3	56	88.6	90	97.8
22	11.4	57	89.4	91	97.9
23	12.6	58	90.2	92	98.0
24	14.0	59	90.9	93	98.1
25	15.4	60	91.6	94	98.2
26	16.9	61	92.2	95	98.4
27	18.5	62	92.7	96	98.5
28	20.2	63	93.1	97	98.6
29	22.0	64	93.5	98	98.7
30	24.1	65	93.8	99	98.8
31	26.4	66	94.1	105	82.5
32	29.1	67	94.4	105.57	80.7
33	32.1	68	94.6	106.4	79.2
34	35.5	..	...	...	...

(Mulder, Scheik. Verhand. 1864. 103.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{Na}_2\text{HPO}_4$ in 100 g. $\text{H}_2\text{O}$
10.26	3.55
25.15	12.02
40.29	54.88
60.23	83.00
99.77	102.15

Three breaks in the curve: at  $36.45^\circ$ , transition from dodecahydrate to heptahydrate; at  $48^\circ$ , transition from heptahydrate to the dihydrate; at  $95.2^\circ$ , transition from dihydrate to the monohydrate. (Shiomi, C. C. 1909, II. 106.)

Solubility of  $\text{Na}_2\text{HPO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{Na}_2\text{HPO}_4$ in 100 g. $\text{H}_2\text{O}$	Solid phase
-0.43	1.42	Ice
-0.24	0.70	"
-0.5*		
+0.05	1.67	$\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$
20.0	7.66	"
25.0	12.0	"
32.0	25.7	"
34.0	33.8	"
35.2*		
39.2	51.8	$\text{Na}_2\text{HPO}_4 + 7\text{H}_2\text{O}$
45.0	67.3	"
48.3*		
50.0	80.2	$\text{Na}_2\text{HPO}_4 + 2\text{H}_2\text{O}$
60.0		
80.0	82.9	"
90.0	92.4	"
95*	101.0	"
96.2	104.6	$\text{Na}_2\text{HPO}_4$
105.0	102.3	"
120	99.2	"

(Menzies and Humphery, Int. Cong. App. Chem. 1912, 2. 177.)

\* Transition points.

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	100 g. $\text{H}_2\text{O}$ dissolve g. $\text{Na}_2\text{HPO}_4$	Solid phase
0°	2.51	$\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$
25	12.47	"
35.4*	46.11	$\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
40.3	54.80	"
48.35*	79.00	$\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$
59.7	91.3	
71	95.1	
91	98.15	

(D'Ans and Schreiner. Z. phys. Ch. 1911, 75. 99.)

\* Transition points.

The composition of the hydrates formed by this salt at different dilutions is calculated



from determinations of the lowering of the fr.-pt. produced by the salt and of the conductivity and sp. gr. of its aqueous solutions. (Jones, *Am. Ch. J.* 1905, **34**, 318.)

$\text{Na}_2\text{HPO}_4 + \text{Aq}$  saturated at  $15^\circ$  has 1.0469 sp. gr. (Michel and Krafft); saturated at  $16^\circ$ , 1.0511 (Stolba).

Sp. gr. of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  at  $19^\circ$ .

% $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$	Sp. gr.
1	1.0041	5	1.0208	9	1.0376
2	1.0083	6	1.0250	10	1.0418
3	1.0125	7	1.0292	11	1.0460
4	1.0166	8	1.0332	12	1.0503

(Schiff, *A.* 110. 70.)

Saturated solution freezes at  $-0.45^\circ$  (Rüdorff, *Pogg.* **122**, 337), and boils at  $105^\circ$  (Griffiths),  $105-106.4^\circ$  (Mulder),  $108.5^\circ$  (Legrand).

Sat.  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  boils at  $105.5^\circ$  (Griffiths); at  $106.5^\circ$ , and contains 113.2 pts.  $\text{Na}_2\text{HPO}_4$  to 100 pts.  $\text{H}_2\text{O}$  (Legrand); forms a crust at  $106.4^\circ$ , and contains 108.8 pts.  $\text{Na}_2\text{HPO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed,  $106.8^\circ$ . (Gerlach, *Z. anal.* **26**, 427.)

B.-pt. of  $\text{Na}_2\text{HPO}_4 + \text{Aq}$  containing pts.  $\text{Na}_2\text{HPO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . G = according to Gerlach (*Z. anal.* **26**, 450); L = according to Legrand (*A. ch.* (2) **69**, 426.)

B.-pt.	G	L	B.-pt.	G	L
100.5°	8.6	11.0	104°	68.4	76.4
101	17.2	21.0	104.5	76.9	84.2
101.5	25.8	31.0	105	85.3	91.5
102	34.4	40.8	105.5	93.7	98.4
102.5	42.9	50.3	106	102.1	105.0
103	51.4	59.4	106.5	110.5	111.4
103.5	59.9	68.1	106.6	...	112.6

+  $\text{H}_2\text{O}$ . Transition point,  $95.2^\circ$ . (Shiomi.)

+  $2\text{H}_2\text{O}$ . Transition point,  $48.35^\circ$ . (D'Ans and Schreiner);  $48^\circ$  (Shiomi);  $48.3^\circ$  (Mensies and Humphrey).

+  $7\text{H}_2\text{O}$ . Not efflorescent. Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

Sol. in 8 pts.  $\text{H}_2\text{O}$  at  $23^\circ$ . (Neesse, *J. B.* **1863**, 181.)

Transition point,  $35.4^\circ$  (D'Ans and Schreiner);  $36.45^\circ$  (Shiomi);  $35.2^\circ$  (Mensies and Humphrey).

### Solubility in $\text{H}_3\text{PO}_4 + \text{Aq}$ at $25^\circ$ .

In 1000 g. of the solution, mols.

Na	PO <sub>4</sub>
6.31	4.63
6.76	4.88
7.31	5.55

(D'Ans and Schreiner, *Z. phys. Ch.* 1910, **75**, 101.)

See also above.

+  $12\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

14 pts.  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  mixed with 100 pts.  $\text{H}_2\text{O}$  at  $10.8^\circ$  lower the temperature  $3.7^\circ$ . (Rüdorff, *B.* **2**, 68.)

Sol. in 8.43 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , or 100 pts.  $\text{H}_2\text{O}$  dissolve 11.8 pts. at  $17^\circ$ , and solution has sp. gr. = 1.0422. (Schiff.)

Sol. in 4 pts. cold, and 2 pts. boiling  $\text{H}_2\text{O}$ . (Pagens.)

Sol. in 4 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ . (Abl.)

100 pts.  $\text{H}_2\text{O}$  dissolve 12.735 pts.  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$ . (Michel and Krafft.)

100 pts.  $\text{H}_2\text{O}$  dissolve 6.5 pts.  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  at  $0^\circ$ ; 27.5 pts. at  $30^\circ$ . (Tilden, *Chem. Soc.* **45**, 409.)

### Solubility in $\text{H}_3\text{PO}_4 + \text{Aq}$ at $25^\circ$ .

In 1000 g. of the solution, mols.

Na	PO <sub>4</sub>
2.62	1.09
1.56	0.78
2.38	1.60
3.18	2.24
4.65	3.55
5.63	3.87

(D'Ans and Schreiner, *Z. phys. Ch.* 1910, **75**, 101.)

See also above.

Melts in crystal water below  $100^\circ$ , and easily forms supersaturated solutions. (Gay-Lussac.)

Melts in crystal  $\text{H}_2\text{O}$  at  $34.6^\circ$  (Persoz),  $35^\circ$  (Kopp),  $40-41^\circ$  (Mulder).

Melts in crystal  $\text{H}_2\text{O}$  at  $35^\circ$ . (Tilden, *Chem. Soc.* **45**, 409.)

Supersaturated solutions are brought to crystallisation by addition of a crystal of  $\text{Na}_2\text{HPO}_4 + 12\text{H}_2\text{O}$  or an isomorphous substance as  $\text{Na}_2\text{HASO}_4 + 12\text{H}_2\text{O}$ . (Thomson, *Chem. Soc.* **35**, 200.)

Insol. in alcohol.

Sodium dihydrogen phosphate,  $\text{NaH}_2\text{PO}_4 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Graham.)

+  $2\text{H}_2\text{O}$ . Unchanged on air. Very sol. in  $\text{H}_2\text{O}$ , and solubility increases rapidly with the temperature. (Joly and Dufet, *C. R.* **102**, 1391.)

100 pts.  $H_2O$  dissolve 59.9 pts. at  $0^\circ$ ; 84.6 pts. at  $18^\circ$ . (Joly and Dufet.)

Solubility of  $NaH_2PO_4$  in  $H_2O$  at  $t^\circ$ .

G. of anhydrous  $NaH_2PO_4$  in 100 g.  $H_2O$ .

Solid phase;  $NaH_2PO_4 + 2H_2O$ .

$t^\circ$	G. $NaH_2PO_4$	$t^\circ$	G. $NaH_2PO_4$
0.1	57.86	28.0	101.71
1.0	59.08	30.0	106.45
3.0	61.47	31.0	108.93
5.0	63.82	33.0	114.31
10.0	69.87	34.0	117.14
15.0	76.72	35.0	120.44
20.0	85.21	37.0	126.76
25.0	94.63	40.2	138.16
26.0	96.73	40.55	110.83
27.0	99.20	...	...

$40.8^\circ$ ; transition point.

Solid phase;  $NaH_2PO_4 + H_2O$ .

41	142.55	52	163.84
42	143.83	55	170.85
45	148.20	56	173.23
50	158.61	57	175.81

$57.4^\circ$ ; transition point.

Solid phase;  $NaH_2PO_4$ .

58	177.24	69.	190.24
60	179.33	80.	207.29
62	181.35	90.	225.31
65	184.99	99.1	246.56

(Imadsu, Chem. Soc. 1912, 33. 359.)

Solubility in  $H_2PO_4 + Aq$  at  $25^\circ$ .

In 1000 g. of the solution, mols.

Na	$PO_4$
6.19	4.68
6.01	4.67
5.12	4.36
4.81	4.22
4.36	4.08
4.06	4.03
4.19	4.38
4.32	4.96
4.65	5.89
4.88	6.40

(D'Ans and Schreiner, Z. phys. Ch. 1910, 75. 101.)

**Trisodium trihydrogen phosphate,**  
 $Na_3H_2(PO_4)_3$ .

Not hygroscopic. Sol. in  $H_2O$  in all proportions. (Joulie, C. R. 1902, 134. 604.)

$+1\frac{1}{2}H_2O$ . Sol. in  $H_2O$ . (Filhol and Senderens, C. R. 93. 388.)

$+7H_2O$ . (Salzer, Arch. Pharm. 1894, 232. 365.)

$+7\frac{1}{2}H_2O$ . (Joulie.)

**Sodium orthophosphate acid,**  $NaH_2PO_4$ ,  $H_2PO_4$ .

Hygroscopic. Decomp. by alcohol. (Staudenmaier, Z. anorg. 1894, 5. 395.)

Solubility of  $NaH_2PO_4$ ,  $H_2PO_4$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $NaH_2PO_4$ , $H_2PO_4$	Solid phase
- 5.7	20.77	Ice
- 7.9	26.92	"
-11.4	34.15	"
-38	56.66	"
-34	80.46	$NaH_2PO_4$
+41	81.82	"
51.7	83.68	"
79.7	87.48	"
85	88.65	"
101.7	91.47	" + $NaH_2PO_4$ , $H_2PO_4$
104.5	92.67	$NaH_2PO_4$ , $H_2PO_4$
110	95.79	"
119	97.99	"
126.5	100	"

(Parravano and Mieli, Gazz. ch. it. 38, II. 536.)

Solubility in anhydrous  $H_2PO_4$ .

$t^\circ$	% $NaH_2PO_4$ , $H_2PO_4$
98.5	52.72
111	69.59
119	77.55
122	81.71
123	87.20

(Parravano and Mieli.)

$+H_2O$ . Very deliquescent. (Salzer, Arch. Pharm. 1894, 232. 369.)

**Sodium pyrophosphate,**  $Na_4P_2O_7$ , and  $+10H_2O$ .

Less sol. in  $H_2O$  than sodium hydrogen orthophosphate. (Clark, Ed. J. Sci. 7. 298.)

100 pts.  $H_2O$  dissolve (a) pts.  $Na_4P_2O_7$ , (b) pts.  $Na_4P_2O_7 + 10H_2O$  at:

	$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$40^\circ$	$50^\circ$
a. 3.16	3.95	6.23	9.95	13.50	17.45	
b. 5.41	6.81	10.92	18.11	24.97	33.25	
	$60^\circ$	$70^\circ$	$80^\circ$	$90^\circ$	$100^\circ$	
a. 21.83	25.62	30.04	35.11	40.26		
b. 44.07	52.11	63.40	77.47	93.11		

(Poggiale.)

Sol. in  $H_2SO_4$ . (Walden, Z. anorg. 1902, 29. 384.)

Crystallises unchanged from  $\text{NH}_4\text{Cl} + \text{Aq}$  (Winkler), or conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Uelsmann.)  
Decomp. into orthophosphate by heating with  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{H}_3\text{PO}_4 + \text{Aq}$ .  
Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)  
Insol. in alcohol. Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Sodium hydrogen pyrophosphate**,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$ .  
Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  containing  $\text{HC}_2\text{H}_3\text{O}_2$ , without decomp. (Bayer, J. pr. 106. 501.)

Sl. sol. in alcohol. Much more sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$ .  
 $+6\text{H}_2\text{O}$ . (Rammelsberg, B. A. B. 1883. 21.)

100 g. sat. solution contain 14.95 g.  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$  at  $18^\circ$ . (Giran, A. ch. 1902, (7) 30. 249.)

$\text{Na}_2\text{H}_2\text{P}_2\text{O}_7$ . Very hygroscopic. (Salzer, Arch. Pharm. 1894, 232. 369.)

100 g. sat. solution contain 62.7 g. at  $18^\circ$ . (Giran, A. ch. 1902, (7) 30. 249.)

$\text{Na}_2\text{HP}_2\text{O}_7 + \text{H}_2\text{O}$ . Sol. in 3 pts.  $\text{H}_2\text{O}$ . (Salzer, Arch. Pharm. 1894, 232. 366.)  
 $+6\text{H}_2\text{O}$ . 100 g. sat. solution contain 28.17 g.  $\text{Na}_2\text{HP}_2\text{O}_7$  at  $18^\circ$ . (Giran.)

**Sodium tetraphosphate**,  $\text{Na}_4\text{P}_4\text{O}_{13}$ .

Slowly sol. in 2 pts. cold  $\text{H}_2\text{O}$ . Easily decomp.  
 $+18\text{H}_2\text{O}$ . (Uelsmann.)

**Sodium hydrogen tetraphosphate**,  
 $\text{Na}_4\text{H}_2\text{P}_4\text{O}_{13}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Sodium dekaphosphate**,  $\text{Na}_{12}\text{P}_{10}\text{O}_{31}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, A. 65. 333.)

**Sodium strontium dimetaphosphate**,  
 $\text{Na}_2\text{Sr}(\text{P}_2\text{O}_6)_2 + 4\text{H}_2\text{O}$ .

As the  $\text{NaBa}$  comp. (Glatzel, Dissert. 1880.)

**Sodium strontium trimetaphosphate**,  
 $\text{Na}_2\text{SrP}_3\text{O}_{10} + 3\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  and acids. (Fleitmann, A. 65. 315.)

**Sodium strontium orthophosphate**,  $\text{NaSrPO}_4$ ,  
 $+ \text{H}_2\text{O}$ .

Scarcely sol. in  $\text{H}_2\text{O}$ ; sol. in acids.  
 $+9\text{H}_2\text{O}$ . (Joly, C. R. 104. 905.)

**Sodium strontium pyrophosphate (?)**.

Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$ . (Baer, Pogg. 75. 166.)

Easily sol. in  $\text{HCl} + \text{Aq}$ , or  $\text{HNO}_3 + \text{Aq}$ .  
Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Sodium thallium pyrophosphate**,  
 $\text{Na}_3[\text{Tl}(\text{P}_2\text{O}_7)_2] + 6\text{H}_2\text{O} = \text{Na}(\text{TlP}_2\text{O}_7)$ ,  
 $\text{Na}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, B. 1915, 48. 588.)

**Sodium thorium orthophosphate**,  
 $\text{NaTh}_3(\text{PO}_4)_3$ .

Insol. in acids. (Wallroth, Bull. Soc. (2) 39. 316.)

**Sodium thorium phosphate**,  $\text{Na}_2\text{O}$ ,  $4\text{ThO}_3$ ,  
 $3\text{P}_2\text{O}_5$ .

Insol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , or aqua regia. (Troost and Ouvrard, C. R. 106. 30.)

$5\text{Na}_2\text{O}$ ,  $2\text{ThO}_3$ ,  $3\text{P}_2\text{O}_5$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (T. and O.)

$\text{Na}_2\text{O}$ ,  $\text{ThO}_3$ ,  $\text{P}_2\text{O}_5$ . (T. and O.)

**Sodium thorium pyrophosphate**,  $\text{Na}_2\text{P}_2\text{O}_7$ ,  
 $\text{ThP}_2\text{O}_7 + 2\text{H}_2\text{O}$ .

(Cleve.)

**Sodium tin (stannic) phosphate**,  $\text{NaSn}_3(\text{PO}_4)_3$ .  
(Ouvrard, C. R. 111. 177.)

$\text{Na}_2\text{Sn}(\text{PO}_4)_2$ . (Wunder, J. pr. (2) 4. 339.)  
 $6\text{Na}_2\text{O}$ ,  $3\text{SnO}_2$ ,  $4\text{P}_2\text{O}_5$ . (Ouvrard.)

**Sodium titanium phosphate**,  $\text{NaTi}_2(\text{PO}_4)_3$ .

Insol. in acids. (Rose, J. B. 1867. 9.)  
 $6\text{Na}_2\text{O}$ ,  $\text{TiO}_2$ ,  $4\text{P}_2\text{O}_5$ . (Ouvrard, C. R. 111. 177.)

**Sodium uranium phosphate**,  $\text{UO}_2$ ,  $\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ .

Easily attacked by acids. (Colani, A. ch. 1907, (8) 12. 137.)

**Sodium uranium metaphosphate**,  $4\text{UO}_2$ ,  $\text{Na}_2\text{O}$ ,  
 $3\text{P}_2\text{O}_5$ .

Insol. in boiling  $\text{HNO}_3$ . (Colani.)

**Sodium uranium pyrophosphate**,  $3\text{UO}_2$ ,  
 $6\text{Na}_2\text{O}$ ,  $4\text{P}_2\text{O}_5$ .

Sol. in acids. (Colani.)

**Sodium uranyl phosphate**,  $\text{Na}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ .  
(Ouvrard, C. R. 110. 1333.)

$2\text{Na}_2\text{O}$ ,  $\text{UO}_2$ ,  $\text{P}_2\text{O}_5$ . (Ouvrard.)  
 $\text{Na}_2\text{O}$ ,  $5\text{UO}_2$ ,  $2\text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ;  
decomp. by acetic acid. (Werther, A. 68. 312.)

**Sodium uranyl pyrophosphate**.

Very sol. in  $\text{H}_2\text{O}$ . (Persoz, A. ch. (3) 20. 322.)

**Sodium ytterbium pyrophosphate**,  $\text{NaYbP}_2\text{O}_7$ .

Easily sol. in the strong acids. (Wallroth.)

**Sodium yttrium pyrophosphate**,  $\text{NaYP}_2\text{O}_7$ .

Sol. in  $\text{H}_2\text{O}$ . (Stromeyer.)  
Insol. in  $\text{H}_2\text{O}$ . Easily sol. in strong acids.  
(Wallroth.)

**Sodium zinc triphosphate,**  
 $\text{Na}_2\text{O}, 4\text{ZnO}, 3\text{P}_2\text{O}_5 + 19\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Schwarz, Z. anorg. 1895, 9. 266.)

**Sodium zinc trimetaphosphate,**  $\text{Na}_2\text{O}, 2\text{ZnO}, 3\text{P}_2\text{O}_5.$

Ppt. Sol. in  $\text{H}_2\text{O}$ . (Fleitmann and Henneberg, A. 65. 304.)

**Sodium zinc tetrametaphosphate,**  
 $\text{Na}_2\text{Zn}(\text{PO}_3)_4 + 6\text{H}_2\text{O}.$

As K comp. (Glatzel, Dissert. 1880.)

**Sodium zinc octometaphosphate,**  
 $\text{Na}_2\text{Zn}_8(\text{PO}_3)_8.$

Insol. in acids.

Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Tammann, J. pr. 1892, (2) 45. 420.)

**Sodium zinc orthophosphate,**  $\text{NaZnPO}_4.$

Difficultly sol. in  $\text{H}_2\text{O}$  or acetic acid. Easily sol. in dil. mineral acids. (Scheffer, A. 145. 53.)

$2\text{Na}_2\text{O}, \text{ZnO}, \text{P}_2\text{O}_5.$  Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ouvrard, C. R. 106. 1796.)

**Sodium zinc pyrophosphate,**  $\text{Na}_2\text{ZnP}_2\text{O}_7.$

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Wallroth.)

$3\text{Na}_2\text{P}_2\text{O}_7, \text{Zn}_3\text{P}_2\text{O}_7 + 24\text{H}_2\text{O}.$  Very efflorescent. (Pahl.)

$\text{Na}_4\text{P}_2\text{O}_7, \text{Zn}_3\text{P}_2\text{O}_7 + 2\frac{1}{2}, 3, 3\frac{1}{2}, \text{ and } 8\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}.$  (Pahl, Sv. V. A. F. 30, 7. 35.)

$4\text{Na}_4\text{P}_2\text{O}_7, 5\text{Zn}_3\text{P}_2\text{O}_7 + 20\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}$ . (Pahl.)

$\text{Na}_4\text{P}_2\text{O}_7, 4\text{Zn}_3\text{P}_2\text{O}_7 + 12\text{H}_2\text{O}.$  Sl. sol. in  $\text{H}_2\text{O}$ . (Pahl.)

**Sodium zirconium phosphate,**  $\text{Na}_2\text{O}, 4\text{ZrO}_2, 3\text{P}_2\text{O}_5 = \text{NaZr}_2(\text{PO}_4)_2.$

Insol. in acids or aqua regia. (Troost and Ouvrard, C. R. 105. 30.)

$6\text{Na}_2\text{O}, 3\text{ZrO}_2, 4\text{P}_2\text{O}_5.$  Sol. in acids. (T. and O.)

$4\text{Na}_2\text{O}, \text{ZrO}_2, 2\text{P}_2\text{O}_5.$  Sol. in acids. (T. and O.)

**Sodium phosphate fluoride,**  $\text{Na}_3\text{PO}_4, \text{NaF} + 12\text{H}_2\text{O}.$

100 pts.  $\text{H}_2\text{O}$  dissolve, at  $25^\circ$ , 12 pts. salt and form solution of 1.0329 sp. gr.; at  $70^\circ$ , 57.5 pts. salt and form solution of 1.1091 sp. gr. (Briegleb, A. 97. 95.)

$2\text{Na}_3\text{PO}_4, \text{NaF} + 19\text{H}_2\text{O}, \text{ and } 22\text{H}_2\text{O}.$  Sol. in  $\text{H}_2\text{O}$ . (Baumgarten, J. B. 1865. 219.)

**Sodium phosphate stannate,**  
 $4\text{Na}_3\text{PO}_4, \text{Na}_2\text{SnO}_3 + 43\text{H}_2\text{O}.$

(Prandtl, B. 1907, 40. 2132.)

**Sodium phosphate titanate,**  
 $\text{Na}_2\text{O}, \text{TiO}_2, \text{P}_2\text{O}_5 + 3\text{H}_2\text{O}.$

Hygroscopic. (Mazzuchelli and Pantanelli, C. C. 1909, II. 420.)

**Sodium phosphate vanadate.**

See Phosphovanadate, sodium.

**Strontium monometaphosphate,**  $\text{Sr}(\text{PO}_3)_2.$

Insol. in  $\text{H}_2\text{O}$  and acids. Not decomp. by alkali carbonates + Aq. (Maddrell, A. 61. 61.)

**Strontium hexametaphosphate.**

Nearly insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Lidert, Z. anorg. 5. 15.)

**Strontium orthophosphate, basic,**  $\text{Sr}(\text{OH})_2, \text{Sr}_3(\text{PO}_4)_2.$

(Woyczynski, Z. anorg. 1894, 6. 311.)

**Strontium orthophosphate,**  $\text{Sr}_3(\text{PO}_4)_2.$

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}.$  (Erlenmeyer, J. B. 1857. 145.)

**Strontium hydrogen phosphate,**  $\text{SrHPO}_4.$

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{PO}_4, \text{HCl}, \text{ or } \text{HNO}_3 + \text{Aq}.$  (Vauquelin.) Easily sol. in cold ammonium nitrate, chloride, or succinate + Aq, but is partly precipitated by a little  $\text{NH}_4\text{OH} + \text{Aq}.$  (Brett.)

Sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}.$  (Fuchs, 1834.) Sol. in Na citrate + Aq. (Spiller.)

Partly decomp. by boiling  $\text{Na}_2\text{CO}_3$ , and  $\text{K}_2\text{CO}_3 + \text{Aq}.$  (Dulong.)

$\text{SrH}_2(\text{PO}_4)_2 + 2\text{H}_2\text{O}.$  Decomp. by treating with  $\text{H}_2\text{O}$ , leaving 4.29%  $\text{SrHPO}_4$ . (Barthe.)

**Strontium phosphate, acid,**  $\text{H}_2\text{O}, 2\text{SrO}, 3\text{P}_2\text{O}_5 + x\text{H}_2\text{O}.$

Entirely sol. in  $\text{H}_2\text{O}$ . (Barthe, C. R. 114. 1287.)

**Strontium pyrophosphate,**  $\text{Sr}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}.$

Somewhat sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}.$  Insol. in  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}.$  (Schwarzenberg, A. 65. 144.) +  $2\frac{1}{2}\text{H}_2\text{O}.$  (Knorre and Oppelt, B. 21. 773.)

**Strontium hydrogen pyrophosphate,**  
 $\text{SrH}_2\text{P}_2\text{O}_7, 2\text{Sr}_2\text{P}_2\text{O}_7 + 6\text{H}_2\text{O}.$

Ppt. (Knorre and Oppelt, B. 21. 772.)  $\text{SrH}_2\text{P}_2\text{O}_7, 3\text{Sr}_2\text{P}_2\text{O}_7 + \text{H}_2\text{O}, \text{ and } + 2\text{H}_2\text{O}.$  (Knorre and Oppelt.)

$\text{Sr}_2\text{H}_2(\text{P}_2\text{O}_7)_2 + 8\text{H}_2\text{O}, \text{ and } + 12\text{H}_2\text{O}.$

Ppt. (Pahl, Gm. - K. 2, 2. 172.)

$\text{Sr}_2\text{H}_2(\text{P}_2\text{O}_7)_{10} + 5\text{H}_2\text{O}, + 18\text{H}_2\text{O} \text{ and } + 20\text{H}_2\text{O}.$

Insol. in  $\text{Sr}(\text{NO}_3)_2 + \text{Aq}$  or  $\text{Na}_4\text{P}_2\text{O}_7 + \text{Aq}.$  (Pahl, Gm. - K. 2, 2. 171.)

**Strontium thorium phosphate,**

$\text{Th}_2\text{O}, \text{SrO}, \text{P}_2\text{O}_5.$

(Colani, C. R. 1909, 149. 209.)

**Strontium uranium metaphosphate,**  
 $\text{UO}_3, \text{SrO}, \text{P}_2\text{O}_5$ .

(Colani, A. ch. 1907, (8) 12. 141.)

**Strontium uranyl phosphate,**  
 $\text{SrO}, 4\text{UO}_3, 2\text{P}_2\text{O}_5 + 21\text{H}_2\text{O}$ .

(Blinkoff, Dissert. 1900.)

 $2\text{SrO}, 5\text{UO}_3, 2\text{P}_2\text{O}_5 + 24\text{H}_2\text{O}$ . As Ba comp. (Blinkoff.)**Strontium phosphate chloride,**  $3\text{Sr}_3(\text{PO}_4)_2, \text{SrCl}_2$ .*Strontium apatite.* Insol. in  $\text{H}_2\text{O}$ . (Deville and Caron.)**Tellurium phosphate (?)**Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Thalious metaphosphate,**  $\text{TiPO}_3$ .

Two modifications:

 $\alpha$ . Difficultly sol. in  $\text{H}_2\text{O}$ . $\beta$ . Extremely easily sol. in  $\text{H}_2\text{O}$ . (Lamy.)**Thalious orthophosphate,**  $\text{Ti}_3\text{PO}_4$ .1 pt. is sol. in 201.2 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 149 pts. boiling  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Crookes.) Sl. sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Very easily sol. in solutions of  $\text{NH}_4$  salts. (Carstanjen.) Insol. in alcohol. (Lamy.)**Thalious hydrogen phosphate,**  $\text{Ti}_2\text{HPO}_4$ .*Anhydrous.* Much less sol. in  $\text{H}_2\text{O}$  than the hydrous salt, but easily sol. in a solution of the hydrous salt. (Lamy.) $+ \frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Lamy.)Composition is  $\text{HTi}_2\text{PO}_4, 2\text{H}_2\text{TiPO}_4$ . (Rammelsberg, W. Ann. 16. 694.)**Thalious dihydrogen phosphate,**  $\text{TiH}_2\text{PO}_4$ .Very easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rammelsberg, B. 3. 278.)**Tri-thalious trihydrogen phosphate,**  $\text{Ti}_3\text{HPO}_4, 2\text{TiH}_2\text{PO}_4$ .True composition of  $\text{Ti}_3\text{HPO}_4$  of Lamy. (Rammelsberg.)**Thalious pyrophosphate,**  $\text{Ti}_2\text{P}_2\text{O}_7$ .Sol. in 2.5 pts.  $\text{H}_2\text{O}$  with slight decomposition. (Lamy.) $+ 2\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than the above salt, with partial decomp. (Lamy.)**Thalious hydrogen pyrophosphate,**  $\text{H}_2\text{Ti}_2\text{P}_2\text{O}_7, + \text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ . (Lamy.)**Thallic phosphate, basic,**  $2\text{Ti}_2\text{O}_3, \text{P}_2\text{O}_5 + 5\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$ .**Thallic phosphate, basic,**  $\text{Ti}_3\text{P}_2\text{O}_{17} + 13\text{H}_2\text{O}$ .

(Rammelsberg, W. Ann. 16. 694.)

 $\text{Ti}_4\text{P}_4\text{O}_{19} + 12\text{H}_2\text{O}$ . (R.)**Thallic phosphate,**  $\text{TiPO}_4 + 2\text{H}_2\text{O}$ .Completely insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HNO}_3$ , and dil.  $\text{HCl} + \text{Aq}$ . (Willm.)**Thorium metaphosphate,**  $\text{Th}(\text{PO}_3)_4$ .Insol. in  $\text{H}_2\text{O}$ . (Troost, C. R. 101. 210.)**Thorium metaphosphate,**  $\text{ThO}_2, 2\text{P}_2\text{O}_5$ .

Insol. in acids. (Johneson, B. 22. 976.)

**Thorium orthophosphate,**  $\text{Th}_3(\text{PO}_4)_4 + 4\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$  and phosphoric acid (Berzelius); also acetic acid. (Cleve.)Sol. in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Cleve.)**Thorium hydrogen phosphate,**  $\text{ThH}_2(\text{PO}_4)_2 + \text{H}_2\text{O}$ .

Precipitate.

**Thorium pyrophosphate,**  $\text{ThP}_2\text{O}_7 + 2\text{H}_2\text{O}$ .Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in great excess of pyrophosphoric acid or sodium pyrophosphate +  $\text{Aq}$ . (Cleve.)**Thorium phosphate bromide.**

See Bromophosphate, thorium.

**Thorium phosphate chloroide.**

See Chlorophosphate, thorium.

**Tin (stannous) phosphate,**  $5\text{SnO}, 4\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$ . (Lensesen, A. 114. 113.) $\text{Sn}_2(\text{PO}_4)_2$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in mineral acids. (Kühn.)Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . Sol. in  $\text{KOH} + \text{Aq}$ .**Tin (stannic) phosphate,**  $2\text{SnO}_2, \text{P}_2\text{O}_5 + 10\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . (Reynoso, J. pr. 54. 261.)*Anhydrous.* Insol. in acids. (Hautefeuille and Margottet, C. R. 102. 1017.)**Tin (stannic) phosphate,**  $\text{SnP}_2\text{O}_7$ .

Insol. in acids. (Hautefeuille and Margottet, C. R. 102. 1017.)

**Tin (stannous) phosphate chloride,**  $3\text{SnO}, \text{P}_2\text{O}_5, \text{SnCl}_2 + \text{H}_2\text{O}$ .Not decomp. by hot  $\text{H}_2\text{O}$ . (Lensesen, A. 114. 113.)**Titanium phosphate,**  $\text{Ti}_2\text{P}_2\text{O}_7 = 2\text{TiO}_2, \text{P}_2\text{O}_5$ .

Insol. in acids. (Hautefeuille and Margottet, C. R. 102. 1017.)

(Ouvrard, C. R. 111. 177.)  
 $+ 3\text{H}_2\text{O}$ . Ppt. Insol. in  $\text{H}_2\text{O}$ . (Merz.)

**TiO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub>.** (Knop.) Is NaTi<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>.  
(Wunder, J. B. 1871. 324.)  
**H<sub>2</sub>TiPO<sub>7</sub>.** Sol. in HCl, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>.  
Sl. sol. in H<sub>2</sub>PO<sub>4</sub>.  
Sol. in KOH, NH<sub>4</sub>OH, (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> and  
(NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub>+Aq.  
Very sl. sol. in acetic acid. (Faber, Z.  
anal. 1907, 46. 288.)

**Uranous metaphosphate, U(PO<sub>3</sub>)<sub>4</sub>.**

Insol. in HNO<sub>3</sub>, HCl, or H<sub>2</sub>SO<sub>4</sub>, even  
when hot and conc. (Colani, A. ch. 1907, (8)  
12. 105.)

**Uranic metaphosphate, U<sub>2</sub>(PO<sub>3</sub>)<sub>6</sub>.**

Insol. in H<sub>2</sub>O and acids. (Hautefeuille and  
Margottet, C. R. 96. 849.)

**Uranous orthophosphate, U<sub>3</sub>(PO<sub>4</sub>)<sub>4</sub>.**

More easily attacked by acids than the pyro  
and meta phosphates, especially by HNO<sub>3</sub>.  
(Colani, A. ch. 1907, (8) 12. 123.)

**Uranous hydrogen orthophosphate, UHPO<sub>4</sub>+  
H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O. Insol. in dil., sl. sol. in  
conc. HCl+Aq. Decomp. by KOH+Aq,  
not by NH<sub>4</sub>OH+Aq. (Rammelsberg, Pogg.  
59. 1.)

**Uranous pyrophosphate, UP<sub>2</sub>O<sub>7</sub>.**

Insol. in H<sub>2</sub>O.  
Sl. sol. in min. acids. (Colani.)

**Uranous phosphate, 2UO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>.**

Easily attacked by boiling HNO<sub>3</sub>.  
(Colani.)

**UO<sub>3</sub>, P<sub>2</sub>O<sub>5</sub>+5H<sub>2</sub>O.** Insol. in H<sub>2</sub>SO<sub>4</sub> and  
in HCl+Aq of medium concentration. Sol.  
in very conc. HCl+Aq. (Aloy, Dissert.  
1901.)

**Uranyl metaphosphate, UO<sub>2</sub>(PO<sub>3</sub>)<sub>2</sub>.**

(Rammelsberg, B. A. B. 1872. 447.)  
**UO<sub>2</sub>, 2P<sub>2</sub>O<sub>5</sub>.** Insol. in acids. (Johnsson,  
B. 22. 976.)

**Uranyl orthophosphate, UO<sub>2</sub>HiPO<sub>4</sub>+1½H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O.  
+3H<sub>2</sub>O.  
+4H<sub>2</sub>O.  
+4½H<sub>2</sub>O. Insol. in H<sub>2</sub>O. Sol. in 67,000  
pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq, 50,000 pts. NH<sub>4</sub>C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+  
Aq, and 300,000 pts. of a mixture of the above  
two solutions. Sol. in K<sub>2</sub>CO<sub>3</sub> or Na<sub>2</sub>CO<sub>3</sub>+  
Aq. (Kitschin, C. N. 27. 199.)

**Uranyl dihydrogen phosphate,**

**UO<sub>2</sub>H<sub>4</sub>(PO<sub>4</sub>)<sub>2</sub>+3H<sub>2</sub>O.**  
Decomp. by H<sub>2</sub>O. Sol. in H<sub>2</sub>PO<sub>4</sub>+Aq.  
(Werther, J. pr. 43. 322.)

**Uranyl pyrophosphate, (UO<sub>2</sub>)<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+5H<sub>2</sub>O.**

Efflorescent. Insol. in H<sub>2</sub>O. Sol. in  
HNO<sub>3</sub>+Aq, and Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Aq. Insol. in  
Na<sub>2</sub>HPO<sub>4</sub>+Aq. Insol. in alcohol or ether.  
(Girard, C. R. 34. 22.)  
+4H<sub>2</sub>O. (Casteing, Bull. Soc. (2) 34. 20.)

**Uranyl tetraphosphate (?), UO<sub>2</sub>P<sub>4</sub>O<sub>11</sub>.**

(Johnsson, B. 22. 978.)

**Uranous orthophosphate chloride, U<sub>3</sub>(PO<sub>4</sub>)<sub>4</sub>,  
UCl<sub>4</sub>.**

Sl. sol. in HCl+Aq. Sol. in HNO<sub>3</sub> and  
HNO<sub>3</sub>+HCl. (Colani, A. ch. 1907, (8) 12.  
127.)

**Uranous hydrogen orthophosphate chloride,  
U(HPO<sub>4</sub>)<sub>3</sub>, UCl<sub>4</sub>.**

Very sl. sol. in H<sub>2</sub>O. (Aloy, Dissert. 1901.)

**Vanadium phosphate, (VO<sub>2</sub>)H<sub>2</sub>PO<sub>4</sub>+4½H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O.

See Phosphovanadic acid.

**Vanadium pyrophosphate,**

**V<sub>4</sub>(P<sub>2</sub>O<sub>7</sub>)<sub>3</sub>+30H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O. (Rosenheim, B. 1915, 48.  
590.)

**Divanadyl phosphate.**

Very deliquescent, and sol. in H<sub>2</sub>O. Insol.  
in alcohol. (Berzelius.)

**Ytterbium metaphosphate, Yb(PO<sub>3</sub>)<sub>4</sub>.**

Insol. in H<sub>2</sub>O. (Cleve, Z. anorg. 1902, 32.  
149.)

**Ytterbium orthophosphate, YbPO<sub>4</sub>+4½H<sub>2</sub>O.**

Ppt. (Cleve.)

**Ytterbium phosphate, Yb<sub>2</sub>O<sub>3</sub>, 2P<sub>2</sub>O<sub>5</sub>+5H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Cleve.)

**Yttrium metaphosphate, Y(PO<sub>3</sub>)<sub>3</sub>.**

Insol. in H<sub>2</sub>O or acids. (Cleve.)

**Yttrium orthophosphate, YPO<sub>4</sub>.**

*Anhydrous.* Insol. in H<sub>2</sub>O or acids after  
ignition.

*Min. Xenotime.* Insol. in conc. acids. Sl.  
sol. in much conc. HCl+Aq, but easily sol.  
therein when first heated with a little HCl+  
Aq. (Wartha, A. 139. 237.)

**Yttrium hydrogen orthophosphate, Y<sub>2</sub>(HPO<sub>4</sub>)<sub>3</sub>.**

Decomp. by boiling with H<sub>2</sub>O into insol.  
YPO<sub>4</sub> and sol. acid salt.

**Yttrium pyrophosphate, YHP<sub>2</sub>O<sub>7</sub>+3½H<sub>2</sub>O.**

Difficultly sol. in acids. Decomp. by  
H<sub>2</sub>SO<sub>4</sub>. Sol. in Na<sub>2</sub>P<sub>2</sub>O<sub>7</sub>+Aq. (Cleve.)

**2Y<sub>2</sub>O<sub>3</sub>, 3P<sub>2</sub>O<sub>5</sub>.** Insol. in acids. (Johnsson,  
B. 22. 976.)

**Zinc metaphosphate.**Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Zinc dimetaphosphate,  $\text{Zn}_2\text{P}_2\text{O}_7$ .**Sol. only in boiling  $\text{H}_2\text{SO}_4$ . (Fleitmann, Pogg. 78. 350.)Not decomp. by boiling  $\text{Na}_2\text{S}$  or  $(\text{NH}_4)_2\text{S} + \text{Aq.} + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling therewith. (Fleitmann, Pogg. 78. 253.)Sol. in 4 pts.  $\text{H}_2\text{O}$ . Conc.  $\text{H}_2\text{SO}_4$  decomp. it easily; other acids act slightly. (Glatzel, Dissert. 1880.)

Difficultly decomp. by boiling acids.

**Zinc trimetaphosphate,  $\text{Zn}_3(\text{PO}_3)_3 + 9\text{H}_2\text{O}$ .**1 l.  $\text{H}_2\text{O}$  dissolves 0.1 g. at  $20^\circ$ . (Tammann, J. pr. 1892, (2) 45. 426.)**Zinc tetrametaphosphate,  $\text{Zn}_4(\text{PO}_3)_4 + 10\text{H}_2\text{O}$ .**Sol. in 55 pts.  $\text{H}_2\text{O}$ . Decomp. by acids only on boiling. (Glatzel, Dissert. 1880.)Somewhat sol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in boiling  $\text{H}_2\text{SO}_4$ . (Glatzel.)**Zinc orthophosphate,  $\text{Zn}_3(\text{PO}_4)_2 + 4\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids,  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{CO}_3$ ,  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Heintz, A. 143. 356.)Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Fuchs.)Easily sol. in Zn salts +  $\text{Aq}$ . (Rose.)Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)Min. *Hopewile*. $+6\text{H}_2\text{O}$ . (Reynoso.)**Zinc hydrogen phosphate,  $\text{ZnHPO}_4 + \text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Gramham.)**Zinc tetrahydrogen phosphate,  $\text{ZnH}_4(\text{PO}_4)_2 + 2\text{H}_2\text{O}$ .**Nearly insol. in  $\text{H}_2\text{O}$ , but decomp. thereby into  $\text{H}_3\text{PO}_4$  and  $10\text{ZnO}$ ,  $4\text{P}_2\text{O}_5 + 10\text{H}_2\text{O}$ . (Demel, B. 12. 1171.)**Zinc phosphate,  $10\text{ZnO}$ ,  $4\text{P}_2\text{O}_5 + 10\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . (Demel, B. 12. 1171.)**Zinc pyrophosphate,  $\text{Zn}_2\text{P}_2\text{O}_7 + \frac{1}{2}\text{H}_2\text{O}$ .**Ppt. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in acids,  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ . (Schwarzenberg, A. 65. 151.)Sol. in  $\text{Na}_2\text{P}_2\text{O}_7 + \text{Aq}$  (Gladstone), and in  $\text{ZnSO}_4 + \text{Aq}$ . (Rose.)

Insol. in acetic acid. (Knorre, Z. anorg. 1900, 24. 389.)

 $+5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Pahl, J. B. 1873. 229.)**Zinc hydrogen pyrophosphate.**Sol. in  $\text{H}_2\text{O}$ . (Pahl, Sv. V. A. F. 30, 7. 45.)**Zinc metaphosphate ammonia.**

Ppt. (Bette.)

**Zinc orthophosphate ammonia,  $2\text{ZnO}$ ,  $\text{P}_2\text{O}_5$ ,  $3\text{NH}_3 + 8\text{H}_2\text{O}$ .**

(Rother, A. 143. 356.)

 $6\text{ZnO}$ ,  $3\text{P}_2\text{O}_5$ ,  $8\text{NH}_3 + 4\text{H}_2\text{O}$ . (Schweikert, A. 145. 517.)**Zinc pyrophosphate ammonia,  $3\text{Zn}_2\text{P}_2\text{O}_7$ ,  $4\text{NH}_3 + 9\text{H}_2\text{O}$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . (Bette.)**Zirconium orthophosphate,  $5\text{ZrO}_2$ ,  $4\text{P}_2\text{O}_5 + 8\text{H}_2\text{O}$ .**

Somewhat sol. in acids. (Hermann, J. pr. 97. 321.)

Insol. in acids. (Paykull, Bull. Soc. (2) 20. 65.)

 $2\text{ZrO}_2$ ,  $\text{P}_2\text{O}_5$ . Not attacked by acids. (Hautefeuille and Margottet, C. R. 102. 1017.)**Zirconium pyrophosphate,  $\text{Zr}(\text{PO}_3)_2$ .**

(Knop, A. 159. 36.)

**Phosphoricovanadicotungstic acid.****Ammonium phosphoricovanadicotungstate,** $14(\text{NH}_4)_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $7\text{V}_2\text{O}_5$ ,  $31\text{WO}_3 + 78\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol, ether,  $\text{CS}_2$  and benzene. (Rogers, J. Am. Chem. Soc. 1903, 25. 305.)**Phosphorimidamide,  $\text{PN}_2\text{H}_2$ .**

(Joannis, C. R. 1904, 139. 365.)

**Phosphorimide,  $\text{P}_1(\text{NH})_1$ .**Very sol. in ammoniacal solution of  $\text{NH}_4\text{I}$ . (Hugot, C. R. 1905, 141. 1236.)**Phosphornitryl,  $\text{PON}$ .**

See Phosphoryl nitride.

**Phosphorosomolybdic acid,  $\text{P}_2\text{O}_5$ ,** $24\text{MoO}_3 + 63\text{H}_2\text{O}$ .

(Rosenheim and Pinsker, Z. anorg. 1911, 70. 77.)

**Ammonium phosphorosomolybdate,** $2(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{P}_2\text{O}_7$ ,  $12\text{MoO}_3 + 12\frac{1}{2}\text{H}_2\text{O}$ .Insol. in cold, slightly sol. in hot  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 5. 361.)**Phosphorosophosphomolybdic acid.****Ammonium phosphorosophosphomolybdate,** $9(\text{NH}_4)_2\text{O}$ ,  $2\text{H}_2\text{P}_2\text{O}_7$ ,  $3\text{P}_2\text{O}_5$ ,  $72\text{MoO}_3 + 38\text{H}_2\text{O}$ .Nearly insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Phosphorosophosphotungstic acid.**

**Potassium phosphorosophosphotungstate,**  
 $5K_2O, 2H_3PO_3, P_2O_5, 24WO_3 + 13H_2O$ .

Sol. in much boiling  $H_2O$ . (Gibbs, Am. Ch. J. 7. 313.)

**Phosphorosotungstic acid.**

**Ammonium phosphorosotungstate,**  $6(NH_4)_2O, 4H_3PO_3, 22WO_3 + 25H_2O$ .

Sl. sol. in cold  $H_2O$ .

**Potassium —,**  $5K_2O, 16H_3PO_3, 32WO_3 + 46H_2O$ .

Sl. sol. in hot  $H_2O$ .

**Sodium —,**  $2Na_2O, 8H_3PO_3, 22WO_3 + 35H_2O$ .

Nearly insol. in cold, sl. sol. in hot  $H_2O$ . (Gibbs, Am. Ch. J. 7. 313.)

**Phosphorous anhydride,  $P_2O_5$ .**

See Phosphorus trioxide.

**Phosphorous acid,  $H_3PO_3$ .**

Deliquescent. Very sol. in  $H_2O$ .

**Phosphites.**

The neutral alkali phosphites are sol. in  $H_2O$ ; most of the others are sl. sol. in  $H_2O$ , but sol. in  $H_3PO_3 + Aq$ ; all are insol. in alcohol.

**Aluminum phosphite, basic,**  $Al_2(HPO_3)_3, Al_2(OH)_3$ .

Ppt. (Grützner, Arch. Pharm. 1897, 235. 698.)

**Aluminum phosphite.**

Precipitate. (Rose, Pogg. 9. 39.)

Sl. sol. in  $H_2O$ .

**Ammonium phosphite,**  $(NH_4)_2HPO_3 + H_2O$ .

Very deliquescent, and sol. in  $H_2O$ . (Rose, Pogg. 9. 28.)

Sol. in 2 pts. cold, and less hot  $H_2O$ . Insol. in alcohol. (Berzelius.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

**Ammonium hydrogen phosphite,**

$(NH_4)H_2PO_3$ .

Very deliquescent, and sol. in  $H_2O$ . 1 pt.  $H_2O$  dissolves 1.71 pts. salt at  $0^\circ$ ; 1.9 pts. at  $14.5^\circ$ ; and 2.60 pts. at  $31^\circ$ . (Amat, C. R. 105. 809.)

**Ammonium hydroxylamine phosphite,**

$NH_4(NH_2OH)HPO_3$ .

Sol. in  $H_2O$  and abs. alcohol. (Hofmann, Z. anorg. 1898, 16. 466.)

**Ammonium magnesium phosphite,**  
 $(NH_4)_2Mg_3(PO_3)_4 + 16H_2O$ .

Slightly sol. in  $H_2O$ . (Rammelsberg, Pogg. 131. 367.)

**Antimonyl phosphite,  $(SbO)_2H_2PO_3$ .**

Very sol. in  $H_2O$  containing  $HCl$ . (Grützner, Arch. Pharm. 1897, 235. 694.)

**Barium phosphite,  $BaHPO_3$ .**

100 pts.  $H_2O$  dissolve 0.25 pt. (Ure.)

Very slightly sol. in  $H_2O$ , and decomp. by boiling  $H_2O$ . (Dulong.)

Easily sol. in  $H_2O$  containing  $NH_4Cl$ . (Wackenroder, A. 41. 315.)

Sol. in  $H_3PO_3 + Aq$  or  $HCl + Aq$ . (Railton.)

**Barium hydrogen phosphite,  $Ba_2H_2(HPO_3)_3 + 8H_2O$ .**

Easily sol. in  $H_2O$ , but decomp. by boiling therewith. Insol. in alcohol. (Rammelsberg, Pogg. 132. 496.)

**Barium dihydrogen phosphite,  $BaH_2(HPO_3)_2 + \frac{1}{2}H_2O$ .**

Easily sol. in  $H_2O$ . (Rose, Pogg. 9. 215.)

Sol. in  $H_2O$ ; decomp. by boiling  $H_2O$  into a neutral insol., and an acid sol. salt. (Wurtz, A. 58. 66.)

$+ 2H_2O$ . Easily sol. in  $H_2O$ . (Rammelsberg, Pogg. 132. 496.)

Insol. in alcohol. (Wurtz.)

**Bismuth phosphite,  $2Bi_2O_3, 3P_2O_3$ .**

Insol. in  $H_2O$ .

$Bi_2(HPO_3)_3 + 3H_2O$ . Ppt. (Grützner, Arch. Pharm. 1897, 235. 696.)

Decomp. by  $H_2S$ . Not decomp. by  $KOH + Aq$ . (Vanino, J. pr. 1906, (2) 74. 151.)

**Cadmium phosphite,  $CdHPO_3 + 3H_2O$ .**

Ppt. (Rose, Pogg. 9. 41.)

**Calcium phosphite,  $CaHPO_3 + \frac{1}{2}H_2O$ .**

Sl. sol. in  $H_2O$ ; the aqueous solution is decomp. by boiling.

$+ H_2O$ . Sol. in  $NH_4Cl + Aq$ . (Wackenroder, A. 41. 315.)

Insol. in alcohol.

**Calcium hydrogen phosphite,  $CaH_2(HPO_3)_2 + H_2O$ .**

Sol. in  $H_2O$ . Aqueous solution is decomp. by alcohol. (Wurtz, A. ch. (3) 7. 212.)

**Chromic phosphite.**

Precipitate. Almost insol. in  $H_2O$ . (Rose, Pogg. 9. 40.)

**Cobaltous phosphite,  $CoPHO_3 + 2H_2O$ .**

Ppt. Sl. sol. in  $H_2O$ . (Rose.)



**Cupric phosphite,  $\text{CuHPO}_3 + 2\text{H}_2\text{O}$ .**  
Ppt. Insol. in  $\text{H}_2\text{O}$ . (Wurtz, A. ch. (3) 16. 213.)

**Didymium phosphite,  $\text{Di}_2(\text{HPO}_3)_2$ .**  
Precipitate. (Frerichs and Smith, A. 191. 331.)

**Glucinum phosphite.**  
Precipitate. Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 9. 39.)

**Iron (ferrous) phosphite,  $\text{FeHPO}_3 + x\text{H}_2\text{O}$ .**  
Ppt. Nearly insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 9. 35.)

**Iron (ferric) phosphite, basic,  $\text{Fe}_2(\text{HPO}_3)_3$ ,  $\text{Fe}_2(\text{OH})_3$ .**  
(Grützner, Arch. Pharm. 1897, 235. 697.)  
 $\text{Fe}_2(\text{HPO}_3)_3$ ,  $\text{Fe}(\text{OH})_3 + 5\text{H}_2\text{O}$ . Hydroscopic. (Berger, C. R. 1904, 138. 1500.)

**Iron (ferric) phosphite,  $\text{Fe}_2(\text{HPO}_3)_3 + 9\text{H}_2\text{O}$ .**  
Ppt. Sol. in iron alum + Aq. (Rose.)

**Lanthanum phosphite,  $\text{La}_2(\text{HPO}_3)_3$ .**  
Precipitate. (Smith.)

**Lead phosphite, basic,  $4\text{PbO}$ ,  $\text{P}_2\text{O}_5 + 2\text{H}_2\text{O}$ .**  
Ppt. (Rose, Pogg. 9. 222.)  
 $3\text{PbO}$ ,  $\text{P}_2\text{O}_5 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in warm dil.  $\text{H}_3\text{PO}_3 + \text{Aq}$ , from which it is pptd. by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Wurtz, A. ch. (3) 16. 214.)

**Lead phosphite,  $\text{PbHPO}_3$ ,**  
Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in a solution of phosphorous acid; easily sol. in cold  $\text{HNO}_3 + \text{Aq}$ . (Wurtz.)

**Lead hydrogen phosphite,  $\text{PbH}_2(\text{PO}_3)_2$ ,**  
Decomp. by  $\text{H}_2\text{O}$ . (Amat, C. R. 110. 901.)

**Lead pyrophosphite,  $\text{PbH}_2\text{P}_2\text{O}_5$ .**  
Gradually decomp. by  $\text{H}_2\text{O}$  into  $\text{H}_2\text{PO}_3$  and  $\text{PbHPO}_3$ . (Amat, C. R. 110. 903.)

**Lithium hydrogen phosphite,  $\text{LiH}_2\text{PO}_3$ .**  
Very sol. in  $\text{H}_2\text{O}$ . (Amat, A. ch. (6) 24. 309.)

**Lithium pyrophosphite,  $\text{Li}_2\text{H}_2\text{P}_2\text{O}_5$ .**  
Very sol. in  $\text{H}_2\text{O}$ . (Amat. A. ch. 1891, (6) 24. 352.)

**Magnesium phosphite,  $\text{MgHPO}_3 + 3\text{H}_2\text{O}$ .**  
Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 9. 28.)  
Sol. in 400 pts.  $\text{H}_2\text{O}$ . (Berzelius.)  
 $+ 4\text{H}_2\text{O}$ .

**Magnesium pyrophosphite,  $\text{Mg}(\text{H}_2\text{PO}_3)_2$ .**  
Very sol. in  $\text{H}_2\text{O}$ . (Amat. A. ch. 1891, (6) 24. 313.)

**Manganous phosphite,  $\text{MnHPO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .**  
Difficultly sol. in  $\text{H}_2\text{O}$ , easily in  $\text{MnCl}_2$  or  $\text{MnSO}_4 + \text{Aq}$ . (Rose, Pogg. 9. 33.)

**Nickel phosphite,  $\text{NiHPO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .**  
Ppt. Sl. sol. in  $\text{H}_2\text{O}$ .

**Potassium phosphite,  $\text{K}_2\text{HPO}_3$ .**  
Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Dulong.)

**Potassium hydrogen phosphite,  $(\text{KH})\text{HPO}_3$ .**  
1 pt.  $\text{H}_2\text{O}$  dissolves about 1.72 pts. salt at  $20^\circ$ . (Amat. C. R. 106. 1351.)  
 $\text{K}_2\text{HPO}_3$ ,  $2\text{H}_2\text{PO}_3$ . Very sol. in  $\text{H}_2\text{O}$ . (Wurtz, A. 58. 63.)  
Sol. in 3 pts. cold, and in less hot  $\text{H}_2\text{O}$ . (Fourcroy and Vauquelin.)

**Potassium pyrophosphite,  $\text{K}_2\text{H}_2\text{P}_2\text{O}_5$ .**  
Very sol. in  $\text{H}_2\text{O}$ . (Amat. A. ch. (6) 24. 351.)

**Sodium phosphite, basic,  $\text{Na}_2\text{HPO}_3$ ,  $\text{NaOH}$  (?)**  
Not obtained in pure state (Zimmerman, B. 7. 290);  $= \text{Na}_2\text{PO}_3$  (Wislicenus.)  
Does not exist. (Amat.)

**Sodium phosphite,  $\text{Na}_2\text{HPO}_3 + 5\text{H}_2\text{O}$ .**  
Deliquescent, and very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.  
Correct formula for  $\text{Na}_2\text{PO}_3$  of Rose and Dulong.

**Sodium hydrogen phosphite,  $(\text{NaH})\text{HPO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ .**  
0.56 pt. salt dissolves in 1 pt.  $\text{H}_2\text{O}$  at  $0^\circ$ ; 0.66 pt. at  $10^\circ$ ; 1.93 pts. at  $42^\circ$ . (Amat, C. R. 106. 1351.)

$\text{Na}_2\text{H}_2(\text{HPO}_3)_2 + \text{H}_2\text{O}$ . Deliquescent in moist air. Sol. in 2 pts. cold, and about the same amt. hot  $\text{H}_2\text{O}$ . Sl. sol. in spirit. (Fourcroy and Vauquelin.)

**Sodium pyrophosphite,  $\text{Na}_2\text{H}_2\text{P}_2\text{O}_5$ .**  
Very sol. in  $\text{H}_2\text{O}$  with gradual decomp. into  $\text{Na}_2\text{HPO}_3$ . (Amat.)

**Strontium phosphite,  $\text{SrHPO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ .**  
Difficultly sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. on heating into a sol. acid salt and an insol. basic salt.

**Strontium hydrogen phosphite,  $\text{SrH}_2(\text{PO}_3)_2$ .**  
Very sol. in  $\text{H}_2\text{O}$ . (Amat, A. ch. (6) 24. 312.)

**Thalious hydrogen phosphite,  $\text{TiH}_2\text{PO}_3$ .**  
Very sol. in  $\text{H}_2\text{O}$ . (Amat, A. ch. (6) 24. 310.)

**Thalious pyrophosphite,  $\text{Ti}_2\text{H}_2\text{P}_2\text{O}_5$ .**  
Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . (Amat.)

**Tin (stannous) phosphite,  $\text{SnHPO}_3$ .**

Ppt. Sol. in  $\text{HCl} + \text{Aq.}$  (Rose, Pogg. 9. 45.)

**Tin (stannic) phosphite,  $2\text{SnO}_3, \text{P}_2\text{O}_3$ .**

Ppt. (Rose, Pogg. 9. 47.)

**Titanium phosphite (?)**

Precipitate. (Rose, Pogg. 9. 47.)

**Uranyl phosphite,  $(\text{UO}_2)_2\text{H}_2(\text{HPO}_3)_4 + 12\text{H}_2\text{O}$ .**

Precipitate. (Rammelsberg. Pogg. 132. 500.)

**Zinc phosphite,  $\text{ZnHPO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 132. 481.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . More easily sol. in cold than warm  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Zinc phosphite, acid,  $\text{Zn}_2\text{H}_3\text{P}_3\text{O}_8$ .**

Sol. in  $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 132. 498.)

$\text{Zn}_2\text{H}_3\text{P}_3\text{O}_{11}$ . Sol. in  $\text{H}_2\text{O}$ .

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

$\text{Zn}_2\text{H}_3\text{P}_3\text{O}_{14}$ . Sol. in  $\text{H}_2\text{O}$ .

+  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Zirconium phosphite,  $\text{Zr}(\text{PO}_3)_2 + \text{H}_2\text{O}$ .**

Ppt. Nearly insol. in dil. mineral acids. (Hauser, Z. anorg. 1913, 84. 92.)

**Phosphorous anhydride,  $\text{P}_2\text{O}_3$ .**

See Phosphorus trioxide.

**Phosphorus, P.**

(a) *Ordinary white phosphorus.* Insol. in  $\text{H}_2\text{O}$ , but slowly decomp. thereby (G. K.); very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius and others.)

A pure aqueous solution containing 0.1 g. P in 500 cc.  $\text{H}_2\text{O}$  can be obtained by dissolving 0.1 g. P in  $\text{CS}_2$  mixed with ether and hot alcohol; this solution is poured into 500 cc. boiling  $\text{H}_2\text{O}$  free from air, and the boiling continued with stirring until the alcohol, ether and  $\text{CS}_2$  are boiled off. (Bokorny, Ch. Ztg. 1896, 20. 1022.)

100 g.  $\text{H}_2\text{O}$  sat. with P contains 0.0003 g. P. (Stich, C. C. 1903, I. 1291.)

Sol. with decomp. in hot conc.  $\text{HNO}_3 + \text{Aq.}$  Decomp. by boiling caustic alkalies +  $\text{Aq.}$  Easily sol. in  $\text{SCl}_2$ , especially if hot. (Wöhler.)

Sol. in sulphur phosphides.

Largely sol. in  $\text{PCl}_5$ .

Easily sol. in  $\text{PCl}_3$ .

Sol. in  $\text{PBr}_3$ . Sol. in  $\text{PSCl}_2$ , easily on warming, separating on cooling. (Serullas, A. ch. 1829, 42. 25.)

Sol. in liquid  $\text{SO}_2$ . (Sestini, Bull. Soc. 1863, (2) 10. 226.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. in  $\text{S}_2\text{Cl}_2$ , without foaming. (Nicolardot, C. R. 1908, 147. 1304.)

Sol. in  $\text{PS}_2\text{Cl}_2$ . (Gladstone, A. 1850, 74. 91.)

Sol. in 320 pts. cold alcohol of 0.799 sp. gr., and in 240 pts. of the same when warm. Pptd. from alcoholic solution by  $\text{H}_2\text{O}$ . (Büchner.)

One grain P dissolves in 1 ounce abs. alcohol. (Schacht.)

Sol. in 20 pts. absolute ether at  $20^\circ$  and 240 pts. ordinary ether at  $20^\circ$ . (Bucholz.)

Sol. in 80 pts. absolute ether at  $15.5^\circ$  and 240 pts. ordinary ether at  $15.5^\circ$ . (Brugnatelli, A. ch. 24. 73.)

**Solubility of P<sub>4</sub> in 100 g. ether at  $t^\circ$ .**

$t^\circ$	G. phosphorus	Sp. gr.
0	0.4335	...
5	0.62	...
8	0.79	...
10	0.85	...
15	0.9	at $13^\circ$ 0.7257
18	1.005	...
20	1.04	at $19^\circ$ 0.7187
23	1.121	...
25	1.39	0.7283
28	1.601	...
30	1.75	...
33	1.8	...
35	1.9984	...

(Christomanos, Z. anorg. 1905, 45. 136.)

**Solubility of P<sub>4</sub> in 100 g. benzene at  $t^\circ$ .**

$t^\circ$	G. phosphorus	Sp. gr.
0	1.513	...
5	1.99	...
8	2.31	...
10	2.4	...
15	2.7	at $13^\circ$ 0.8959
18	3.1	...
20	3.21	at $19^\circ$ 0.8912
23	3.3995	at $22^\circ$ 0.8875
25	3.7	0.8861
28	4.35	...
30	4.601	...
33	5.0	...
35	5.17	...
40	5.75	...
45	6.105	...
50	6.8	...
55	7.315	...
60	7.9	...
65	8.4	...
70	8.898	...
75	9.4	...
81	10.027	...

(Christomanos.)

Sol. to about 1% in acetic acid. (Vulpus, Arch. Pharm. 1878, 213. 38.)  
 100 g. 96% acetic acid dissolve 0.105% P. (Stich, Pharm. Ztg. 1903, 48. 343.)  
 Sol. in 0.05 pt. CS<sub>2</sub> (Böttger); 0.125 pt. (Trommsdorf.)  
 Alcohol ppts. P from CS<sub>2</sub> solution.  
 1 pt. CS<sub>2</sub> dissolves 17-18 pts. P. (Vogel, J. B. 1868. 149.)

Solubility in CS<sub>2</sub> at t°.  
 (g. per 100 g. of solution.)

t°	G. P.	t°	G. P.
-10	31.40	-2.5	75.00
-7.5	35.85	0.0	81.27
-5	41.95	+5.0	86.30
-3.5	66.14	+10.0	89.80
-3.2	71.72	...	...

(Cohen and Inouye, Z. phys. Ch. 1910, 72. 418.)

Very sol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)  
 Strong vinegar dissolves P. (Beudet.)  
 Sol. in considerable amount in stearic acid. (Vulpus, Arch. Pharm. (3) 13. 38.)  
 Sol. in ethyl chloride, benzoyl chloride, stannic chloride, and in liquid cyanogen.  
 Sl. sol. in ethyl nitrite, and wood-spirit.  
 Sl. sol. in acetone, with gradual decomposition.  
 Insol. in nicotine, and coniine.  
 Sl. sol. in cold, more sol. in hot benzene. (Mansfield.)  
 Sol. in 14 pts. hot, and less in cold petroleum from Amiano. (Saussure.)  
 Sl. sol. in "liquid paraffine." (Crismer, B. 17. 649.)  
 Sl. sol. in warm essential oils, as oil of turpentine, and in the fatty oils.  
 Sol. in hot oil of copaiba, separating out on cooling.  
 Sol. in hot oil of caraway, and mandarin oil. (Luca.)  
 Sl. sol. in cold, more sol. in hot caoutchouin, depositing on cooling.  
 Readily sol. in warm, less in cold styrene.  
 Sol. in aniline, and quinoline. (Hofmann.)  
 Sl. sol. in cold creosote.  
 Somewhat sol. in fusel oil.  
 Easily sol. in valerianic acid, and amyl valerate.  
 Sol. in hexyl alcohol, ethylene chloride, allyl sulphocyanide, mercury methyl, chloroform, bromoform, warm chloral, acetic ether, aldehyde, hot cacodyl sulphide, and in cacodyl oxide.  
 100 g. oil of almonds sat. with P contain 1.25 g. (Stich, C. C. 1903, I. 1291.)  
 100 g. oleic acid sat. with P contain 1.06 g. (Stich.)  
 100 g. paraffine sat. with P contain 1. g. (Stich.)

(b) *Amorphous phosphorus*. Insol. in H<sub>2</sub>O. Insol. in NH<sub>4</sub>OH + Aq. (Flückiger.)  
 Sol. in boiling KOH + Aq.

The statement of Burgess and Chapman, (Chem. Soc. 79. 1235) that red P is sol. in aqueous alcoholic alkali is incorrect. Both ordinary crystalline and amorphous red P are insol. in aqueous alcoholic alkali. (Michaelis, A. 1902, 325. 367.)

Insol. in liquid NH<sub>3</sub>. (Hugot, A. ch. 1900 (7) 21, 31); (Franklin, Am. Ch. J. 1898, 20. 828.)

Bright red variety is sol. in liquid NH<sub>3</sub> at ord. temp. leaving a black residue. (Stoch, Böttcher and Lenger, B. 1909, 42. 2854.)

*Red. Amorphous.*

Sol. in S<sub>2</sub>Cl<sub>2</sub> with foaming. (Nicolardot, C. R. 1908, 147. 1304.)

Solubility of amorphous bright red P<sub>4</sub> in PBr<sub>3</sub> is diminished by long heating as follows:

	172°	185°
Initial concentration	0.555	0.476
Final concentration	0.374	0.397
Length of expt. in hours	34	24

	198°	218°
	0.592	0.476
	0.416	0.592
	18	17

(Buck, Dissert. 1904.)

Ordinary amorphous P<sub>4</sub> is sol. in PBr<sub>3</sub>.

A sample prepared by heating bright red amorphous P with 94.2% P dissolved by heating in PBr<sub>3</sub> as follows:

% P	0.106	0.121	0.178
hours	10	20	42

A finely pulverized commercial product containing 98.0% P:

% P	0.92	0.116
hours	10	20

An ordinary commercial product with 98% P:

% P	0.056	0.108
hours	10	42

(Buck.)

100 g. PBr<sub>3</sub> dissolve 0.2601 g. bright red phosphorus at 172°; 0.3634 g. at 184° (Schenk, B. 1902, 35. 353.)

Insol. in KOH + Aq.

Conc. H<sub>2</sub>SO<sub>4</sub> does not act upon it in the cold, but dissolves easily when hot.

Insol. in dil., easily sol. in conc. HNO<sub>3</sub> + Aq with decomposition.

Much more sol. in HNO<sub>3</sub> + Aq than ordinary P. (Personne, C. R. 45. 115.)

Insol. in methylene iodide. (Retgers.)

Appreciably sol. in isobutyl alcohol. (Svedberg.)

Insol. in CS<sub>2</sub>, alcohol, ether, naphtha, ligroine, PCl<sub>3</sub>, etc.

Sl. sol. in boiling oil of turpentine and

other high-boiling liquids, with conversion into ordinary phosphorus.

Insol. in oil of turpentine even at 270°.  
(Colson, A. ch. 1908, (8) 14. 554.)

(c) *Crystalline*. Insol. in, and not attacked by dil.  $\text{HNO}_3$  + Aq.

Sol. in  $\text{CS}_2$ .

#### Phosphorus tribromide, $\text{PBr}_3$ .

Decomposed by  $\text{H}_2\text{O}$ , slowly at 8°, but very rapidly at 25°. (Léwig, Pogg. 14. 485.)

Sol. in liquid  $\text{H}_2\text{S}$ . (Antony and Magri, Gazz. ch. it. 1906, 35. (1) 206.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

Sol. in ether, acetone,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$  and  $\text{CS}_2$ . (Christomanos, Z. anorg. 1904, 41. 287.)

#### Phosphorus pentabromide, $\text{PBr}_5$ .

Fumes on air, and is violently decomp. by  $\text{H}_2\text{O}$ .

#### Phosphorus tribromide ruthenium bromide, $\text{Ru}_2\text{P}_3\text{Br}_{15}$ .

Decomp. by boiling  $\text{H}_2\text{O}$ .

Slowly sol. in hot alcohol with decomp.

Insol. in benzene,  $\text{CCl}_4$ , ligroin and cold alcohol. (Strecker, B. 1909, 42. 1775.)

#### Phosphorus thiophosphoryl bromide, $\text{PBr}_3$ , $\text{PSBr}_3$ .

Decomp. by  $\text{H}_2\text{O}$  into  $\text{PSBr}_3$ . (Michaelis.)

#### Phosphorus tribromide ammonia, $3\text{PBr}_3$ , $5\text{NH}_3$ .

Slowly but completely sol. with decomp. in  $\text{H}_2\text{O}$ . (Storer's Dict.)

#### Phosphorus pentabromide ammonia, $\text{PBr}_5$ , $9\text{NH}_3$ .

(Besson, C. R. 111. 972.)

#### Phosphorus monobromotetrachloride, $\text{PBrCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Prinvault, C. R. 74. 868.)

#### Phosphorus dibromotrichloride, $\text{PBr}_2\text{Cl}_3$ .

Very unstable. (Michaelis, B. 5. 9.)

#### Phosphorus tetrabromotrichloride, $\text{PBr}_4\text{Cl}_3$ .

Decomp. with  $\text{H}_2\text{O}$ . (Geuther.)

#### Phosphorus heptabromodichloride, $\text{PBr}_7\text{Cl}_2$ .

Very unstable. (Prinvault, C. R. 74. 868.)

#### Phosphorus octobromotrichloride, $\text{PBr}_8\text{Cl}_3$ .

Very easily decomp. (Michaelis, B. 5. 9.)

#### Phosphorus bromofluoride, $\text{PF}_3\text{Br}_3$ .

Decomp. violently with  $\text{H}_2\text{O}$ . (Moissan, Bull. Soc. (2) 43. 2.)

#### Phosphorus bromonitride.

See Nitrogen bromophosphide.

#### Phosphorus dichloride, $\text{P}_2\text{Cl}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 1910, 150. 103.)

#### Phosphorus trichloride, $\text{PCl}_3$ .

Gradually decomp. by  $\text{H}_2\text{O}$ .

0.11 g. is sol. in 100 ccm. liquid  $\text{H}_2\text{S}$ . (Antony, Gazz. ch. it. 1905, 35. (1) 206.)

Acted upon by liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Miscible with  $\text{CS}_2$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CHCl}_3$ , and ether.

Decomp. with alcohol.

#### Phosphorus pentachloride, $\text{PCl}_5$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with violent decomp. and evolution of heat. Sol. in liquid  $\text{HCl}$ . Acted upon by liquid  $\text{NH}_3$ . Somewhat sol. without decomp. in  $\text{CS}_2$ . (Schiff, A. 102. 118. (Franklin, Am. Ch. J. 1898, 20. 828.)

Sol. without decomp. in benzoyl chloride. (Gerhardt.)

Sol. in oil of turpentine with evolution of heat.

#### Monophosphorus platinous chloride, $\text{PCl}_3$ , $\text{PtCl}_3$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with formation of chloroplatinophosphoric acid. Similarly decomp. by alcohol. Abundantly sol. in hot benzene, toluene, chloroform, or carbon tetrachloride, and crystallizes on cooling. (Schützenberger, Bull. Soc. (2) 17. 482.)

#### Diphosphorus platinous chloride, $2\text{PCl}_3$ , $\text{PtCl}_5$ .

Decomp. by  $\text{H}_2\text{O}$  with formation of chloroplatinodiphosphoric acid. Similarly decomp. by alcohol. Sol. without decomp. in  $\text{PCl}_3$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , or  $\text{C}_7\text{H}_8$ . (Schützenberger.)

Sol. in propyl alcohol with formation of the propyl ether of platinochlorophosphoric acid and  $\text{HCl}$ . (Pomey, C. R. 104. 364.)

#### Phosphorus diplatinous chloride, $\text{PCl}_3$ , $2\text{PtCl}_3$ .

Sol. in alcohol, with formation of ether  $(\text{PtCl}_3)_2\text{P}(\text{OC}_2\text{H}_5)_2$ . (Cochin, C. R. 86. 1402.)

#### Phosphorus platinic chloride, $\text{PCl}_5$ , $\text{PtCl}_5$ . (Schützenberger.)

#### Phosphorus pentachloride platinic chloride, $\text{PCl}_5$ , $\text{PtCl}_5$ , or $(\text{PCl}_5)_2\text{PtCl}_5$ .

Decomp. at once by  $\text{H}_2\text{O}$ . (Baudrimont, A. ch. (4) 2. 47.)

**Phosphorus pentachloride selenium tetrachloride**,  $2\text{PCl}_5, \text{SeCl}_4$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Baudrimont, A. ch. (4) 2. 5.)

**Phosphorus trichloride ruthenium chloride**,  $\text{Ru}_2\text{P}_2\text{Cl}_{10}$ .

Slowly decomp. by boiling  $\text{H}_2\text{O}$ .

Sol. in benzene and  $\text{CHCl}_3$ .

Sl. sol. in  $\text{CCl}_4$ . Insol. in ligroin. (Strecker, B. 1909, 42. 1774.)

**Phosphorus tellurium chloride**,  $\text{PCl}_5, 2\text{TeCl}_4$ .

Very deliquescent.

Sol. in  $\text{H}_2\text{O}$ . (Metzner, A. ch. 1898, (7) 15. 203.)

**Phosphorus pentachloride stannic chloride**,  $\text{PCl}_5, \text{SnCl}_4$ .

Very deliquescent. Sol. in much  $\text{H}_2\text{O}$  with evolution of heat, forming  $\text{SnCl}_4$ ,  $\text{HCl}$ , and  $\text{H}_3\text{PO}_4$ , and soon separates out stannic phosphate. (Casselmann, A. 83. 257.)

**Phosphorus trichloride titanium chloride**,  $\text{PCl}_5, \text{TiCl}_4$ .

(Bertrand, Bull. Soc. (2) 33. 565.)

**Phosphorus pentachloride titanium chloride**,  $\text{PCl}_5, \text{TiCl}_4$ .

Deliquescent. Decomp. by  $\text{H}_2\text{O}$  and alcohol. Sol. in ether. Sl. sol. in  $\text{PCl}_5$ . (Tüttschew, A. 141. 111.)

Completely sol. in dil. acids. (Weber.)

**Phosphorus uranium pentachloride**,  $\text{PCl}_5, \text{UCl}_4$ .

Decomp. with  $\text{H}_2\text{O}$ .

**Phosphorus pentachloride zirconium chloride**,  $\text{PCl}_5, \text{ZrCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$  with pptn. of Zr phosphate. (Paykull.)

**Phosphorus trichloride ammonia**,  $\text{PCl}_5, 5\text{NH}_3$ .

Insol. as such in  $\text{H}_2\text{O}$ , but slowly decomp. by boiling  $\text{H}_2\text{O}$ . More easily sol. with decomp. in acids. Sol. with decomp. by boiling with  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . (Berzelius.)

**Phosphorus pentachloride ammonia**,  $\text{PCl}_5, 5\text{NH}_3$ .

Properties as  $\text{PCl}_5, 5\text{NH}_3$ . (Berzelius.)

$\text{PCl}_5, 8\text{NH}_3$ . Sl. decomp. on air. (Beeson, C. R. 111. 972.)

**Phosphorus pentachloride tungsten trioxide**,  $2\text{PCl}_5, \text{WO}_3(?)$ .

(Persoz and Bloch, C. R. 28. 389.)

**Phosphorus chlorobromide**.

See Phosphorus bromochloride.

**Phosphorus chlorofluoride**,  $\text{PCl}_2\text{F}_2$ .

Absorbed by  $\text{H}_2\text{O}$  with decomp. Absorbed by alcohol or ether. (Poulenc, A. ch. (6) 24. 555.)

**Phosphorus chloriodide**,  $\text{PCl}_2\text{I}_2$ .

Decomp. by moist air or  $\text{H}_2\text{O}$ . Sol. in  $\text{CS}_2$ . (Most, B. 13. 2029.)

**Phosphorus chloronitride**.

See Nitrogen chlorophosphide.

**Phosphorus trifluoride**,  $\text{PF}_3$ .

Decomp. slowly by  $\text{H}_2\text{O}$ . (Moissan, Bull. Soc. (2) 43. 2.)

Rapidly absorbed by  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , slowly by  $\text{BaO}, \text{H}_2\text{S}$ , and  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Absorbed by absolute alcohol with decomp. (Moissan, C. R. 99. 655.)

**Phosphorus pentafluoride**,  $\text{PF}_5$ .

Fumes on air. (Thorpe, A. 182. 20.)

**Phosphorus pentafluoride ammonia**,  $2\text{PF}_5, 5\text{NH}_3$ .

(Moissan, C. R. 101. 1490.)

**Phosphorus pentafluoride nitrogen peroxide**.

Decomp. by  $\text{H}_2\text{O}$ . (Tassel, C. R. 110. 1264.)

**Phosphorus fluobromide**.

See Phosphorus bromofluoride.

**Phosphorus fluochloride**.

See Phosphorus chlorofluoride.

**Phosphorus subiodide**,  $\text{P}_2\text{I}_4$ .

Sol. in dil.  $\text{HNO}_3$  and in alkalies +  $\text{Aq}$ . (Boulouch, C. R. 1905, 141. 257.)

**Phosphorus diiodide**,  $\text{P}_2\text{I}_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{CS}_2$ . (Corenwinder, A. ch. (3) 30. 242.)

0.09 g. is sol. in 100 ccm. liquid  $\text{H}_2\text{S}$ . (Antony, C. C. 1905, I. 1692.)

**Phosphorus triiodide**,  $\text{PI}_3$ .

Very deliquescent. Decomp. in moist air and by  $\text{H}_2\text{O}$ . (Corenwinder, A. ch. (3) 30. 242.)

Very sol. in  $\text{CS}_2$ .

**Phosphorus pentaiodide**,  $\text{PI}_5(?)$ .

(Hampton, C. N. 42. 180.)

**Phosphorus iodosulphide**.

See Phosphorus sulphiodide.

**Phosphorus nitride**,  $\text{P}_2\text{N}_4$ .

Very slightly decomp. by long boiling with  $\text{H}_2\text{O}$ .

Completely insol. in any solvent. (Stock, B. 1903, 36. 317.)

**Phosphorus suboxide,  $P_2O$ .**

Unchanged in dry, gradually oxidized in moist air. Insol. in  $H_2O$ , alcohol, ether, and oils; not acted on by  $HCl + Aq$ ; oxidized by  $HNO_3$  or  $H_2SO_4$ . (Marchand, J. pr. 13. 442.)

Sl. sol. in  $H_2O$ . (le Verrier, A. 27. 167.)

Forms hydrate  $P_2O \cdot 2H_2O$ , which gives up its  $H_2O$  when dried.

Two modifications: (a) decomp. slowly by  $H_2O$  or alkalis, (b) not decomp. by  $H_2O$  or alkalis. (Reinitzer and Goldschmidt, B. 13. 847.)

Is oxyphosphuretted hydrogen (?),  $P_2H(OH)$ . (Franke, J. pr. (2) 35. 341.)

**—  $H_2P_2O$ .**

Insol. in all solvents. Decomp. by  $H_2O$ . Not attacked by non-oxidizing acids. Decomp. by dil. alkalis. (Gautier, C. R. 76. 173.)

**—  $P_4HO$ .**

Insol. in nearly all substances. Not attacked by dilute acids; oxidized by ordinary  $HNO_3$ , and conc.  $H_2SO_4$  at  $200^\circ$ . Attacked by very dil. alkaline solutions. Perhaps identical with phosphorus suboxide  $P_2O$ . (Gautier, C. R. 76. 49.)

**Phosphorus oxide,  $P_2O$ .**

Decomp. by heating with  $H_2O$  at  $100^\circ$ . (Besson, C. R. 1897, 124. 764.)

**Phosphorus trioxide,  $P_2O_3$  (formerly  $P_2O_4$ ).**

Deliquescent, but very slowly dissolved by cold  $H_2O$  to form  $H_3PO_3$ . Violently decomp. by hot  $H_2O$  or alcohol.

Sol. without decomp. in ether, carbon disulphide, benzene, or chloroform. (Thorpe and Tutton, Chem. Soc. 57. 545.)

**Phosphorus tetroxide,  $P_2O_4$ .**

Very deliquescent. Sol. with evolution of heat in  $H_2O$ . (Thorpe and Fulton, Chem. Soc. 49. 833.)

**Phosphorus pentoxide,  $P_2O_5$ .**

Very deliquescent. Sol. in  $H_2O$  with great evolution of heat, forming  $H_3PO_4$ .

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Eidmann, C. C. 1899, (I. 1014); (Naumann, B. 1904, 37. 4329.)

**Phosphorus sulphur oxide,  $P_2O_4 \cdot 3SO_2 = (PO)_2(SO_4)_3$  (phosphoryl sulphate) (?).**

Decomp. by  $H_2O$ . Sol. in cold, more sol. in warm  $SO_2$ . (Weber, B. 20. 86.)

**Phosphorus oxy-compounds.**

See under Phosphoryl compounds.

**Phosphorus oxysulphide.**

See Phosphorus sulphoxide.

**Phosphorus semiselenide,  $P_2Se$ .**

Decomp. with  $H_2O$ . Insol. in cold, decomp. by boiling  $KOH + Aq$ . Insol. in, but apparently decomp. by alcohol and ether. Easily sol. in  $CS_2$ . (Hahn, J. pr. 93. 430.)

**Phosphorus monoselenide,  $P_2Se$ .**

Stable in dry, decomp. in moist air and by  $H_2O$ . Insol. in alcohol and ether. Decomp. by boiling  $KOH + Aq$ .  $CS_2$  dissolves out P. (Hahn, J. pr. 93. 430.)

Sl. sol. in  $CS_2$ . (Gore, Phil. Mag. (4) 30. 414.)

**Phosphorous sesquiselenide,  $P_4Se_3$ .**

Sol. in  $CCl_4$ ; sl. sol. in  $CS_2$ . (Meyer, Z. anorg. 1902, 30. 258.)

**Phosphorus triselenide,  $P_2Se_3$ .**

Decomp. by boiling  $H_2O$  and slowly in moist air. Easily sol. in cold  $KOH + Aq$ , less easily in  $M_2CO_3 + Aq$ . Insol. in alcohol, ether, and  $CS_2$ . (Hahn, J. pr. 93. 430.)

**Phosphorus pentaselenide,  $P_2Se_5$ .**

Slowly decomp. in moist air or by  $H_2O$ , easily by  $KOH + Aq$  or alcohol. Insol. in  $CS_2$ . Sol. in  $CCl_4$ . (Hahn, J. pr. 93. 430.)

**Phosphorus selenides with  $M_2Se$ .**

See M phosphoselenide, under M.

**Phosphorus semisulphide,  $P_2S(?)$ .**

1. *Liquid*. Not decomp. by, and insol. in boiled  $H_2O$ . Insol. in alcohol and ether. Sl. sol. in fats and volatile oils; decomp. by alkalis. Dissolves P on warming, with separation on cooling. Sol. in  $CS_2$ .

2. *Red modification*. Not attacked at first by  $HNO_3 + Aq$  (sp. gr. 1.22), but after a time is attacked with the greatest violence. Weak acids attack only when hot. (Berzelius, A. 46. 129.)

Existence is doubtful. (Schulze, B. 13. 1862; Isambert, C. R. 96. 1628.)

**Phosphorus monosulphide,  $P_2S(?)$ .**

1. *Ordinary*. Same properties as phosphorus semisulphide, 1.

2. *Red modification*. Unchanged by air,  $H_2O$ , or alcohol. Decomp. by conc.  $KOH + Aq$ , not by dilute. Sl. sol. in  $NH_4OH + Aq$ . (Berzelius, A. 46. 129.)

Existence is doubtful. (Schulze; Isambert.)

Does not exist. (Helff, Z. phys. Ch. 12. 206.)

**Phosphorus sesquisulphide,  $P_2S_3$ .**

Not attacked by cold, slowly by hot  $H_2O$ . Cold  $KOH + Aq$  dissolves with decomp.

Oxidized by  $\text{HNO}_3$  and aqua regia. Sol. in alcohol and ether with decomp. Sol. in  $\text{CS}_2$  (100 pts.  $\text{CS}_2$  dissolve 60 pts.  $\text{P}_2\text{S}_2$ ),  $\text{PCl}_3$ , and  $\text{PSCl}_3$ , and in  $\text{K}_2\text{S}$  or  $\text{Na}_2\text{S} + \text{Aq.}$  (Lemoine, Bull. Soc. (2) 1. 407.)

Very sol. in  $\text{CS}_2$ . (Rebs, A. 246. 367.)

Decomp. by dil. and conc.  $\text{KOH} + \text{Aq.}$  1 pt.  $\text{P}_2\text{S}_2$  is sol. in 9 pts.  $\text{CS}_2$  at  $-20^\circ$ ; in 3.7 pts.  $\text{CS}_2$  at  $0^\circ$ ; in 1 pt.  $\text{CS}_2$  at  $17^\circ$ ; in 40 pts. benzene at  $17^\circ$ ; in 9 pts. benzene at  $80^\circ$ ; in 32 pts. toluene at  $17^\circ$ ; in 6.5 pts. toluene at  $111^\circ$ . (Stock, B. 1910, 43. 156.)

#### Phosphorus trisulphide, $\text{P}_2\text{S}_3$ .

Decomp. by water. (Kekulé, A. 90. 310.)

Sol. in  $\text{M}_2\text{CO}_3 + \text{Aq}$  with separation of S. Easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq.}$  (Berzelius, A. 46. 129.)

Sol. in alcohol and ether. (Lemoine.)

Correct formula is  $\text{P}_2\text{S}_3$ . (Isambert, C. R. 102. 1386.)

Extremely sl. sol. in  $\text{CS}_2$ . (Rebs, A. 246. 368.)

Existence doubtful. (Helff, Z. phys. Ch. 12. 210.)

#### Phosphorus sulphide, $\text{P}_2\text{S}_7$ .

Sl. sol. in  $\text{CS}_2$ . (Mai, A. 265. 192.)

Slowly decomp. by cold, rapidly by hot  $\text{H}_2\text{O}$ .

Sol. in cold alkalis.

1 pt. is sol. in 3500 pts.  $\text{CS}_2$  at  $17^\circ$ ; in 20,000 pts. at  $0^\circ$ . (Stock, B. 1910, 43. 416.)

#### Phosphorus disulphide, $\text{P}_2\text{S}_2$ (formerly $\text{P}_2\text{S}_4$ ).

Almost insol. in  $\text{CS}_2$ . (Helff.)

#### Phosphorus pentasulphide, $\text{P}_2\text{S}_5$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$ . Very sol. in  $\text{KOH}$ ,  $\text{NaOH}$ ,  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{M}_2\text{CO}_3 + \text{Aq}$  with separation of S at low temp. Decomposes alcohol, acetic acid, etc. (Kekulé, A. 106. 331.)

Sol. in  $\text{CS}_2$ . (Isambert, C. R. 102. 1386.)

Not very sol. in  $\text{CS}_2$ . (Rebs, A. 246. 367.)

Mpt.,  $290^\circ$ ; bpt.,  $513-515^\circ$  at 760 mm.

Decomp. by  $\text{H}_2\text{O}$ .

Easily sol. in warm  $\text{NaOH} + \text{Aq.}$

1 pt. is sol. in 450 pts.  $\text{CS}_2$  at room temp.; in 550 pts. at  $0^\circ$ ; in 1200 pts. at  $-20^\circ$ . (Stock, B. 1910, 43. 1225.)

Ordinary form.

Sol. in 195 pts. boiling  $\text{CS}_2$ .

New form.

Sol. in 32 pts.  $\text{CS}_2$ . (Stock, B. 1905, 38. 2722.)

#### Phosphorus persulphide, $\text{P}_2\text{S}_8$ (?).

Decomp. by  $\text{H}_2\text{O}$ , alkalis, etc. Consists of S, and mechanically united P. (Ramme, B. 12. 941.)

#### Phosphorus sulphides with $\text{M}_2\text{S}$ .

See M Phosphosulphide, under M.

#### Phosphorus zinc sulphide, $\text{ZnP}_2\text{S}_2$ .

Sol. in  $\text{HCl} + \text{Aq}$  with separation of  $\text{P}_2\text{S}$  (?). (Berzelius, A. 46. 150.)

#### Phosphorus trisulphide ammonia, $\text{P}_2\text{S}_3, 2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bineau.)

#### Phosphorus pentasulphide ammonia,

$\text{P}_2\text{S}_5, 6\text{NH}_3$ .

Sol. in liquid  $\text{NH}_3$ . (Stock, B. 1903, 36. 314.)

$\text{P}_2\text{S}_5, 7\text{NH}_3$ . (Stock.)

#### Phosphorus sulphobromide.

See Thiophosphoryl bromide.

#### Phosphorus sulphochloride.

See Thiophosphoryl chloride.

#### Phosphorus sulphiodide, $\text{P}_2\text{S}_2\text{I}$ .

Sl. attacked by cold, rapidly by hot  $\text{H}_2\text{O}$ ; violently decomp. by fuming  $\text{HNO}_3$ . Easily sol. in  $\text{CS}_2$ . Sl. sol. in  $\text{C}_6\text{H}_6$  or  $\text{CHCl}_3$ , and still less in ether or absolute alcohol. (Ouvrard, C. R. 115. 1301.)

$\text{P}_2\text{S}_2\text{I}$ . Easily sol. in  $\text{CS}_2$ . More easily than  $\text{P}_2\text{S}_2\text{I}_2$ , and less than  $\text{PI}_3$ . (Ouvrard, A. ch. 1894, (7) 2. 224.)

$\text{P}_2\text{SI}_2$ . Easily decomp. (Ouvrard.)

$\text{P}_2\text{SI}_3$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in warm ether. Sl. sol. in benzene,  $\text{CHCl}_3$ , and glacial acetic acid; sol. in toluene and xylene. (Wolter, Ch. Ztg. 1907, 31. 640.)

Easily sol. in  $\text{CS}_2$ . Sl. sol. in benzene, ether, absolute alcohol and  $\text{CHCl}_3$ . (Ouvrard, C. R. 1892, 115. 1301.)

#### Phosphorus sulphoxide, $\text{P}_2\text{O}_2\text{S}_4$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in 2 pts.  $\text{CS}_2$  without decomp. Sol. in benzene with decomp. (Thorpe and Tutton, Chem. Soc. 59. 1019.)

$\text{P}_2\text{O}_2\text{S}_4$ . Slowly decomp. by  $\text{H}_2\text{O}$ . Violently attacked by fuming  $\text{HNO}_3$ . (Besson, C. R. 1897, 124. 152.)

$\text{P}_2\text{SO}_4$ . Deliquescent; sol. in  $\text{H}_2\text{O}$  with decomp.; insol. in most solvents. (Stock, B. 1913, 46. 1382.)

#### Phosphoryl triamide, $\text{PO}(\text{NH}_2)_3$ .

Insol. in boiling  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ , or dil. acids. Decomp. by long boiling with  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . More easily decomp. with aqua regia. Easily sol. in warm  $\text{H}_2\text{SO}_4$ , or nitrosulphuric acid. (Schiff, A. 101. 300.)

Does not exist. (Gladstone; Mente, A. 248. 238.)

#### Phosphoryl bromide, $\text{POBr}_3$ .

Not miscible with  $\text{H}_2\text{O}$ , but gradually decomp. in contact with it. Sol. in  $\text{H}_2\text{SO}_4$ , ether, oil of turpentine (Gladstone, Phil. Mag. (3) 35. 345); in  $\text{CHCl}_3$ ,  $\text{CS}_2$  (Baudrimont, Bull. Soc. 1861. 118.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, **29**, 374.)

Sol. in  $\text{CCl}_4$  and in  $\text{C}_6\text{H}_6$ . (Oddo, Chem. Soc. 1900, **78**, (2) 75.)

**Phosphoryl bromide sulphide.**

See Thiophosphoryl bromide.

**Phosphoryl bromochloride,  $\text{POCl}_2\text{Br}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Menschutkin, A. 139, 343.)

**Phosphoryl dibromochloride,  $\text{POClBr}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Geuther, Jena Zeit. 10, 130.)

**Phosphoryl chloride,  $\text{POCl}$ .**

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp. Insol. in most solvents. Sol. in  $\text{PCl}_5$ . (Besson, C. R. 1897, **125**, 772.)

$\text{POCl}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Not acted on by liquid  $\text{CO}_2$ ,  $\text{P}$ ,  $\text{PH}_3$ ,  $\text{CS}_2$ ,  $\text{I}$ ,  $\text{Br}$ ,  $\text{Cl}$ , etc. Sol. in  $\text{CCl}_4$ ,  $\text{C}_6\text{H}_6$ ,  $\text{CS}_2$ ,  $\text{CHCl}_3$ , and ether. (Oddo, Gazz. ch. it. 1899, **29**, (2) 318; Chem. Soc. 1900, **78**, (2) 74.)

**Phosphoryl boron chloride,  $\text{POCl}_2\text{BCl}_2$ .**

See Boron phosphoryl chloride.

**Phosphoryl stannous chloride,  $\text{POCl}_2\text{SnCl}_2$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Casselmann, A. 91, 242.)

**Phosphoryl stannic chloride,  $\text{POCl}_2\text{SnCl}_4$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Casselmann.)

**Phosphoryl titanium chloride,  $\text{POCl}_2\text{TiCl}_4$ .**

Deliquescent, and decomp. by  $\text{H}_2\text{O}$ . (Weber, Pogg. **132**, 453.)

**Pyrophosphoryl chloride,  $\text{P}_2\text{O}_5\text{Cl}_4$ .**

Decomp. violently with  $\text{H}_2\text{O}$ . (Geuther and Michaelis, B. 4, 766.)

Very sol. in  $\text{H}_2\text{O}$  with decomp.; very unstable. (Besson, C. R. 1897, **124**, 1100.)

**Metaphosphoryl chloride,  $\text{PO}_2\text{Cl}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Gustavson.)

Does not exist. (Michaelis.)

**Phosphoryl fluoride,  $\text{POF}_3$ .**

Absorbed and decomp. at once by  $\text{H}_2\text{O}$  or alcohol. (Moissan, C. R. **102**, 1245.)

**Phosphoryl imidoamide,  $\text{PN}(\text{H})\text{H}_2\text{O}$  =  $\text{PO}(\text{NH})\text{NH}_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; gradually decomp. by boiling with  $\text{H}_2\text{O}$ , more rapidly in presence of  $\text{KOH}$ . Insol. in boiling conc.  $\text{HCl}$  + Aq. Insol. in cold, decomp. by hot  $\text{H}_2\text{SO}_4$ . Moderately dil.  $\text{H}_2\text{SO}_4$  + Aq dissolves without evolution

of gas. Insol. in boiling nitric or nitrosulphuric acid. (Gerhardt, A. ch. (3) **20**, 255.) Insol. in alcohol, oil of turpentine, etc.

**Phosphoryl iodide,  $\text{P}_2\text{I}_4\text{O}_5$  (?)**

Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Burton, Am. Ch. J. **3**, 280.)

$\text{PO}_2\text{I}_2$ . (Burton.)

**Phosphoryl nitride,  $\text{PON}$ .**

Insol. in  $\text{H}_2\text{O}$ , acids, or alkalies. (Gladstone, Chem. Soc. **2**, 121.)

**Phosphoryl chlorosulphide,  $\text{P}_2\text{O}_5\text{SCl}_4$ .**

Slowly decomp. in contact with  $\text{H}_2\text{O}$ . (Besson, C. R. 1897, **124**, 153.)

**Phosphoryl thio-compounds.**

See Thiophosphoryl compounds.

**Phosphoselenic acid.**

See Selenophosphoric acid.

**Phosphoselenide,  $\text{M}$ .**

See under  $\text{M}$ .

**Phosphosilicic acid.**

See Silicophosphoric acid.

**Phosphosilicosovanadicotungstic acid.**

**Ammonium phosphosilicosovanadicotungstate.**

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25**, 1225.)

**Phosphosilicovanadic acid,  $3\text{SiO}_2$ ,  $2\text{V}_2\text{O}_5$ ,  $2\text{P}_2\text{O}_5$  +  $6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Phosphostannosovanadicotungstic acid.**

**Ammonium phosphostannosovanadicotungstate.**

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, **25**, 1226.)

**Phosphosulphide,  $\text{M}$ .**

See under  $\text{M}$ .

**Phosphosulphuric anhydride,  $\text{P}_2\text{O}_5$ ,  $3\text{SO}_2$ .**

Very easily decomp. (Weber, B. **19**, 3190.)

**Phosphotelluric acid.**

**Ammonium phosphotellurate,  $2(\text{NH}_4)_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $\text{TeO}_2$  +  $4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1901, **23**, 61.)

$4(\text{NH}_4)_2\text{O}$ ,  $3\text{P}_2\text{O}_5$ ,  $2\text{TeO}_2$  +  $11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Weinland.)



**Potassium phosphotellurate**,  $1.5K_2O, P_2O_5, TeO_3$ .

+17.5  $H_2O$ . Very sol. in  $H_2O$ .

+4.5  $H_2O$ . Ppt. (Weinland.)

**Rubidium phosphotellurate**,  $1.5Rb_2O, P_2O_5, TeO_3 + 4.5H_2O$ .

Ppt. (Weinland.)

**Sodium phosphotellurate**,  $2Na_2O, P_2O_5, 2TeO_3 + 9H_2O$ .

Difficultly sol. in cold  $H_2O$ . (Weinland.)

**Phosphothorosovanadicotungstic acid.**

**Ammonium phosphothorosovanadicotungstate.**

Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1226.)

**Phosphotitanosovanadicotungstic acid.**

**Ammonium phosphotitanosovanadicotungstate.**

Formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1226.)

**Phosphotungstic acid**,  $P_2O_5, 12WO_3 + 42H_2O$ .

Not efflorescent. Sol. in  $H_2O$ , alcohol, and ether. (Péchar, C. R. 110. 754.)

$P_2O_5, 16WO_3 + 69H_2O$ . Very efflorescent. Sol. in  $H_2O$ , alcohol, and ether. (Péchar, C. R. 109. 301.)

+ $xH_2O = H_2PW_3O_{11} + xH_2O$  ( $\alpha$ -phospholuteotungstic acid). Known only in aqueous solution. (Kehrmann, B. 20. 1808.)

+ $48H_2O = H_2PW_3O_{11} + 16H_2O$  ( $\alpha$ -anhydrophospholuteotungstic acid). Sol. in its crystal  $H_2O$  by warmth of the hand; sol. in less than  $\frac{1}{2}$  pt.  $H_2O$ . (Kehrmann.)

Correct composition is represented by  $H_2PW_3O_{11} + 9H_2O$ . (Kehrmann, Z. anorg. 1. 422.)

$P_2O_5, 20WO_3 + 8H_2O$ . Very efflorescent. (Gibbs, B. 10. 1386.)

+ $19H_2O = H_{11}PW_{10}O_{38} + 8H_2O$ . Sol. in  $H_2O$ . (Scheibler, B. 5. 801.)

+50, and  $62H_2O$ . Very efflorescent. (Péchar, C. R. 109. 301.)

$3H_2O, P_2O_5, 21WO_3 + 30H_2O$ . Efflorescent. Sol. in  $H_2O$  in nearly every proportion.

$P_2O_5, 22WO_3 + 28H_2O = H_2PW_{11}O_{43} + 18H_2O$ . Efflorescent. (Scheibler, B. 5. 801.) Composition is  $6H_2O, 22WO_3, P_2O_5 + 45H_2O$ . (Gibbs.)

$H_2PO_4, 12WO_3 + 18H_2O$ , or  $P_2O_5, 24WO_3 + 39H_2O$ . Sol. in  $H_2O$ , alcohol and ether. (Soboleff, Z. anorg. 1896, 12. 18.)

$P_2O_5, 24WO_3 + 40H_2O = 6H_2O, P_2O_5, 24WO_3 + 34H_2O$ . Very efflorescent. Sol. in  $H_2O$ . (Gibbs.)

+ $45H_2O$ .

### Solubility in $H_2O$ at $t^\circ$ .

$t^\circ$	100 ccm. $H_2O$ dissolve g. of the cryst. acid	Sp. gr. of the solution
0	18.206	1.1890
22	49.718	1.6913
43	53.64	1.8264
92	86.75	2.5813

(Soboleff, Z. anorg. 1896, 12. 31.)

### Solubility in ether at $t^\circ$ .

$t^\circ$	100 ccm. ether dissolves g. of the cryst. acid.
0	81.196
7.8	85.327
19.2	96.017
24.2	101.348

(Soboleff.)

+ $53H_2O = 6H_2O, P_2O_5, 24WO_3 + 47H_2O$ . Sol. in  $H_2O$ . (Gibbs.)

Sol. in ether. If an equal vol. of ether is placed above a layer of conc. aqueous solution of acid, oily drops form between the two layers, which sink to bottom, forming a third layer. The sp. gr. of the latter is 1.525. The crystallized acid dissolved in smallest amt. ether forms an oil of sp. gr. = 2.063. Ethereal solution is miscible with alcohol, and also with a large quantity of  $H_2O$ . (Drechsel, B. 20. 1452.)

+ $61H_2O$ . Sol. in  $H_2O$ . (Gibbs, Proc. Am. Acad. 18. 116.)

**Aluminum ammonium phosphotungstate.**

See **Aluminicophosphotungstate, ammonium.**

**Ammonium phosphotungstate**,  $3(NH_4)_2O, P_2O_5, 7WO_3 + Aq$ .

Sl. sol. in cold  $H_2O$  without decomp. Decomp. by hot  $H_2O$ . (Kehrmann, Z. anorg. 1892, 1. 438.)

$2(NH_4)_2O, P_2O_5, 12WO_3 + 5H_2O$ . Insol. in cold  $H_2O$ . (Péchar, C. R. 110. 754.)

$6(NH_4)_2O, P_2O_5, 16WO_3 + 10H_2O$ . Easily sol. in hot  $H_2O$ . (Péchar.)

$5(NH_4)_2O, P_2O_5, 16WO_3 + xH_2O = (NH_4)_3PW_3O_{11} + xH_2O$ . (Ammonium  $\alpha$ -phospholuteotungstate). Sl. sol. in  $H_2O$ . (Kehrmann.)

$3(NH_4)_2O, P_2O_5, 16WO_3 + 16H_2O = (NH_4)_3PW_3O_{11} + 8H_2O$ . (Ammonium  $\alpha$ -anhydrophospholuteotungstate). Efflorescent. Easily sol. in  $H_2O$ . (Kehrmann.)

$5(NH_4)_2O, P_2O_5, 17WO_3 + 16H_2O$ . Very sl. sol. in cold  $H_2O$ . (Kehrmann, Z. anorg. 1894, 6. 387.)

$3(NH_4)_2O, P_2O_5, 18WO_3 + 14H_2O$ . (Phospholuteotungstate.) (Kehrmann, Z. anorg. 1893, 4. 140.)

$3(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 21\text{WO}_3 + x\text{H}_2\text{O}$ . Rather sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  and alcohol. Insol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Kehrmann and Freinkel, B. 25. 1972.)

$3(\text{NH}_4)_2\text{O}, 3\text{H}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 18\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Gibbs.)

$3(\text{NH}_4)_2\text{O}, 3\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 26\text{H}_2\text{O}$ . Very sl. sol. even in hot  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 122.)

**Ammonium barium  $\alpha$ -anhydropospholuteotungstate**,  $\text{NH}_4\text{BaPW}_{12}\text{O}_{41} + x\text{H}_2\text{O} = (\text{NH}_4)_2\text{O}, 2\text{BaO}, \text{P}_2\text{O}_5, 16\text{WO}_3 + x\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

**Barium phosphotungstate**,  $2\text{BaO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 15\text{H}_2\text{O}$ .

Very efflorescent. Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar, C. R. 110. 754.)

$3\text{BaO}, \text{P}_2\text{O}_5, 16\text{WO}_3 + x\text{H}_2\text{O} = \text{Ba}_3(\text{PW}_{12}\text{O}_{41}) + x\text{H}_2\text{O}$ . (Barium  $\alpha$ -anhydropospholuteotungstate). Not efflorescent. Quite difficultly sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$2\text{BaO}, \text{P}_2\text{O}_5, 16\text{WO}_3 + 10\text{H}_2\text{O}$ . Efflorescent. (Péchar, A. ch. (6) 22. 240.)

$2\text{BaO}, 6\text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 24\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 10. 1386.)

$6\text{BaO}, 2\text{H}_2\text{O}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 46\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 126.)

$7\text{BaO}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 59\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Sprenger, J. pr. (2) 22. 418.)

$+53\text{H}_2\text{O}$ . (Kehrmann, B. 24. 2335.)

$4\text{BaO}, 2\text{H}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 39\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Gibbs.)

$\text{BaO}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 59\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Sprenger.)

$2\text{BaO}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 59\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Sprenger.)

$3\text{BaO}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 46\text{H}_2\text{O} = 3\text{BaO}, 3\text{H}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 43\text{H}_2\text{O}$ . Easily sol. in hot  $\text{H}_2\text{O}$ . (Gibbs.)

$3\text{BaO}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 48\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Soboleff, Z. anorg. 1896, 12. 18.)

$+58\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Sprenger.)

Efflorescent. Sl. sol. in dil.  $\text{BaCl}_2 + \text{Aq.}$  (Kehrmann, Z. anorg. 1. 423.)

**Barium potassium phosphotungstate**,  $5\text{BaO}, 2\text{K}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 48\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Kehrmann and Freinkel, B. 25. 1968.)

**Barium silver phosphotungstate**,  $4\text{BaO}, 3\text{Ag}_2\text{O}, \text{P}_2\text{O}_5, 22\text{WO}_3 + 34\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . (Kehrmann and Freinkel, B. 25. 1966.)

**Barium sodium phosphotungstate**,  $2\text{BaO}, \text{Na}_2\text{O}, \text{P}_2\text{O}_5, 24\text{WO}_3 + 46\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , forming cloudy liquid, which clears up. Solution in  $\text{HCl}$  is not cloudy. (Brandhorst and Kraut, A. 249. 380.)

**Calcium phosphotungstate**,  $\text{CaO}, 5\text{H}_2\text{O}, 16\text{WO}_3, \text{P}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Readily sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 130.)

$2\text{CaO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 19\text{H}_2\text{O}$ . Efflorescent. Insol. in alcohol. (Péchar, C. R. 110. 754.)

$2\text{CaO}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 22\text{H}_2\text{O}$ . Efflorescent. (Péchar, A. ch. (6) 22. 233.)

**Cadmium phosphotungstate**,  $2\text{CdO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 13\text{H}_2\text{O}$ .

Sl. efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

**Cupric phosphotungstate**,  $3\text{CuO}, 24\text{WO}_3, \text{P}_2\text{O}_5 + 58\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Sprenger, J. pr. (2) 22. 418.)

$2\text{CuO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 11\text{H}_2\text{O}$ . Very efflorescent. (Péchar, C. R. 110. 754.)

$2\text{CuO}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 13\text{H}_2\text{O}$ . Efflorescent. (Péchar, A. ch. (6) 22. 235.)

**Lead phosphotungstate**,  $2\text{PbO}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 6\text{H}_2\text{O}$ .

Insol. in cold, sol. in boiling  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

$2\text{PbO}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 6\text{H}_2\text{O}$ . Sol. in boiling  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 236.)

**Lithium phosphotungstate**,  $\text{Li}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 21\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

**Magnesium phosphotungstate**,  $2\text{MgO}, \text{P}_2\text{O}_5, 12\text{WO}_3$ .

Sl. efflorescent. (Péchar, C. R. 110. 754.)

$2\text{MgO}, \text{P}_2\text{O}_5, 20\text{WO}_3 + 19\text{H}_2\text{O}$ . Sl. efflorescent. (Péchar, A. ch. (6) 22. 234.)

**Mercurous phosphotungstate**.

Insol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Péchar, C. R. 110. 754.)

**Potassium phosphotungstate**,  $\text{K}_2\text{O}, \text{P}_2\text{O}_5, 12\text{WO}_3 + 9\text{H}_2\text{O}$ .

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

$5\text{K}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + x\text{H}_2\text{O} = \text{K}_5\text{PW}_{12}\text{O}_{41} + x\text{H}_2\text{O}$ . (Potassium  $\alpha$ -phospholuteotungstate). Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in cold dil.  $\text{HNO}_3 + \text{Aq.}$  (Kehrmann.)

$3\text{K}_2\text{O}, \text{P}_2\text{O}_5, 16\text{WO}_3 + 16\text{H}_2\text{O} = \text{K}_3\text{PW}_{12}\text{O}_{41} + 8\text{H}_2\text{O}$ . (Potassium  $\alpha$ -anhydropospholuteotungstate). Efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$5\text{K}_2\text{O}, \text{P}_2\text{O}_5, 17\text{WO}_3 + 21$  or  $22\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1894, 6. 387.)

$3\text{K}_2\text{O}, \text{P}_2\text{O}_5, 18\text{WO}_3 + 28\text{H}_2\text{O}$ . (Duparc and Pearce, Bull. Soc. Min. 1895, 18. 42.)

$\text{K}_2\text{O}, 5\text{H}_2\text{O}, \text{P}_2\text{O}_5, 18\text{WO}_3 + 14\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 18\text{WO}_3 + 30\text{H}_2\text{O}$ , and  $23\text{H}_2\text{O}$ .

The  $23\text{H}_2\text{O}$  salt is more sol. in  $\text{H}_2\text{O}$  than the  $30\text{H}_2\text{O}$  salt. (Gibbs.)

$7\text{K}_2\text{O}$ ,  $\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+27\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, B. 10. 1386.)

$\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+5\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Péchar, A. ch. (6) 22. 231.)

$8\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+18\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$3\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $21\text{WO}_3+31\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$  or alcohol. Much less sol. in very dil.  $\text{HCl}+\text{Aq}$  or  $\text{KCl}+\text{Aq}$ . Decomp. by boiling  $\text{H}_2\text{O}$ . (Kehrmann and Freinkel, B. 25. 1971.)

$2\text{K}_2\text{O}$ ,  $4\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3+2\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$7\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3+31\text{H}_2\text{O}$ . Easily sol. in cold or hot  $\text{H}_2\text{O}$ . Insol. in alcohol. (Kehrmann, B. 25. 1966.)

$3\text{K}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3+8$ , and  $14\text{H}_2\text{O}$ . Sol. in a large amount of  $\text{H}_2\text{O}$  with partial decomp. (Gibbs, Proc. Am. Acad. 16. 120.)

Practically insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH}$ , alkalies, or alkali carbonates +  $\text{Aq}$ . (Kehrmann, B. 24. 2329.)

$6\text{K}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3+18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 15. 1.)

#### Potassium lead $\alpha$ -phospholutedungstate.

Sl. sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

Silver phosphotungstate,  $\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3+8\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Péchar, C. R. 110. 754.)

$5\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3+x\text{H}_2\text{O}=\text{Ag}_5\text{PW}_6\text{O}_{33}+x\text{H}_2\text{O}$  (Silver  $\alpha$ -phospholutedungstate). Ppt. (Kehrmann.)

$3\text{Ag}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $16\text{WO}_3+16\text{H}_2\text{O}=\text{Ag}_3\text{PW}_6\text{O}_{33}+8\text{H}_2\text{O}$ . (Silver  $\alpha$ -anhydrophospholutedungstate). Easily sol. in  $\text{H}_2\text{O}$ . (Kehrmann.)

$\text{Ag}_2\text{O}$ ,  $24\text{WO}_3$ ,  $\text{P}_2\text{O}_5+60\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ .

$3\text{Ag}_2\text{O}$ ,  $24\text{WO}_3$ ,  $\text{P}_2\text{O}_5+58\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Sprenger, J. pr. (2) 22. 418.)

Sodium phosphotungstate,  $3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $7\text{WO}_3+\text{Aq}$ .

Sol. in  $\text{H}_2\text{O}$ . (Kehrmann, Z. anorg. 1. 437.)

$5\text{Na}_2\text{O}$ ,  $11\text{H}_2\text{O}$ ,  $2\text{P}_2\text{O}_5$ ,  $12\text{WO}_3+26\text{H}_2\text{O}=\text{Na}_5\text{H}_{11}\text{P}_2\text{W}_{12}\text{O}_{61}+13\text{H}_2\text{O}$  (?). (Scheibler, B. 5. 801.)

$2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3+18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Péchar, C. R. 110. 754.)

$5\text{Na}_2\text{O}$ ,  $14\text{WO}_3$ ,  $2\text{P}_2\text{O}_5+42\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+2\text{H}_2\text{O}+19\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 1895, 17. 183.)

$\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+23\text{H}_2\text{O}=\text{Na}_2\text{O}$ ,  $7\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+16\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

+  $25\text{H}_2\text{O}$ . Sl. efflorescent; very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar, A. ch. (6) 22. 227.)

$2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Péchar.)

+  $30\text{H}_2\text{O}$ . (P.)

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $20\text{WO}_3+32\text{H}_2\text{O}$ . As above. (P.)

$2\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3+9\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$3\text{Na}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3+22\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Brandhorst and Kraut, A. 249. 379.)

+  $30\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Soboleff, Z. anorg. 1896, 12. 18.)

+  $42\text{H}_2\text{O}$ .

#### Solubility in $\text{H}_2\text{O}$ at $t^\circ$ .

$t^\circ$	100 ccm. $\text{H}_2\text{O}$ dissolve g. of the cryst. salt
0	22.04
22	59.65
93	98.184

(Soboleff, Z. anorg. 1896, 12. 31.)

$2\text{Na}_2\text{O}$ ,  $4\text{H}_2\text{O}$ ,  $24\text{WO}_3$ ,  $\text{P}_2\text{O}_5+23\text{H}_2\text{O}$ . Readily sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 16. 118.)

Sp. gr. at  $20^\circ$  of solutions of  $2\text{Na}_2\text{O}$ ,  $4\text{H}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $24\text{WO}_3+23\text{H}_2\text{O}$  containing:

10.22	20.94	31.13% salt,
1.085	1.190	1.316

42.61	52.92	64.11% salt.
1.496	1.702	2.001

or, by calculation,  $a=\text{sp. gr. if } \% \text{ is crystal-lized salt}$ ,  $b=\text{sp. gr. if } \% \text{ is anhydrous salt}$ :

	5	10	15	20	25% salt,
a	1.040	1.084	1.131	1.181	1.237
b	1.044	1.092	1.143	1.199	1.262

	30	35	40	45	50% salt,
a	1.299	1.370	1.449	1.538	1.640
b	1.333	1.414	1.507	1.613	1.734

	55	60	64% salt.
a	1.754	1.884	1.998
b	1.872	...	...

(Brandhorst and Kraut, A. 249. 377.)

Strontium phosphotungstate,  $2\text{SrO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3+17\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Péchar, C. R. 110. 754.)

Thallium phosphotungstate,  $\text{Tl}_2\text{O}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3+4\text{H}_2\text{O}$ .

Ppt. (Péchar, C. R. 110. 754.)

Zinc phosphotungstate,  $2\text{ZnO}$ ,  $\text{P}_2\text{O}_5$ ,  $12\text{WO}_3+7\text{H}_2\text{O}$ .

Efflorescent. (Péchar, C. R. 110. 754.)

#### Monometaphosphotungstic acid.

Ammonium monometaphosphotungstate,

$(\text{NH}_4)_3\text{O}$ ,  $2\text{NH}_4\text{PO}_3$ ,  $18\text{WO}_3+11\text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ .

**Potassium monometaphosphotungstate**,  
 $3K_2O, 2KPO_3, 24WO_3 + 20H_2O$ .

Very sl. sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 7. 319.)

**Orthometaphosphotungstic acid.**

**Potassium sodium orthometaphosphotungstate**,  
 $2K_2O, 4Na_2O, 6NaPO_3, 6K_2PO_4, 22WO_3 + 42H_2O$ .

Sl. sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 7. 319.)

**Pyrophosphotungstic acid.**

**Ammonium manganous sodium pyrophosphotungstate**,  
 $5(NH_4)_2O, 6MnO, 2Na_2O, 2P_2O_5, 28WO_3 + 48H_2O$ .

Very sol. in cold and in hot  $H_2O$ . (Gibbs, Am. Ch. J. 1895, 17. 90.)

**Ammonium sodium pyrophosphotungstate**,  
 $6(NH_4)_2P_2O_7, 3Na_2P_2O_7, 2(NH_4)_2O, 22WO_3 + 31H_2O$ .

Nearly insol. in cold  $H_2O$  or  $NH_4OH + Aq$ . Sol. in a large amount of hot  $H_2O$ .

**Manganous sodium pyrophosphotungstate**,  
 $6Na_2O, 3MnO, P_2O_5, 14WO_3 + 36H_2O$ .

Efflorescent in dry air. Sol. in  $H_2O$  and can be recryst. therefrom. (Gibbs.)

**Potassium pyrophosphotungstate**,  
 $9K_2P_2O_7, 22WO_3 + 49H_2O$ .

Very sl. sol. in cold  $H_2O$ .

$6K_2P_2O_7, 3H_2P_2O_7, 22WO_3, K_2O, H_2O + 42H_2O$ . Sl. sol. in cold. Sol. in much boiling  $H_2O$ . (Gibbs, Am. Ch. J. 7. 392.)

**Phosphovanadic acid**,  $P_2O_5, V_2O_5, 2H_2O + 9H_2O$ .

Sol. in  $H_2O$ .

Composition is vanadium phosphate  $(VO_2)_2H_3PO_4 + 4\frac{1}{2}H_2O$ . (Friedheim, B. 23. 1531.)

This is the only "acid" which exists. (F.)  $P_2O_5, V_2O_5 + 14H_2O$ . Sol. in  $H_2O$ ; can be recryst. from dil.  $H_3PO_4 + Aq$ . (Ditte, C. R. 102. 757.)

$3P_2O_5, 2V_2O_5 + 9H_2O$ . Sol. in  $H_2O$ . (Ditte.)  $P_2O_5, 3V_2O_5$ . (Berzelius.)

$3H_2O, 7P_2O_5, 6V_2O_5 + 34H_2O$ . Sol. in  $H_2O$ . Decomp. by much  $H_2O$  into—

$6H_2O, P_2O_5, 20V_2O_5 + 53H_2O$ . Sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 7. 209.)

**Ammonium phosphovanadate**,  $(NH_4)_2O, P_2O_5, V_2O_5 + H_2O$ .

Sl. sol. in cold  $H_2O$ . (Gibbs, Am. Ch. J. 7. 209.)

$+ 3H_2O$ . Composition is  $(VO_2)(NH_4)HPO_4 + H_2O$ . (Friedheim.)

$(NH_4)_2O, P_2O_5, 2V_2O_5 + 7H_2O$ . Easily sol. in  $H_2O$ . (Gibbs.) Sl. sol. in  $H_2O$ . (Fried-

heim.) Composition is  $(NH_4)_2O, V_2O_5, + 2(VO_2)_2H_3PO_4 + 5H_2O$ . (Friedheim.)

$5(NH_4)_2O, 2P_2O_5, 3V_2O_5 + 24H_2O$ . Easily sol. in  $H_2O$ . (Ditte, C. R. 102. 1019.) Could not be obtained. (Friedheim.)

$5(NH_4)_2O, 4P_2O_5, 2V_2O_5 + 24H_2O$ . As above. (Ditte.) Could not be obtained. (Friedheim.)

$7(NH_4)_2O, P_2O_5, 12V_2O_5 + 26H_2O$ . Easily sol. in  $H_2O$ . Composition is  $2(NH_4)_2HPO_4 + 5(NH_4)_2O, 12V_2O_5 + 25H_2O$ . (Friedheim.)

**Potassium phosphovanadate**,  $K_2O, P_2O_5, 2V_2O_5 + 7H_2O$ .

Sl. sol. in  $H_2O$ ; decomp. thereby to  $7K_2O, 12V_2O_5, P_2O_5 + 26H_2O$ .

Composition is  $K_2O, V_2O_5 + 2(VO_2)_2H_3PO_4 + 5H_2O$ . (Friedheim.)

$3K_2O, 4P_2O_5, 6V_2O_5 + 21H_2O$ . Sl. sol. in  $H_2O$ . (Gibbs.)

$7K_2O, P_2O_5, 12V_2O_5 + 26H_2O$ . Easily sol. in  $H_2O$ . Composition is  $2K_2HPO_4 + 5K_2O, 12V_2O_5 + 25H_2O$ . (Friedheim.)

$2K_2O, P_2O_5, V_2O_5, 3K_2O, 2P_2O_5, 2V_2O_5 + 5H_2O$ .

$13K_2O, 2P_2O_5, 22V_2O_5 + 58H_2O$ .

$15K_2O, 2P_2O_5, 25V_2O_5 + 76H_2O$ . (Friedheim, Z. anorg. 1894, 5. 446.)

$16K_2O, 2P_2O_5, 27V_2O_5 + 57H_2O$ .

$6K_2O, P_2O_5, 11V_2O_5 + 33H_2O$ .

$7K_2O, P_2O_5, 13V_2O_5 + 38H_2O$ .

$4K_2O, P_2O_5, 3V_2O_5 + 3H_2O$ . (Friedheim, Z. anorg. 1894, 5. 459-465.)

**Silver phosphovanadate**,  $2Ag_2O, P_2O_5, V_2O_5 + 5H_2O$ .

Sl. sol. in cold or hot  $H_2O$ . (Gibbs.)

**Phosphovanadicotungstic acid.**

**Ammonium phosphovanadicotungstate**,  
 $(NH_4)_2O, P_2O_5, V_2O_5, WO_3 + zH_2O$ .

Ppt. (Smith, J. Am. Chem. Soc. 1902, 24. 577.)

$15(NH_4)_2O, 2P_2O_5, 6V_2O_5, 44WO_3 + 106H_2O$ . Sol. in  $H_2O$ . Insol. in alcohol, ether or benzene. (Rogers, J. Am. Chem. Soc. 1903, 25. 303.)

**Phosphovanadicovanadiotungstic acid.**

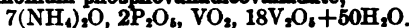
**Ammonium phosphovanadicovanadiotungstate**,  
 $14(NH_4)_2O, 2P_2O_5, 3V_2O_5, 7V_2O_5, 27WO_3 + 66H_2O$ .

Sparingly sol. in cold  $H_2O$ . Sol. in hot  $H_2O$ . (Rogers, J. Am. Chem. Soc. 1903, 25. 309.)

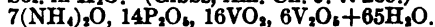
**Phosphovanadicozirconosotungstic acid.**

**Ammonium phosphovanadicozirconosotungstate**.

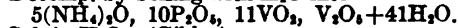
Exact formula not known. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1226.)

**Phosphovanadico vanadic acid.****Ammonium phosphovanadico vanadate,**

Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 209.)



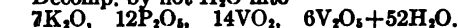
Decomp. by boiling with  $\text{H}_2\text{O}$  into—



Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Potassium** —,  $5\text{K}_2\text{O}, 12\text{P}_2\text{O}_5, 12\text{VO}_3, 6\text{V}_2\text{O}_5 + 40\text{H}_2\text{O}.$

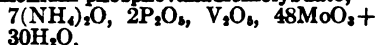
Decomp. by hot  $\text{H}_2\text{O}$  into—



Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

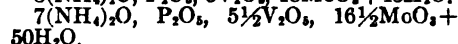
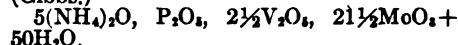
**Sodium** —,  $4\text{Na}_2\text{O}, 5\text{P}_2\text{O}_5, \text{VO}_3, 4\text{V}_2\text{O}_5 + 37\text{H}_2\text{O}.$

Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

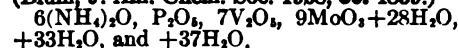
**Phosphovanadiomolybdic acid.****Ammonium phosphovanadiomolybdate,**

Sl. sol. in cold, somewhat more in hot  $\text{H}_2\text{O}$  with partial decomp. (Gibbs, Am. Ch. J. 5. 391.)

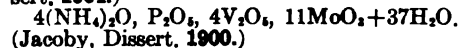
$8(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 8\text{V}_2\text{O}_5, 14\text{MoO}_3 + 50\text{H}_2\text{O}.$   
Easily sol. in hot  $\text{H}_2\text{O}$  without decomp. (Gibbs.)



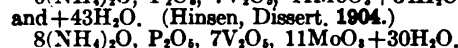
All above compounds are sol. in  $\text{H}_2\text{O}$ . (Blum, J. Am. Chem. Soc. 1908, 30. 1859.)



Can be recryst. from  $\text{H}_2\text{O}$ . (Hinsen, Dissert. 1904.)



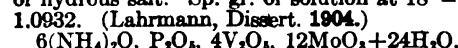
(Jacoby, Dissert. 1900.)



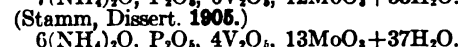
and  $+ 43\text{H}_2\text{O}$ . (Hinsen, Dissert. 1904.)



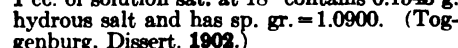
(Hinsen.)



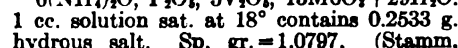
1 cc. of solution in  $\text{H}_2\text{O}$  contains 0.2624 g. of hydrous salt. Sp. gr. of solution at  $18^\circ = 1.0932$ . (Lahrman, Dissert. 1904.)



Nearly insol. in cold  $\text{H}_2\text{O}$ . (Lahrman.)



(Stamm, Dissert. 1905.)



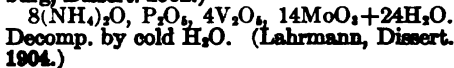
1 cc. of solution sat. at  $18^\circ$  contains 0.1543 g. hydrous salt and has sp. gr. = 1.0900. (Toggenburg, Dissert. 1902.)



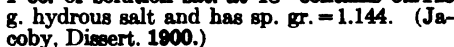
1 cc. solution sat. at  $18^\circ$  contains 0.2533 g. hydrous salt. Sp. gr. = 1.0797. (Stamm, Dissert. 1905.)



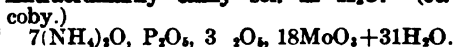
$6(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 4\text{V}_2\text{O}_5, 14\text{MoO}_3 + 28\text{H}_2\text{O}.$   
Easily sol. in  $\text{H}_2\text{O}$  with decomp. (Toggenburg, Dissert. 1902.)



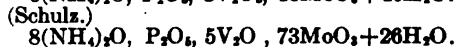
Decomp. by cold  $\text{H}_2\text{O}$ . (Lahrman, Dissert. 1904.)



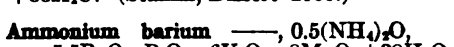
1 cc. of solution sat. at  $18^\circ$  contains 0.2445 g. hydrous salt and has sp. gr. = 1.144. (Jacoby, Dissert. 1900.)



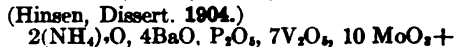
Extraordinarily easily sol. in  $\text{H}_2\text{O}$ . (Jacoby.)



(Schulz, Dissert. 1905.)



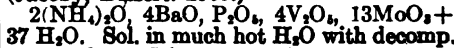
(Schulz.)



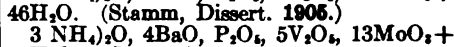
$+ 33\text{H}_2\text{O}.$  (Stamm, Dissert. 1905.)

**Ammonium barium** —,  $0.5(\text{NH}_4)_2\text{O}, 5.5\text{BaO}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 8\text{MoO}_3 + 38\text{H}_2\text{O}.$

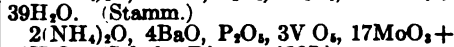
(Hinsen, Dissert. 1904.)



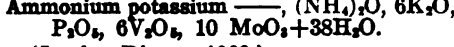
Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. on heating. (Toggenburg, Dissert. 1902.)



Less sol. in  $\text{H}_2\text{O}$  than  $\text{NH}_4$  comp. (Jacoby, Dissert. 1900.)



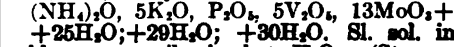
Sol. in much hot  $\text{H}_2\text{O}$  with decomp. (Toggenburg, Dissert. 1902.)



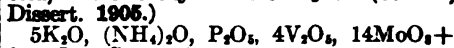
(Stamm, Dissert. 1905.)



(Stamm.)



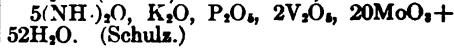
(Stamm.)



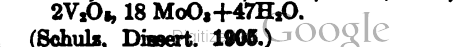
(Schulz, Dissert. 1905.)

**Ammonium potassium** —,  $(\text{NH}_4)_2\text{O}, 6\text{K}_2\text{O}, \text{P}_2\text{O}_5, 6\text{V}_2\text{O}_5, 10\text{MoO}_3 + 38\text{H}_2\text{O}.$

(Jacoby, Dissert. 1900.)



(Jacoby, Dissert. 1900.)



(Jacoby.)



Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Stamm, Dissert. 1905.)



(Stamm.)



(Jacoby, Dissert. 1900.)



(Schulz, Dissert. 1905.)



(Schulz.)



(Schulz, Dissert. 1905.)

**Potassium phosphovanadomolybdate**,  $7K_2O$ ,  $P_2O_5$ ,  $7V_2O_5$ ,  $9MoO_3$  +  $25H_2O$ .

(Hinsen, Dissert. 1904.)

$5K_2O$ ,  $P_2O_5$ ,  $2V_2O_5$ ,  $20MoO_3$  +  $53H_2O$ .  
(Schuls, Dissert. 1905.)

### Phosphovanadiotungstic acid.

**Ammonium phosphovanadiotungstate**,  
 $10(NH_4)_2O$ ,  $3P_2O_5$ ,  $V_2O_5$ ,  $60WO_3$  +  $60H_2O$ .

Nearly insol. in cold, sl. sol. in hot  $H_2O$ .  
Sol. in  $(NH_4)_2HPO_4$  + Aq. and in  $NH_4OH$  + Aq.

$5(NH_4)_2O$ ,  $P_2O_5$ ,  $3V_2O_5$ ,  $16WO_3$  +  $37H_2O$ .  
Easily sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 5. 391.)

$13(NH_4)_2O$ ,  $2P_2O_5$ ,  $8V_2O_5$ ,  $34WO_3$  +  $86H_2O$ .  
Very sol. in cold and hot  $H_2O$ .

nsol. in alcohol, ether,  $CS_2$ , benzene and nitrobenzene. (Rogers, J. Am. Chem. Soc. 1903, 25. 299.)

**Barium** —,  $18BaO$ ,  $3P_2O_5$ ,  $2V_2O_5$ ,  $60WO_3$  +  $144H_2O$ .

Easily sol. in hot  $H_2O$  with decomp  
(Gibbs, Am. Ch. J. 5. 391.)

**Potassium** —,  $3K_2O$ ,  $P_2O_5$ ,  $V_2O_5$ ,  $7WO_3$  +  $11H_2O$ .

Sol. in  $H_2O$ .

$8K_2O$ ,  $3P_2O_5$ ,  $4V_2O_5$ ,  $18WO_3$  +  $23H_2O$ . Sol. in hot  $H_2O$  with decomp. into preceding salt. (Gibbs, Am. Ch. J. 5. 391.)

**Silver** —,  $13Ag_2O$ ,  $2P_2O_5$ ,  $8V_2O_5$ ,  $33WO_3$  +  $41H_2O$ .

Somewhat sol. in  $H_2O$ .

Completely sol. in  $H_2O$  containing a few drops  $HNO_3$ . (Rogers, J. Am. Chem. Soc. 1903, 25. 302.)

### Phosphovanadovanadicotungstic acid.

**Barium phosphovanadovanadicotungstate**,  
 $18BaO$ ,  $3P_2O_5$ ,  $V_2O_5$ ,  $VO_3$ ,  $60WO_3$  +  $150H_2O$ .

Sl. sol. in cold, easily sol. in hot  $H_2O$ .  
(Gibbs, Am. Ch. J. 5. 391.)

### Phosphuretted hydrogen.

See Hydrogen phosphide.

### Platibromonitrous acid.

**Potassium platibromonitrite**,  $K_2Pt(NO_2)_4Br_2$ .

Rather sl. sol. in  $H_2O$ . (Blomstrand, J. pr. (2) 3. 214.)

Sol. in about 40 pts. cold, and 20 pts. boiling  $H_2O$ . Insol. in alcohol. Sl. sol. in  $KBr$  or  $KNO_3$  + Aq. (Vèzes, A. ch. (6) 29. 198.)

$K_2Pt(NO_2)_4Br_2$ . Sol. in about 5 pts. warm  $H_2O$  with decomp. (Vèzes.)

$K_2Pt(NO_2)_4Br_2$ . Sol. in less than 5 pts.  $H_2O$  with decomp. (Vèzes.)

### Platichloronitrous acid.

**Potassium platichloronitrite**,  $K_2Pt(NO_2)_4Cl_2$ .

Rather sl. sol. in  $H_2O$ . (Blomstrand J. pr. (2) 3. 214.)

Sol. in 40 pts. cold, and 20 pts. boiling  $H_2O$ . Insol. in alcohol. Sl. sol. in  $KCl$  or  $KNO_3$  + Aq. (Vèzes, A. ch. (6) 29. 183.)

$K_2Pt(NO_2)_4Cl_2$ . Very sol. in  $H_2O$ . (Vèzes.)  
 $K_2Pt(NO_2)_4Cl_2 + H_2O$ . Sol. in  $H_2O$  with decomp. (Vèzes.)

### Platiodonitrous acid.

**Potassium platiodonitrite**,  $K_2Pt(NO_2)_4I_4$ .

Sl. sol. in cold, more easily in hot  $H_2O$ ; decomp. by boiling. (Vèze, A. ch. (6) 29. 207.)

$K_2Pt(NO_2)_4I_4$ . As above. (Vèzes.)

### Platin-.

See also Pla ino-, plato-, p'at-, and platos-.

### Platindiamine compounds.

See Chloro-, bromo-, hydroxylo-, iodo-, nitro-, nitrito-, sulphato-, etc., platindiamine compounds.

### Platindiamine carbonate,

$Pt(NH_2)_6(CO_3)_2$ .

Ppt. Sol. in  $NaOH$  + Aq. (Geddes, J. pr. (2) 26. 257.)

— chloride  $Pt(NH_2)_6Cl_4$ .

Sol. in hot  $H_2O$  (Gerdes.)

— chloroplatinate,  $Pt(NH_2)_4Cl_4$ ,  $PtCl_4$  +  $2H_2O$ .

Very sl. sol. in  $H_2O$ . (Gerdes.)

— nitrate,  $Pt(NH_2)_6(NO_3)_4$ .

Easily sol. in  $H_2O$ ; sl. sol. in  $HNO_3$  + Aq. (Gerdes.)

— sulphate,  $Pt(NH_2)_6(SO_4)_2 + H_2O$ .

Nearly insol. in  $H_2O$ . (Gerdes.)

**Tetraplatinamine iodide**,  $Pt_4(NH_2)_{16}I_{10}$ .

(Blomstrand, B. 16. 1469.)

**Octoplatinamine iodide**,  $Pt_8(NH_2)_{16}I_{18}$ .

(Blomstrand.)

### Platinic acid.

**Barium platinate, basic (?)**,  $3BaO$ ,  $2PtO_3$ .

Insol. in  $HCl$  + Aq.; easily sol. in  $HCl$  + Aq. (Rousseau.)

**Barium platinate, BaPtO<sub>3</sub>.**

(Rousseau, C. R. 109. 144.)  
 +H<sub>2</sub>O. Insol. in dil. HNO<sub>3</sub>+Aq; sol. in warm HCl+Aq. (Topsoë, B. 3. 464.)  
 +4H<sub>2</sub>O. Very sl. sol. in H<sub>2</sub>O, BaO<sub>2</sub>H<sub>2</sub>, or NaOH+Aq. Easily sol. in dil. acids, except HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, in which it is insol. in the cold, but decomp. on heating. (Topsoë, l. c.)  
 Composition is 3BaPtO<sub>3</sub>, BaCl<sub>2</sub>, PtCl<sub>2</sub>O+4H<sub>2</sub>O (?). (Johannsen, A. 155. 204.)

**Calcium platinate chloride (?)**, 2Ca<sub>2</sub>Pt<sub>2</sub>O<sub>4</sub>Cl<sub>2</sub>+7H<sub>2</sub>O (?).

"Herschel's precipitate."

Easily sol. in HCl+Aq, and in HNO<sub>3</sub>+Aq, if freshly pptd. (Herschel.)

Very sol. in HNO<sub>3</sub>+Aq. (Weiss and Döbereiner, A. 14. 252.)

Composition is CaPtO<sub>3</sub>, PtCl<sub>2</sub>O, CaO+7H<sub>2</sub>O (?). (Johannsen, A. 155. 204.)

**Potassium platinate.**

Sol. in H<sub>2</sub>O. (Berzelius.)

K<sub>2</sub>O, PtO<sub>3</sub>+3H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Blondel, A. ch. 1905, (8) 6. 90.)

K<sub>2</sub>Pt(OH)<sub>6</sub>. Sol. in H<sub>2</sub>O; insol. in alcohol. (Bellucci, Z. anorg. 1905, 44. 173.)

**Sodium platinate**, Na<sub>2</sub>O, 3PtO<sub>3</sub>+6H<sub>2</sub>O.

Dil. acids dissolve out Na<sub>2</sub>O and leave PtO<sub>3</sub>. Sol. in HNO<sub>3</sub>+Aq. (Döbereiner, Pogg. 28. 180.)

Na<sub>2</sub>O, PtO<sub>3</sub>+3H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Blondel.)

**Metaplatinic acid**, 5PtO<sub>3</sub>, 5H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Blondel, A. ch. 1905, (8) 6. 103.)

**Sodium metaplatinate**, Na<sub>2</sub>O, 5PtO<sub>3</sub>+9H<sub>2</sub>O.

Insol. in H<sub>2</sub>O. (Blondel.)

**Platinimolybdic acid**, 4H<sub>2</sub>O, PtO<sub>3</sub>, 10MoO<sub>3</sub>. (Gibbs.)

**Ammonium platinimolybdate**, 8MoO<sub>3</sub>, 2PtO<sub>3</sub>, 3(NH<sub>4</sub>)<sub>2</sub>O+12H<sub>2</sub>O.

4MoO<sub>3</sub>, 2PtO<sub>3</sub>, 2(NH<sub>4</sub>)<sub>2</sub>O+19H<sub>2</sub>O.

Sol. in hot H<sub>2</sub>O. (Gibbs, Am. Ch. J. 1895, 17. 80-82.)

**Potassium platinimolybdate**, 60MoO<sub>3</sub>, PtO<sub>3</sub>, 10K<sub>2</sub>O+40H<sub>2</sub>O.

Sol. in hot H<sub>2</sub>O. (Gibbs.)

**Silver platinimolybdate.**

**Sodium platinimolybdate**, 4Na<sub>2</sub>O, PtO<sub>3</sub>, 10 MoO<sub>3</sub>+29H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Gibbs, Sill. Am. J. (3) 14. 61.)

**Platinitungstic acid.**

**Ammonium platinitungstate**, 4(NH<sub>4</sub>)<sub>2</sub>O, PtO<sub>3</sub>, 10WO<sub>3</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Gibbs, B. 10. 1384.)

**Potassium platinitungstate**, 4K<sub>2</sub>O, PtO<sub>3</sub>, 10WO<sub>3</sub>+9H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Gibbs.)

**Sodium platinitungstate**, 4Na<sub>2</sub>O, PtO<sub>3</sub>, 10WO<sub>3</sub>+25H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Gibbs.)

5Na<sub>2</sub>O, 7WO<sub>3</sub>, 2PtO<sub>3</sub>+35H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Gibbs.)

Is double salt 3Na<sub>2</sub>O, 7WO<sub>3</sub>+2Na<sub>2</sub>PtO<sub>3</sub>. (Rosenheim, B. 24. 2397.)

10WO<sub>3</sub>, PtO<sub>3</sub>, 4Na<sub>2</sub>O+23H<sub>2</sub>O.

10WO<sub>3</sub>, PtO<sub>3</sub>, 6Na<sub>2</sub>O+28H<sub>2</sub>O.

20WO<sub>3</sub>, PtO<sub>3</sub>, 9Na<sub>2</sub>O+58H<sub>2</sub>O.

30WO<sub>3</sub>, 2PtO<sub>3</sub>, 15Na<sub>2</sub>O+89H<sub>2</sub>O.

30WO<sub>3</sub>, PtO<sub>3</sub>, 12Na<sub>2</sub>O+72H<sub>2</sub>O.

All are sol. in boiling H<sub>2</sub>O. (Gibbs, Am. Ch. J. 1895, 17. 74-80.)

**Platino-**

See also Plato—.

**Platinochlorophosphoric acid.**

See Chloroplantinophosphoric acid.

**Platinocyanhydric acid**, H<sub>2</sub>Pt(CN)<sub>4</sub>.

Deliquescent. Very sol. in H<sub>2</sub>O, alcohol, and ether.

**Ammonium platinocyanide**, (NH<sub>4</sub>)<sub>2</sub>Pt(CN)<sub>4</sub>+3H<sub>2</sub>O.

Very sol. in H<sub>2</sub>O.

+2H<sub>2</sub>O. Sol. in 1 pt. H<sub>2</sub>O, and still more easily in alcohol.

+H<sub>2</sub>O.

**Ammonium hydroxylamine platinocyanide**, NH<sub>4</sub>(NH<sub>4</sub>O)Pt(CN)<sub>4</sub>+3½H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Scholz, M. Ch. 1. 900.)

**Ammonium magnesium platinocyanide**, (NH<sub>4</sub>)<sub>2</sub>MgPt(CN)<sub>4</sub>+6H<sub>2</sub>O.

**Barium platinocyanide**, BaPt(CN)<sub>4</sub>+4H<sub>2</sub>O.

Sol. in 33 pts. H<sub>2</sub>O at 16°, and in much less at 100°. Sol. in alcohol.

**Barium potassium platinocyanide**, BaK<sub>2</sub>[Pt(CN)<sub>4</sub>]<sub>2</sub>.

Sol. in H<sub>2</sub>O.

**Barium rubidium platinocyanide**, BaRb<sub>2</sub>[Pt(CN)<sub>4</sub>]<sub>2</sub>.

Sol. in H<sub>2</sub>O.

**Cadmium platincyanide**,  $\text{CdPt}(\text{CN})_4$ .

Ppt. Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Martius, A. 117. 376.)

$\text{CdPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O. (M.)}$

**Calcium platincyanide**,  $\text{CaPt}(\text{CN})_4 + 5\text{H}_2\text{O.}$

Very sol. in  $\text{H}_2\text{O.}$

**Calcium potassium platincyanide**,

$\text{CaK}_2[\text{Pt}(\text{CN})_4]_2.$

Sol. in  $\text{H}_2\text{O.}$

**Cerium platincyanide**,  $\text{Ce}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$

**Cobaltous platincyanide ammonia**,

$\text{CoPt}(\text{CN})_4, 2\text{NH}_3.$

Insol. in  $\text{H}_2\text{O}$ , but sol. in hot  $\text{NH}_4\text{OH} + \text{Aq.}$

**Cupric platincyanide**,  $\text{CuPt}(\text{CN})_4 + x\text{H}_2\text{O.}$

Ppt.

**Cupric platincyanide ammonia**,  $\text{CuPt}(\text{CN})_4, 2\text{NH}_3 + \text{H}_2\text{O.}$

$\text{CuPt}(\text{CN})_4, 4\text{NH}_3.$  Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.

**Didymium platincyanide**,  $\text{Dy}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O.}$

Efflorescent in dry air. Sol. in  $\text{H}_2\text{O.}$  (Cleve.)

**Dysprosium platincyanide**,  $\text{Dy}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O.}$

Easily sol. in  $\text{H}_2\text{O.}$  (Jantsch, B. 1911, 44. 1277.)

**Erbium platincyanide**,  $\text{Er}_2[\text{Pt}(\text{CN})_4]_3 + 21\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$  (Cleve.)

**Gadolinium platincyanide**,

$2\text{Gd}(\text{CN})_3, 3\text{Pt}(\text{CN})_2 + 18\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O}$ ; decomp. in the air. (Benedicks, Z. anorg. 1900, 22. 405.)

**Glucinum platincyanide**,  $\text{GHPt}(\text{CN})_4.$

(Toosynski, Dissert. 1871.)

**Hydroxylamine platincyanide**,

$(\text{NH}_2\text{O})_2\text{Pt}(\text{CN})_4 + 2\text{H}_2\text{O.}$

Deliquescent. Very sol. in  $\text{H}_2\text{O.}$  (Scholz.)

**Hydroxylamine lithium platincyanide**,

$(\text{NH}_2\text{O})\text{LiPt}(\text{CN})_4 + 3\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$

**Indium platincyanide**,

$\text{In}_2[\text{Pt}(\text{CN})_4]_3 + 2\text{H}_2\text{O.}$

Hydroscopic; sol. in  $\text{H}_2\text{O.}$  (Renz, B. 1901, 34. 2765.)

**Lanthanum platincyanide**,  $\text{La}_2[\text{Pt}(\text{CN})_4]_3 + 18\text{H}_2\text{O.}$

Easily sol. in  $\text{H}_2\text{O.}$  (Cleve.)

**Magnesium platincyanide**,  $\text{MgPt}(\text{CN})_4 + 2\text{H}_2\text{O.}$

Solubility in  $\text{H}_2\text{O.}$

100 g. of the sat. solution contain at:

96.4°	100°
44.33	43.96 g. $\text{MgPt}(\text{CN})_4$

(Buxhoevdén, Z. anorg. 1897, 15. 325.)

+  $4\text{H}_2\text{O.}$

Solubility in  $\text{H}_2\text{O.}$

100 g. of the sat. solution contain at:

42.2°	46.3°	48.7°	55°
40.21	39.79	40.75	40.02 g. $\text{MgPt}(\text{CN})_4$

58.1°	69°	77.8°	87.4°
42.01	43.48	44.88	45.52 g. $\text{MgPt}(\text{CN})_4$

90°	93°
45.59	45.04 g. $\text{MgPt}(\text{CN})_4$

(Buxhoevdén.)

+  $7\text{H}_2\text{O.}$  Sol. in 3.4 pts.  $\text{H}_2\text{O}$  at 16°.

Easily sol. in alcohol and ether.

Solubility in  $\text{H}_2\text{O.}$

100 g. of the sat. solution contain at:

-4.12°	+0.5°	5.5°	18.0°
24.9	26.33	28.07	31.23 g. $\text{MgPt}(\text{CN})_4$

36.6°	45.0°	46.2°
38.36	41.32	41.96 g. $\text{MgPt}(\text{CN})_4$

(Buxhoevdén.)

**Magnesium potassium platincyanide**,

$\text{MgK}_2[\text{Pt}(\text{CN})_4]_3 + 7\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$

**Mercuric platincyanide**,  $\text{HgPt}(\text{CN})_4.$

Ppt.

**Mercuric platincyanide nitrate**,  $5\text{HgPt}(\text{CN})_4.$

$\text{Hg}(\text{NO}_3)_2 + 10\text{H}_2\text{O.}$

Ppt.

**Nickel platincyanide ammonia**,  $\text{NiPt}(\text{CN})_4,$

$2\text{NH}_3 + \text{H}_2\text{O.}$

**Potassium platincyanide**,  $\text{K}_2\text{Pt}(\text{CN})_4 + 3\text{H}_2\text{O.}$

Extremely efflorescent. Sl. sol. in cold, easily in hot  $\text{H}_2\text{O.}$  (Willm, B. 19. 950.)

Sol. in alcohol and ether.

**Potassium sodium platincyanide**,  $\text{K}_2\text{Pt}(\text{CN})_4,$

$\text{Na}_2\text{Pt}(\text{CN})_4 + 6\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$  (Willm, B. 19. 950.)

**Praseodymium platincyanide**,

$2\text{Pr}(\text{CN})_3, 3\text{Pt}(\text{CN})_2.$

Sol. in  $\text{H}_2\text{O.}$  (Von Scheele, Z. anorg. 1898, 18. 355.)



**Samarium platincyanide**,  $\text{Sm}_2[\text{Pt}(\text{CN})_6]_2 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Scandium platincyanide**,  $\text{Sc}_2[\text{Pt}(\text{CN})_6]_2 + 21\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  and insol. in alcohol; when boiled in alcohol it is dehydrated. (Crookes, Phil. Trans. 1910, 210. A, 368.)

+  $21\text{H}_2\text{O}$ . (Orlow, Ch. Z. 1912, 36. 1407.)

**Silver platincyanide**,  $\text{Ag}_2\text{Pt}(\text{CN})_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Silver platincyanide ammonia**,  $\text{Ag}_2\text{Pt}(\text{CN})_4 \cdot 2\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Silver platincyanide bromide**.

See Bromoplatincyanide, silver.

**Silver platincyanide chloride**.

See Chloroplatincyanide, silver.

**Silver platincyanide iodide**.

See Iodplatincyanide, silver.

**Sodium platincyanide**,  $\text{Na}_2\text{Pt}(\text{CN})_4 + 3\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Willm, Z. anorg. 4. 298.)

Sol. in alcohol.

**Strontium platincyanide**,  $\text{SrPt}(\text{CN})_4 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Thallous platincyanide**,  $\text{Tl}_2\text{Pt}(\text{CN})_4$ .

Nearly insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Friswell, Chem. Soc. 24. 461.)

**Thallous platincyanide carbonate**,  $2\text{Tl}_2\text{Pt}(\text{CN})_4 \cdot \text{Tl}_2\text{CO}_3$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (F.)

**Thorium platincyanide**,  $\text{Th}[\text{Pt}(\text{CN})_6]_2 + 16\text{H}_2\text{O}$ .

Somewhat difficultly sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Cleve, Sv. V. A. H. Bih. 2. No. 6.)

**Uranyl platincyanide**,  $(\text{UO}_2)\text{Pt}(\text{CN})_4 + x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Levy, Chem. Soc. 1908, 33. 1459.)

**Ytterbium platincyanide**,  $2\text{Yb}(\text{CN})_3 \cdot 3\text{Pt}(\text{CN})_2 + 18\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, Z. anorg. 1902, 32. 139.)

**Yttrium platincyanide**,  $\text{Y}_3[\text{Pt}(\text{CN})_6]_2 + 21\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in absolute alcohol. (Cleve and Höglund.)

**Zinc platincyanide ammonia**,  $\text{ZnPt}(\text{CN})_4 \cdot 2\text{NH}_3 + \text{H}_2\text{O}$ .

**Platinonitrous acid**.

See Platonitrous acid.

**Platinoplatincyanhydric acid**,  $\text{HPt}(\text{CN})_4 + x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Levy, Chem. Soc. 1912, 101. 1093.)

**Platinoselenocyanhydric acid**.

**Potassium platinoselenocyanide**,  $\text{K}_2\text{Pt}(\text{SeCN})_4$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Clarke and Dudley, B. 1878, 11. 1325.)

**Platinoselenostannic acid**.

See under Selenostannate, platinum.

**Platinososulphocyanhydric acid**,  $\text{H}_2\text{Pt}(\text{SCN})_4$ .

Known only in aqueous solution.

**Potassium platinososulphocyanide**,  $\text{K}_2\text{Pt}(\text{SCN})_4$ .

Permanent. Sol. in 2.5 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and more readily at higher temp. Very sol. in warm alcohol.

**Silver —**,  $\text{Ag}_2\text{Pt}(\text{SCN})_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KSCN} + \text{Aq}$ , and partly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Platinosulphocyanhydric acid**,  $\text{H}_2\text{Pt}(\text{SCN})_4$ .

Known only in aqueous, and alcoholic solutions.

**Ammonium platinosulphocyanide**,  $(\text{NH}_4)_2\text{Pt}(\text{SCN})_4$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Barium —**,  $\text{BaPt}(\text{SCN})_4$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Ferrous —**,  $\text{FePt}(\text{SCN})_4$ .

Insol. in  $\text{H}_2\text{O}$  or alcohol. Not attacked by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ .

**Lead —**,  $\text{PbPt}(\text{SCN})_4$ .

Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . Sol. in alcohol.

$\text{PbPt}(\text{SCN})_4$ ,  $\text{PbO}$ . Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in acetic or nitric acids.

**Mercurous —**,  $\text{Hg}_2\text{Pt}(\text{SCN})_4$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ .

**Potassium platinosulphocyanide,**  
 $K_2Pt(SCN)_2$ .

Sol. in 12 pts.  $H_2O$  at  $60^\circ$ . Much more easily in boiling  $H_2O$ , and still more easily in hot alcohol.

+ $2H_2O$ . (Miolati and Bellucci, *Gazz. Ch. it.* 1900, **30**, II. 592.)

**Silver —,  $Ag_2Pt(SCN)_2$ .**

Insol. in  $H_2O$  or  $K_2Pt(SCN)_2$ +Aq. Sol. in cold  $NH_4OH$ +Aq and in  $KCN$ +Aq.

**Sodium —,  $Na_2Pt(SCN)_2$ .**

Sol. in  $H_2O$  and alcohol.

**Platinosulphostannic acid.**

See under Sulphostannate, platinum.

**Platinosulphurous acid.**

See Platosulphurous acid.

**Platinum, Pt.**

Not attacked by  $H_2O$ ,  $H_2SO_4$ ,  $HCl$ , or  $HNO_3$ +Aq. Slowly sol. in aqua regia, or a mixture of  $HBr$  and  $HNO_3$ , but much less easily than Au.

Precipitated Pt is remarkably sol. in  $HCl$ +Aq in presence of air. (Wilm, B. 1881, **14**, 636.)

Pure Pt foil is attacked by fuming  $HCl$  under influence of light, but not in the dark. (Berthelot, C. R. 1904, **138**, 1297.)

Dil.  $HCl$ +Aq dissolves 10–15% Pt from active Pt black. (Wöhler, B. 1903, **36**, 3482.)

Conc.  $HNO_3$  oxidizes Pt black; Pt sponge, less easily; sheet Pt, slightly. (Wöhler, *Dissert.* 1901.)

Pt in presence of Hg is more or less sol. in conc.  $HNO_3$ . (Tarugi, *Gazz. ch. it.* 1903, **33**, II. 171.)

Pt vessels are attacked by evaporating  $HNO_3$  therein. (Jaunek and Meyer, Z. anorg. 1913, **83**, 71.)

Sl. sol. in conc.  $H_2SO_4$  containing small amounts of nitrogen oxides. (Scheurer-Kestner, C. R. **86**, 1082.)

Pt black, pptd. by formic acid, is easily sol. in boiling  $H_2SO_4$ . (Deville and Stas, *Paris*, 1878.)

Thin sheet Pt is attacked by boiling  $H_2SO_4$  containing  $K_2SO_4$ ; 1 sq. cm. loses 0.01 g. in 1 hour and velocity of the reaction is not accelerated by addition of  $HNO_3$ . Pt black is completely dissolved under the above conditions in 50 hours. (Delépine, C. R. 1905, **141**, 1013.)

Further data on solubility of Pt in  $H_2SO_4$  are given by Delépine. (C. R. 1906, **142**, 631.)

95%  $H_2SO_4$  dissolves 0.04 g. Pt from commercial Pt at  $250$ – $260^\circ$  in 28 hours. (Conroy, J. Soc. Chem. Ind. 1903, **22**, 465.)

See also Quenecsen. (Bull. Soc. 1906, (3) **35**, 620.)

0.0038 g. is dissolved by 10 cc. of boiling  $H_2SO_4$ . (McCoy, Eighth Inter. Cong. App. Chem. 1912, 2.)

$HCl$ + $HNO_3$ , so long as they are sufficiently dil. or the temperature is so low that they cannot react on each other, have no action on Pt. Addition of  $Cl$  does not bring about reaction, but a few drops of  $KNO_3$  or  $N_2O_5$ +Aq bring about an immediate reaction. (Millon.)

Slowly sol. in  $HI$ +Aq. (Deville, C. R. **42**, 896.)

Conc.  $H_3PO_4$  attacks Pt when heated in presence of air, but not in its absence. (Hüttner, Z. anorg. 1908, **59**, 216.)

Pt dissolves easily in most acids when they contain  $H_2O_2$ . (Fairley, B. 1875, **8**, 1600.)

Slowly sol. in boiling  $FeCl_3$ +Aq. (Saint-Pierre, C. R. **54**, 1077.)

$FeCl_3$  in acid solution is without influence on Pt. (Marie, C. R. 1908, **146**, 476.)

Pt is completely insol. in  $KCN$ +Aq. (Rössler, Z. Chem. 1866, 175.)

Pt is attacked by boiling conc.  $KCN$ +Aq. (Deville and Debray, C. R. **82**, 241.)

Solubility of Pt in 10%  $KCN$ +Aq is very small at ord. temp. (1.4 mg. in 8 days) but is considerably greater in boiling conc.  $KCN$ +Aq. (71.5 mg. in 5 hours). (Glaser, Z. Elektrochem. 1903, **9**, 15.)

Pt foil is dissolved in boiling  $KCN$ +Aq (0.030 g. for 1 cc. in 1 hour). Insol. in cold  $KCN$ +Aq. (Brochet and Petit, C. R. 1904, C. R. **138**, 1255.)

Sol. in  $RbCl$ +Aq. (Erdmann, Arch. Pharm. 1894, **232**, 30.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, **20**, 828.)

**Platinum ammonium compounds.**

Data published since the first edition of this work have not been included in this edition.

See —

Platosamine comps.,  $Pt < \begin{matrix} NH_3.R \\ NH_3.R \end{matrix}$ .

Platosemidiamine comps.,

$Pt < \begin{matrix} NH_3.NH_3.R \\ R. \end{matrix}$ .

Platomonodiamine comps.,

$Pt < \begin{matrix} NH_3.NH_3.R \\ NH_3.R. \end{matrix}$ .

Platodiamine comps.,  $Pt < \begin{matrix} NH_3.NH_3.R \\ NH_3.NH_3.R. \end{matrix}$ .

Platososemidiamine comps.,  $Pt < \begin{matrix} NH_3.R \\ R. \end{matrix}$ .

Diplatodiamine comps.,

$Pt - \begin{matrix} NH_3.NH_3.R \\ NH_3.NH_3.R \end{matrix}$ .

Bromoplatinamine comps.,

$Br_2Pt < \begin{matrix} NH_3.R \\ NH_3.R. \end{matrix}$ .

Chloroplatinamine comps.,

$Cl_2Pt < \begin{matrix} NH_3.R \\ NH_3.R. \end{matrix}$ .

Chloronitratoplatinamine comps.,  
 $\text{Cl}(\text{NO}_3)_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Iodoplatinamine comps.,  $\text{I}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Hydroxyloplatinamine comps.,  
 $(\text{OH})_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Nitratoplatinamine comps.,  
 $(\text{NO}_3)_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Sulphatoplatinamine comps.,  
 $\text{SO}_4\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Bromoplatinsemidiamine comps.,  
 $\text{Br}_2\text{PtNH}_3.\text{NH}_3.\text{R}$

Bromonitritoplatinsemidiamine comps.,  
 $\text{Br}_2(\text{NO}_2)\text{PtNH}_3.\text{NH}_3.\text{R}$

Chloroplatinsemidiamine comps.,  
 $\text{Cl}_2\text{PtNH}_3.\text{NH}_3.\text{R}$

Chlorohydroxylonitrosemidiamine comps.,  
 $\text{Cl}(\text{OH})(\text{NO}_2)\text{PtNH}_3.\text{NH}_3.\text{R}$

Chloronitritoplatinsemidiamine comps.,  
 $\text{Cl}_2(\text{NO}_2)\text{PtNH}_3.\text{NH}_3.\text{R}$

Iodoplatinsemidiamine comps.,  
 $\text{I}_2\text{PtNH}_3.\text{NH}_3.\text{R}$

Hydroxylosemidiamine comps.,  
 $(\text{OH})_2\text{PtNH}_3.\text{NH}_3.\text{R}$

Bromoplatinmonodiamine comps.,  
 $\text{Br}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Bromohydroxyloplatinmonodiamine comps.,  
 $\text{Br}(\text{OH})\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Chloroplatinmonodiamine comps.,  
 $\text{Cl}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Iodonitratoplatinmonodiamine comps.,  
 $\text{I}(\text{NO}_3)\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Hydroxyloplatinmonodiamine comps.,  
 $(\text{OH})_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Bromoplatinndiamine comps.,  
 $\text{Br}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{NH}_3.\text{R} \end{smallmatrix}$

Bromocarbonatoplatinndiamine comps.,  
 $\text{CO}_3 > [\text{Pt}(\text{NH}_3)_2\text{R}]_2$

Bromochloroplatinndiamine comps.,  
 $\text{BrClPt}(\text{NH}_3)_2\text{R}_2$

Bromohydroxyloplatinndiamine comps.,  
 $\text{Br}(\text{OH})\text{Pt}(\text{NH}_3)_2\text{R}_2$

Bromonitratoplatinndiamine comps.,  
 $\text{Br}(\text{NO}_3)\text{Pt}(\text{NH}_3)_2\text{R}_2$

Bromosulphatoplatinndiamine comps.,  
 $\text{Br}_2(\text{SO}_4)[\text{Pt}(\text{NH}_3)_2\text{R}_2]_2$

Carbonatochloroplatinndiamine comps.,  
 $(\text{CO}_3)_2\text{Cl}_2[\text{Pt}(\text{NH}_3)_2\text{R}_2]_2$

Carbonatonitratoplatinndiamine comps.,  
 $(\text{CO}_3)(\text{NO}_3)_2[\text{Pt}(\text{NH}_3)_2\text{R}_2]_2$

Chloroplatinndiamine comps.,  
 $\text{Cl}_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Chlorohydroxyloplatinndiamine comps.,  
 $\text{Cl}(\text{OH})(\text{NH}_3)_2\text{R}_2$

Chloriodoplatinndiamine comps.,  
 $\text{ClIPt}(\text{NH}_3)_2\text{R}_2$

Chloronitratoplatinndiamine comps.,  
 $\text{Cl}(\text{NO}_3)_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Hydroxyloplatinndiamine comps.,  
 $(\text{OH})_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Hydroxylonitratodiamine comps.,  
 $(\text{OH})(\text{NO}_3)\text{Pt}(\text{NH}_3)_2\text{R}_2$

Hydroxylsulphatodiamine comps.,  
 $(\text{OH})\text{SO}_4[\text{Pt}(\text{NH}_3)_2\text{R}_2]_2$

Iodoplatinndiamine comps.,  $\text{I}_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Iodonitratoplatinndiamine comps.,  
 $\text{I}(\text{NO}_3)_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Nitratoplatinndiamine comps.,  
 $(\text{NO}_3)_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Nitritoplatinndiamine comps.,  
 $(\text{NO}_2)_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Sulphatoplatinndiamine comps.,  
 $(\text{SO}_4)_2\text{Pt}(\text{NH}_3)_2\text{R}_2$

Iododiplatinamine comps.,  
 $\text{I}-\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

$\text{I}-\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{R} \\ \text{NH}_3.\text{R} \end{smallmatrix}$

Bromodiplatinndiamine comps.,  
 $\text{Br}-\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{NH}_3.\text{R} \end{smallmatrix}$

$\text{Br}-\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{NH}_3.\text{R} \end{smallmatrix}$

Hydroxyiodoplatinndiamine comps.,  
 $(\text{OH})\text{Pt}_2(\text{NH}_3)_4\text{R}_4$

Iododiplatinndiamine comps.,  
 $\text{I}_2\text{Pt}_2(\text{NH}_3)_4\text{R}_4$

Nitratodiplatinndiamine comps.,  
 $(\text{NO}_3)_2\text{Pt}_2(\text{NH}_3)_4\text{R}_4$

Platintriamine comps.,  
 $\text{R}_2\text{Pt} < \begin{smallmatrix} \text{NH}_3.\text{NH}_3.\text{NH}_3.\text{R} \\ \text{NH}_3.\text{NH}_3.\text{NH}_3.\text{R} \end{smallmatrix}$

Tetraplatinamine comps.,  $\text{Pt}_4(\text{NH}_3)_{16}\text{R}_{16}$

Octoplatinamine comps.,  $\text{Pt}_8(\text{NH}_3)_{32}\text{R}_{32}$

Platinum antimonide,  $\text{PtSb}_2$ .  
 (Christofle, 1863.)

Platinum arsenide,  $\text{Pt}_2\text{As}_2$ .  
 (Tivoli, Gazz. ch. it. 14. 487.)  
 $\text{PtAs}_2$ . Min. Sperryite. Sl. attacked by aqua regia. (Wells, Sill. Am. J. (3) 37. 67.)

Platinum arsenic hydroxide (?),  $\text{PtAsOH}$ .  
 Insol. in, and slowly decomp. by  $\text{H}_2\text{O}$  and alcohol. Easily decomp. by  $\text{HCl} + \text{Aq}$ ; not attacked by  $\text{HNO}_3 + \text{Aq}$ . Sol. in aqua regia; not attacked by cold conc.  $\text{H}_2\text{SO}_4$ , but decomp. on heating. (Tivoli, Gazz. ch. it. 14. 487.)

**Platinum potassium azotimide.**

Ppt. Explodes violently even in aq. solution. (Curtius, J. pr. 1898, (2) 58. 304.)

**Platinum boride,  $Pt_2B_3$ .**

Very slowly sol. in aqua regia. (Martius, A. 109. 79.)

**Platinous bromide,  $PtBr_2$ .**

Insol. in  $H_2O$ . Sol. in  $HBr + Aq$ . Sl. sol. in  $KBr + Aq$ . (Topsoë, J. B. 1868. 274.)

**Platinic bromide,  $PtBr_4$ .**

Not deliquescent; sol. in  $H_2O$ . (Meyer and Züblin, B. 13. 404.)

Sl. sol. in  $H_2O$ . 100 g.  $PtBr_4 + Aq$  sat. at  $20^\circ$  contain 0.41 g.  $PtBr_4$ . (Halberstadt, B. 17. 2962.)

Easily sol. in  $HBr + Aq$ ; sl. sol. in  $HC_2H_3O_2 + Aq$ . Sol. in considerable amount in K or  $NH_4$  oxalate +  $Aq$ .

Very sl. sol. in alcohol or ether, also in glycerine. (Halberstadt.)

**Platinic hydrogen bromide.**

See Bromoplatinic acid.

**Platinous bromide carbonyl.**

See Carbonyl platinous bromide.

**Platinic bromide with  $MBr$ .**

See Bromoplatinate, M.

**Platinum carbide,  $PtC_2$ .**

Hot aqua regia dissolves out nearly all the Pt. (Zeise, J. pr. 20. 209.)

**Platinum carbon disulphide,  $PtCS_2$ .**

See Platinum sulphocarbide.

**Platinum monochloride,  $PtCl + xH_2O$ .**

Easily sol. in  $HCl$ ; mod. sol. in hot dil.  $H_2SO_4$  without decomp. (Sonstadt, Proc. Chem. Soc. 1898, 14. 179.)

**Platinous chloride,  $PtCl_2$ .**

Insol. in  $H_2O$ , conc.  $H_2SO_4$ , or  $HNO_3$ . Sol. in hot  $HCl + Aq$  with exclusion of air. (Berzelius.)

Insol. in alcohol or ether; sol. in  $NH_4OH + Aq$ . (Raewsky, A. ch. (3) 22. 280.) Sol. in aqua regia with formation of  $PtCl_4$ .

Insol. in cold conc.  $KI + Aq$ , but sol. when heated. (Lassaigne, A. ch. (2) 51. 117.)

Sl. sol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Insol. in acetone. (Fidmann, C. C. 1899, II. 1014.)

**Platinum trichloride,  $PtCl_3$ .**

Sl. sol. in cold, more sol. in hot  $H_2O$ .

Partially hydrolyzed by boiling with  $H_2O$ .

Insol. in cold conc.  $HCl$ . Sol. in hot conc.  $HCl$  with decomp.

Sol. in  $KI + Aq$ . (Wöhler, B. 1909, 42. 3961.)

**Platinic chloride,  $PtCl_4$ .**

Not deliquescent. Very sol. in  $H_2O$ . (Pulinger, Chem. Soc. 61. 420.)

Sp. gr. of aqueous solution containing:

5	10	15	20	25 % $PtCl_4$
1.046	1.097	1.153	1.214	1.285
30	35	40	45	50 % $PtCl_4$
1.362	1.450	1.546	1.666	1.785

(Precht, Z. anal. 18. 512.)

Insol. in conc.  $H_2SO_4$ . (Dumas.)

Sl. sol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Sol. in alcohol and ether; sol. in anhydrous acetone. (Zeise, A. 33. 34.)

Insol. in ether. (Willstätter, B. 1903, 36. 1830.)

Sl. sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

+  $H_2O$ . Sol. in  $H_2O$ . (Gutbier and Heinrich, Z. anorg. 1913, 81. 378.)

+  $4H_2O$ . Sol. in  $H_2O$ . (Pigeon, C. R. 1891, 112. 792.)

+  $5H_2O$ . Not deliquescent. Sol. in  $H_2O$  or  $HCl + Aq$ .

Composition is probably  $H_2PtCl_4O + 4H_2O$ . (Norton, J. pr. 110. 469.)

+  $7H_2O$ . Sol. in  $H_2O$ . (Pigeon.)

+  $8H_2O$ . (Blondel, A. Ch. 1905, (8) 6. 98.)

**Platinic thallium chloride,  $Tl_2Pt_2Cl_3H_2O_4$ .**

Ppt.; insol. in  $H_2O$ . (Miolati, Z. anorg. 1900, 22. 460.)

**Platinous hydrogen chloride.**

See Chloroplatinous acid.

**Platinic hydrogen chloride.**

See Chloroplatinic acid.

**Platinous chloride with  $MCl$ .**

See Chloroplatinite, M.

**Platinic chloride with  $MCl$ .**

See Chloroplatinate, M.

**Platinous phosphorus chloride.**

See Phosphorus platinous chloride.

**Platinic phosphorus chloride.**

See Phosphorus platinic chloride.

**Platinous chloride carbonyl.**

See Carbonyl platinous chloride.

**Platinum chloride hydroxylamine,**  
 $\text{Pt}(\text{NH}_2\text{OH})_2\text{Cl}_2$ .

Ppt. Sol. in alcohol and in ether. Decomp. in aq. solution.

 $\text{Pt}(\text{NH}_2\text{OH})_2\text{Cl}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Uhlenhuth, A. 1900, 311. 124.)**Platinous chloride sulphocarbamide,**  
 $\text{PtCl}_2 \cdot 4\text{CS}(\text{NH}_2)_2$ .Sl. sol. in  $\text{H}_2\text{O}$ ; very sol. in hot  $\text{H}_2\text{O}$ ; decomp. sl. on boiling. (Kurnakow, J. pr. 1894, (2) 50. 483.)**Platinum chloroiodide,  $\text{PtCl}_2\text{I}_2$ .**

Very deliquescent. (Kämmerer, A. 148. 329.)

 $\text{PtClI}_2$ . Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in alcohol. Sol. in  $\text{KOH} + \text{Aq}$ , from which it is pptd. by  $\text{H}_2\text{SO}_4$ . (Mather, Sill. Am. J. 27. 257.)**Platinum chloronitride,  $\text{PtNCl}$ .**

(Alexander, C. C. 1887. 1254.)

**Platinous cyanide with MCN.**See **Platinocyanide, M.****Platinous fluoride,  $\text{PtF}_2(?)$ .**Insol. in  $\text{H}_2\text{O}$ . (Moissan, A. ch. (6) 24. 287.)**Platinic fluoride,  $\text{PtF}_4$ .**Deliquescent. Sol. in  $\text{H}_2\text{O}$  with immediate decomp. into  $\text{PtO}_4\text{H}_4$  and  $\text{HF}$ . (Moissan, C. R. 109. 807.)**Platinous hydroxide,  $\text{PtO}_2\text{H}_2$ .**Sol. in  $\text{HCl}$ ,  $\text{HBr}$ , and  $\text{H}_2\text{SO}_4 + \text{Ao}$ , but not in other oxygen acids. Decomp. by boiling  $\text{KOH} + \text{Aq}$ . (Thomsen, J. pr. (2) 16. 344.)When freshly pptd. is insol. in dil.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ , and in  $\text{HC}_2\text{H}_3\text{O}_2$ ; sol. in conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . Very sol. in  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$ . After drying, is insol. in conc.  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Wöhler, Z. anorg. 1904, 40. 424.)**Platinic hydroxide,  $\text{Pt}(\text{OH})_4$ .**Easily sol. in dil. acids and in  $\text{NaOH} + \text{Aq}$ . (Topsoë, J. B. 1870. 386.)

Nearly insol. in acetic acid. (Döbereiner.)

Insol. in all acids except conc.  $\text{HCl}$  and aqua regia. (Wöhler, Z. anorg. 1904, 40. 438.) $+ \text{H}_2\text{O}$ . Ppt. (Prost, Bull. Soc. (2) 44. 256.) Insol. in  $2\text{N}-\text{H}_2\text{SO}_4$  and dil.  $\text{HNO}_3 + \text{Aq}$ ; mod. sol. in conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $2\text{N}-\text{HCl}$  and  $\text{NaOH} + \text{Aq}$ . (Wöhler.) $+ 2\text{H}_2\text{O}$ . Easily sol. in dil. acids, even acetic acid, and in  $\text{NaOH} + \text{Aq}$ . (Topsoë.)Insol. in acetic acid; sl. sol. in  $2\text{N}-\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ ; easily sol. in  $\text{HCl}$ , and  $\text{NaOH} + \text{Aq}$ . (Wöhler.)**Platinoplatinic hydroxide,  $\text{Pt}_2\text{O}_4 \cdot 9\text{H}_2\text{O}$ .**

Ppt. (Prost, Bull. Soc. (2) 46. 156.)

 $\text{Pt}_2\text{O}_{11}$ ,  $11\text{H}_2\text{O}$ . Ppt. (Prost.)**Platinum hydroxylamine comps.**

See—

Platodioxamine comps.,  $\text{Pt}(\text{NH}_2\text{O})_2\text{R}_2$ .Platosoxamine comps.,  $\text{Pt}(\text{NH}_2\text{O})_2\text{R}_2$ .

Platosoxamine-amine comps.,

 $\text{Pt}(\text{NH}_2\text{O})_2\text{NH}_2\text{R}_2$ .**Platinous iodide,  $\text{PtI}_2$ .**Insol. in  $\text{H}_2\text{O}$ , acids, or alcohol. (Lassaigne, A. ch. (2) 51. 113.)Difficultly sol. in  $\text{Na}_2\text{SO}_3 + \text{Aq}$ . (Topsoë.)Gradually decomp. by hot  $\text{HI} + \text{Aq}$  of 1.038 sp. gr., also by hot  $\text{KI} + \text{Aq}$ ,  $\text{PtI}_4$  being dissolved out and  $\text{Pt}$  left behind. Not attacked by conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ , but gradually decomp. by  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ . (Lassaigne.)

Insol. in acetone. (Eidmann, C. C. 1889, II. 1014.)

**Platinic iodide,  $\text{PtI}_4$ .**Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH}$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_3 + \text{Aq}$ . Sol. in  $\text{HI} + \text{Aq}$  or alkali iodides  $+ \text{Aq}$ . Sol. in alcohol, with partial decomp. Not attacked by acids. (Lassaigne, A. ch. (2) 51. 122.)Very sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Sol. in alcohol. (Belluci, C. C. 1902, I. 625.)

**Platinic iodide with  $\text{MI}$ .**See **Iodoplatinate, M.****Platinum nitride chloride,  $\text{PtNCl}$ .**See **Platinum chloronitride.****Platinous oxide,  $\text{PtO}$ .**Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in other acids. (Döbereiner, Pogg. 23. 183.)Sol. in conc.  $\text{H}_2\text{SO}_4$ ; easily in conc.  $\text{HCl} + \text{Aq}$ . (Storer's Dict.)Very sl. sol. in  $\text{HCl} + \text{Aq}$ . Sl. sol. in aqua regia. (Wöhler, B. 1903, 36. 3482.)**Platinic oxide,  $\text{PtO}_2$ .**

Insol. in acids, even aqua regia. (Wöhler, Dissert, 1901.)

**Platinum trioxide,  $\text{PtO}_3$ .**Unattacked by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or acetic acid. Sol. with decomp. in dil. and conc.  $\text{HCl}$ , conc.  $\text{H}_2\text{SO}_4$ , or conc.  $\text{HNO}_3$ . (Wöhler, B. 1909, 42. 3329.)**Platinum sesquioxide,  $\text{Pt}_2\text{O}_3 + x\text{H}_2\text{O}$ .**Insol. in dil. sol. in conc.  $\text{H}_2\text{SO}_4$ . Sl. sol. in hot dil.  $\text{HNO}_3$ . Sol. in  $\text{HCl}$ . Sol. in conc. alkali hydroxides  $+ \text{Aq}$ . (Wöhler, B. 1909, 42. 3964.)

+2H<sub>2</sub>O. Insol. in HNO<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. Insol. in alkalis +Aq, also cold dil. HCl+Aq. Sol. in aqua regia. (Dudley, Am. Ch. J. 1902, 28. 66.)  
+5H<sub>2</sub>O. (Delépine, Bull. Soc. 1910, (4) 7. 103.)

#### Platinoplatinic oxide, Pt<sub>2</sub>O<sub>4</sub>.

Not attacked by long boiling with HCl, HNO<sub>3</sub>, or aqua regia. (Jørgensen, J. pr. (2) 16. 344.)

Does not exist. (Wöhler, Z. anorg. 1904, 40. 450.)

#### Platinum oxychloride, 3PtO, PtCl<sub>2</sub> (?).

Sol. in HCl, and in KOH+Aq. (Kane, Phil. Trans. 1842. 298.)

PtCl<sub>2</sub>(OH)<sub>2</sub>=H<sub>2</sub>PtCl<sub>2</sub>O<sub>2</sub>. (Jørgensen, J. pr. (2) 16. 345.)

5PtO<sub>3</sub>, 2HCl+9H<sub>2</sub>O. Insol. in cold H<sub>2</sub>O; decomp. on boiling. Slowly sol. in HCl. (Blondel, A. ch, 1905, (8) 6. 100.)

#### Platinum oxysulphide, PtOS.

See Platinum sulphhydroxide.

#### Platinum phosphide, PtP<sub>3</sub>.

Insol. in HCl+Aq. Sol. in aqua regia. (Schrötter, W. A. B. 1849. 303.)

PtP<sub>3</sub>H<sub>2</sub>. Insol. in H<sub>2</sub>O, and HCl+Aq. (Cavazzi, Gazz. ch. it. 13. 324.)

PtP. Insol. in aqua regia. (Clark and Joslin.)

Pt<sub>2</sub>P. Sol. in aqua regia. (Clark and Joslin.)

\*Pt<sub>3</sub>P<sub>3</sub>. Partially sol. in aqua regia. (Clark and Joslin, C. N. 48. 385.)

Attacked very slowly by aqua regia. Rapidly sol. in molten alkalis. (Granger, C. N. 1898, 77. 229.)

Completely sol. in aqua regia if the action sufficiently prolonged, though with difficulty. (Granger, C. R. 1898, 123. 1285.)

#### Platinum diselenide, PtSe<sub>2</sub>.

As PtS<sub>2</sub>. (Minozzi, Chem. Soc. 1909, 96. (2) 899.)

#### Platinum triselenide, PtSe<sub>3</sub>.

Sl. attacked by hot conc. HNO<sub>3</sub>; not attacked by cold conc. HCl+Aq; slowly sol. in aqua regia and Cl<sub>2</sub>+Aq; insol. in CS<sub>2</sub>.

#### Platinum silicide, Pt<sub>2</sub>Si.

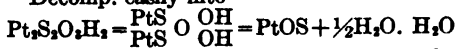
Sol. in hot aqua regia. (Vigouroux, C. R. 1896, 123. 117.)

Pt<sub>2</sub>Si<sub>2</sub>. (Colson, C. R. 94. 27.)  
Pt<sub>2</sub>Si<sub>3</sub>. Slowly decomp. by aqua regia. (Guyard, Bull. Soc. (2) 25. 511.)

PtSi. Insol. in HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>, HF, and HCl. Completely sol. in aqua regia. (Lebeau and Novitsky, C. R. 1907, 145. 241.)

#### Platinum sulphhydroxide, PtOS+H<sub>2</sub>O=PtS(OH)<sub>2</sub>.

Decomp. easily into—



H<sub>2</sub>O cannot be removed without decomposing the compound. (v. Meyer, J. pr. (2) 15. 1.)

#### Platinous sulphide, PtS.

Not attacked by boiling acids, aqua regia, or KOH+Aq. (Böttger, J. pr. 2. 274.)

Sol. in large excess of (NH<sub>4</sub>)<sub>2</sub>S+Aq.

#### Platinoplatinic sulphide, Pt<sub>2</sub>S<sub>3</sub>.

Not attacked by HCl or HNO<sub>3</sub>+Aq, and only slowly by aqua regia. (Schneider, Pogg. 138. 607.)

#### Platinic sulphide, PtS<sub>2</sub>.

Anhydrous. Aqua regia attacks sl., other acids not at all. (Davy.)

Hydrated Insol. in HCl+Aq; sl. sol. in boiling HNO<sub>3</sub>+Aq. Sol. n aqua regia. (Fresenius.) Sol. in alkali sulphides, hydrates and carbonates+Aq. (Berzelius.) Very sl. sol. in (NH<sub>4</sub>)<sub>2</sub>S+Aq. (Claus.)

Insol. in NH<sub>4</sub>Cl, or NH<sub>4</sub>NO<sub>3</sub>+Aq. 1 pt. PtCl<sub>4</sub> in 100 pts. H<sub>2</sub>O+25 pts. HCl is not pptd. by H<sub>2</sub>S. (Reinsch.)

Difficultly sol. in alkali sulphhydroxides+Aq, but more easily in presence of SnS, Sb<sub>2</sub>S<sub>3</sub>, As<sub>2</sub>S<sub>3</sub>, or SnS<sub>2</sub>. (Ribau, C. R. 85. 283.)

#### Platinum sulphide, Pt<sub>2</sub>S<sub>3</sub>, or Tetraplatinum sulphoplatinate, 4PtS, PtS<sub>2</sub>.

Decomp. on moist air, but not attacked by acids. (Schneider, J. pr. (2) 7. 214.)

#### Platinum sulphides with M<sub>2</sub>S.

See Sulphoplatinate, M.

#### Platinum sulphocarbide, PtC<sub>2</sub>S<sub>2</sub>.

Not attacked by hot HCl, HNO<sub>3</sub>+Aq, slightly by aqua regia. (Schützenberger, C. R. 111. 391.)

#### Platinum telluride, PtTe.

Decomp. by fused oxidising agents; slowly sol. in conc. HNO<sub>3</sub>. (Roessler, Z. anorg. 1897, 15. 407.)

#### Platinum ditelluride, PtTe<sub>2</sub>.

Insol. in boiling conc. KOH+Aq; slowly sol. in boiling conc. HNO<sub>3</sub>; decomp. by fused oxidizing agents. (Roessler.)

#### Plato-.

See also Platino-

**Platoamidosulphonic acid.**

**Potassium platoamidosulphonate,**  
 $K_2Pt(NH_2SO_3)_4 \cdot 2H_2O$ .

Very al. sol. in cold  $H_2O$ ; sol. in 10 pts. boiling  $H_2O$ . (Ramberg and St. Kahlenberg, B. 1912, 45. 1514.)

**Sodium —,**  $Na_2(Pt(NH_2SO_3)_4 \cdot 4H_2O$ .

Very sol. in  $H_2O$ . (Ramberg and St. Kahlenberg.)

**Platodiamine bromide,**  $Pt[(NH_2)_2Br]_2 + 3H_2O$ .

Easily sol. in  $H_2O$ . (Cleve.)

— **carbonate,**  $Pt(N_2H_4)_2CO_3 + H_2O$ .

Sol. in  $H_2O$ . (Peyrone, A. 51. 14.)  
 $Pt(N_2H_4CO_2H)_2$ . Sl. sol. in, but decomp. by boiling with  $H_2O$  into—

— **sesquicarbonate.**

More sol. than preceding salt. (Reiset, C. R. 11. 711.)

— **chloride,**  $Pt[(NH_2)_2Cl]_2 + H_2O$ .

"Reiset's first chloride." Sol. in 4 pts.  $H_2O$  at  $16.5^\circ$ , and in less hot  $H_2O$ . Insol. in alcohol or ether. (Reiset, A. ch. (3) 11. 419.)

As sol. in  $NH_4Cl + Aq$  as in  $H_2O$ ; insol. in absolute alcohol; sl. sol. in dil. alcohol; very sol. in dil.  $HCl + Aq$ . (Peyrone, A. ch. (3) 12. 196.)

— **cuprous chloride,**  $Pt(NH_2)_2Cl_2$ ,  $Cu_2Cl_2$ .

Sol. in  $H_2O$ , and pptd. from  $H_2O$  solution by alcohol. (Buckton.)

— **cupric chloride,**  $Pt(NH_2)_2Cl_2$ ,  $CuCl_2$ .

Sl. sol. in cold, decomp. by hot  $H_2O$  into  $Pt(NH_2)_2Cl_2$ ,  $Cu_2Cl_2$ . (Buckton, Chem. Soc. 5. 218.)

Nearly insol. in  $H_2O$ ; easily sol. in warm  $HCl + Aq$ ; insol. in alcohol. (Millon and Commaille, C. R. 57. 822.)

Millon and Commaille's salt is  $Cu(NH_2)_2Cl_2$ ,  $PtCl_2$ , cuprammonium chloroplatinite.

— **lead chloride,**  $Pt(NH_2)_2Cl_2$ ,  $PbCl_2$ .

Sol. in hot, much less in cold  $H_2O$ . Insol. in  $HCl + Aq$  or alcohol. (Buckton, Chem. Soc. 5. 213.)

— **mercuric chloride,**  $Pt(NH_2)_2Cl_2$ ,  $HgCl_2$ .

Easily sol. in hot  $H_2O$ , much less in cold. Insol. in  $HCl + Aq$ . (Buckton.)

— **zinc chloride,**  $Pt(NH_2)_2Cl_2$ ,  $ZnCl_2$ .

Easily sol. in hot  $H_2O$ . Insol. in alcohol. (Buckton.)

**Platodiamine chloroplatinate,**  $Pt(NH_2)_2Cl_2$ ,  $PtCl_4$ .

Ppt. Insol. in  $H_2O$ . (Cossa, Gazz. ch. it. 17. i.)

— **chloroplatinite,**  $Pt(NH_2)_2Cl_2$ ,  $PtCl_2$ .

(Magnus' green salt.) Insol. in, and not decomp. by  $H_2O$ ,  $HCl + Aq$ , or alcohol. (Magnus.)

Slowly sol. in boiling  $NH_4OH + Aq$  and in conc.  $NH_4$  salts +  $Aq$ . (Reiset, A. ch. (3) 11. 427.)

Almost as sol. in  $(NH_4)_2CO_3 + Aq$  as in  $NH_4OH + Aq$ . Sol. in hot  $PtCl_4 + Aq$ . (Reiset.)

Not decomp. by boiling  $KOH$ , dil.  $HCl$ , or  $H_2SO_4 + Aq$ , but easily by  $HNO_3 + Aq$ . (Gros, A. 27. 245.)

— **chromate,**  $Pt(NH_2)_2CrO_4$ .

Scarcely sol. in  $H_2O$ . (Cleve.)

— **dichromate,**  $Pt(NH_2)_2Cr_2O_7$ .

Sl. sol. in  $H_2O$ . Insol. in alcohol. Sol. in  $KOH + Aq$ . (Buckton, Chem. Soc. 5. 213.)

— **platinous cyanide,**  $Pt(NH_2)_2(CN)_2$ ,  $Pt(CN)_2$ .

Sl. sol. in cold, easily in boiling  $H_2O$ ; sol. in  $KOH$ ,  $HCl$ , and dil.  $H_2SO_4 + Aq$  without decomp., but conc.  $H_2SO_4$  decomposes.

— **potassium ferrocyanide,**

$Pt(NH_2)_2K_2[Fe(CN)_4] \cdot 3H_2O$ .

— **hydroxide,**  $Pt[(NH_2)_2OH]_2$ .

"Reiset's first base." Easily sol. in  $H_2O$ . Sl. sol. in alcohol.

— **iodide,**  $Pt[(NH_2)_2I]_2$ .

Sl. sol. in cold, more easily in hot  $H_2O$ , but slowly decomp. on boiling. (Reiset.)

— **nitrate,**  $Pt[(NH_2)_2NO_3]_2$ .

Sol. in about 10 pts. boiling  $H_2O$ . Insol. or but sl. sol. in alcohol. (Peyrone, A. ch. (3) 12. 203.)

— **nitrate sulphate,**  $[Pt(NH_2)_2NO_3]_2SO_4$ ,  $Pt(NH_2)_2SO_4$ .

Very easily sol. in  $H_2O$ . (Carlgren, Sv. V. A. F. 47. 310.)

— **nitrite,**  $Pt[(NH_2)_2NO]_2 + 2H_2O$ .

Efflorescent. Very sol. in hot or cold  $H_2O$ . Insol. in 90% alcohol. (Lang.)

— **platinous nitrite,**  $Pt[(NH_2)_2NO]_2$ ,  $Pt(NO_2)_2$ .

Scarcely sol. in cold, somewhat more easily in hot  $H_2O$ . Not attacked by cold dil. acids. More sol. in  $NH_4OH + Aq$  than in  $H_2O$ . (Lang.)

**Platodiamine phosphate**,  $\text{Pt}(\text{N}_2\text{H}_5)_2\text{HPO}_4 \cdot \text{H}_2\text{O}$ .

Rather difficultly sol. in cold, and very easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **ammonium phosphate**,  $\text{Pt}[(\text{N}_2\text{H}_5)_2\text{PO}_4(\text{NH}_4)]_2, 4\text{NH}_4\text{H}_2\text{PO}_4 + \text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$  with decomp. into—  
 $\text{Pt}(\text{N}_2\text{H}_5\text{H}_2\text{PO}_4)_2, 2\text{NH}_4\text{H}_2\text{PO}_4 + 9\text{H}_2\text{O}$ .  
Much more sol. in  $\text{H}_2\text{O}$  than the preceding comp. (Cleve.)

— **sulphate**,  $\text{Pt}(\text{NH}_3)_2\text{SO}_4$ .

Sol. in 32 pts.  $\text{H}_2\text{O}$  at  $16.5^\circ$ ; more easily when heated. (Reiset.)

Sol. in 50–60 pts. boiling  $\text{H}_2\text{O}$ ; less in cold  $\text{H}_2\text{O}$ ; insol. in alcohol. (Cleve.)

— **sulphate, acid**,  $\text{Pt}[(\text{NH}_3)_2\text{SO}_4\text{H}]_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol into neutral salt.

$3\text{Pt}(\text{NH}_3)_2\text{SO}_4, \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **sulphite**,  $\text{Pt}(\text{NH}_3)_2\text{SO}_3$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Birnbbaum, A. 152. 143.)

$\text{Pt}[(\text{NH}_3)_2\text{SO}_3\text{H}]_2 + 2\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{HCl} + \text{Aq}$ . (Cleve.)

— **platinous sulphite**,  
 $3\text{Pt}(\text{NH}_3)_2\text{SO}_3, \text{PtSO}_3 + 2\text{H}_2\text{O}$ .

Scarcely sol. in cold  $\text{H}_2\text{O}$ ; sol. in 190 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . Easily sol. in warm  $\text{HCl} + \text{Aq}$  with decomp. (Peyrone.)

$+ 4\text{H}_2\text{O}$ . (Carlgren, Sv. V. A. F. 47. 308.)  
 $2\text{Pt}(\text{NH}_3)_2\text{SO}_3, \text{PtSO}_3, \text{H}_2\text{SO}_3$ . Insol. in cold  $\text{H}_2\text{O}$  or alcohol. Scarcely sol. in hot  $\text{H}_2\text{O}$ . (Peyrone.)

— **sulphocyanide**,  $\text{Pt}(\text{NH}_3)_4(\text{CNS})_2 + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Solution is decomp. on boiling. (Cleve, Sv. V. A. H. 10, 9. 7.)

— **platinous sulphocyanide**,  
 $\text{Pt}(\text{NH}_3)_4(\text{CNS})_2, \text{Pt}(\text{CNS})_2$ .

Insol. in  $\text{H}_2\text{O}$  and alcohol; sol. in dil.  $\text{HCl} + \text{Aq}$ . (Buckton, Chem. Soc. 13. 122.)

**Platomonodiamine chloride**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Platomonodiamine chloroplatinite**

$2\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{NH}_3\text{Cl} \end{smallmatrix}, \text{PtCl}_2$ .

Moderately sol. in cold, but more easily in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrate**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_3 \\ \text{NH}_3\text{NO}_3 \end{smallmatrix} + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Platomonodiamine sulphate**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_4 \\ \text{NH}_3 \end{smallmatrix}$ .

Easily sol. in cold, but much more in hot  $\text{H}_2\text{O}$ .

**Platosemidiamine bromide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{Br} \\ \text{Br} \end{smallmatrix}$ .

Sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Cleve.)

— **chloride**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{Cl} \\ \text{Cl} \end{smallmatrix}$ .

(Peyrone's chloride.) Sol. in 387 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 28 pts. at  $100^\circ$  (Cleve); in 33 pts. at  $100^\circ$ . (Peyrone.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; very sl. sol. in  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; more easily in  $\text{HNO}_3 + \text{Aq}$ ; sol. in alkali carbonates  $+ \text{Aq}$ . (Peyrone, A. ch. (3) 12. 193.)

**Platosemidiamine chlorosulphurous acid**,

$\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_3\text{H} \\ \text{Cl} \end{smallmatrix}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium platosemidiamine chlorosulphite platosemidiamine sulphite**,

$\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_3\text{NH}_4 \\ \text{Cl} \end{smallmatrix}, \text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_3\text{NH}_4 \\ \text{SO}_3\text{NH}_4 \end{smallmatrix} + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Cleve.)

**Platosemidiamine cyanide**,

$\text{Pt}(\text{CN})(\text{NH}_3)_2\text{CN}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **platinous cyanide**,  $\text{Pt}(\text{CN})(\text{NH}_3)_2\text{CN}$ ,

$\text{Pt}(\text{CN})_2(?)$ .

Ppt.

— **hydroxide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{OH} \\ \text{OH} \end{smallmatrix}$ .

Not known.

— **iodide**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{I} \\ \text{I} \end{smallmatrix}$ .

Sl. sol. in boiling  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrate**  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_3 \\ \text{NO}_3 \end{smallmatrix}$ .

Moderately sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **nitrite**,  $\text{Pt} \begin{smallmatrix} (\text{NH}_3)_2\text{NO}_2 \\ \text{NO}_2 \end{smallmatrix}$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

— **oxalate**,  $\text{Pt}(\text{NH}_3)_2\text{C}_2\text{O}_4$ .

(Cleve.)  
 $+ 2\text{H}_2\text{O}$ . (Cleve.)

— **sulphate**,  $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2 \\ \text{SO}_4 \end{smallmatrix}$ .

Very sl. sol. even in hot  $\text{H}_2\text{O}$ . (Cleve.)



**Platosemidiamine sulphocyanide,**  
 $\text{Pt}(\text{SCN})(\text{NH}_3)_2\text{SCN}$ .Easily sol. in warm  $\text{H}_2\text{O}$ , but solution soon decomposes.**Platosemidiamine sulphurous acid.****Ammonium platosemidiamine sulphite,**  
 $\text{Pt} < \begin{smallmatrix} (\text{NH}_3)_2\text{SO}_3(\text{NH}_3) \\ \text{SO}_3(\text{NH}_3) \end{smallmatrix}, (\text{NH}_3)_2\text{SO}_3$ .Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)**Barium** —,  $\text{Pt}(\text{SO}_3)[(\text{NH}_3)_2\text{SO}_3]\text{Ba}$ ,  $\text{BaSO}_3$ .  
Ppt. (Cleve.)**Silver** —,  $\text{Pt}(\text{SO}_3\text{Ag})[(\text{NH}_3)_2\text{SO}_3\text{Ag}]$ ,  
 $\text{Ag}_2\text{SO}_3$ .  
Ppt. (Cleve.)**Diplatodiamine chloride**,  $\text{Pt}_2(\text{NH}_3)_4\text{Cl}_2$ .  
Insol. in  $\text{H}_2\text{O}$ .— hydroxide,  $\text{Pt}_2(\text{NH}_3)_4(\text{OH})_2 + \text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ .— nitrate,  $\text{Pt}_2(\text{NH}_3)_4(\text{NO}_3)_2$ .  
Insol. in  $\text{H}_2\text{O}$ . (Cleve.)— sulphate,  $\text{Pt}_2(\text{NH}_3)_4\text{SO}_4$ .  
Insol. in  $\text{H}_2\text{O}$ . (Cleve.)**Platobromonitrous acid.****Potassium platobromonitrite**,  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Br}$   
 $+ 2\text{H}_2\text{O}$ .Sol. in about 3 pts. cold, and 2 pts. boiling  
 $\text{H}_2\text{O}$ . (Vèzes, A. ch. (6) 29. 194.) $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Br}_2 + \text{H}_2\text{O}$ . Sol. in 1 pt. cold,  
and still less hot  $\text{H}_2\text{O}$ . Insol. in alcohol.  
(Vèzes.)**Platochloronitrous acid.****Potassium chloronitrite**,  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Cl} +$   
 $2\text{H}_2\text{O}$ .Sol. in about 3 pts. cold, and 2 pts. boiling  
 $\text{H}_2\text{O}$ . (Vèzes, A. ch. (6) 29. 178.) $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{Cl}_2$ . Sol. in about 3 pts. cold,  
and 2 pts. boiling  $\text{H}_2\text{O}$ . (Vèzes.)**Platochlorosulphurous acid.**

See Chloroplatosulphurous acid.

**Platiodonitrous acid**,  $\text{H}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$ .Known only in solution. (Nilson, J. pr. (2)  
21. 172.)**Aluminum platiodonitrite**,  $\text{Al}_3[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3$   
 $+ 27\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)**Ammonium** —,  $(\text{NH}_4)_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ ; decomp. on heating.**Barium platiodonitrite**,  $\text{BaPt}(\text{NO}_2)_2\text{I}_2 +$   
 $4\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ .**Cadmium** —,  $\text{CdPt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ .**Cæsium** —,  $\text{Cs}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ .**Calcium** —,  $\text{CaPt}(\text{NO}_2)_2\text{I}_2 + 6\text{H}_2\text{O}$ .Very easily sol. in  $\text{H}_2\text{O}$ .**Cerium** —,  $\text{Ce}_3[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 18\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ .**Cobalt** —,  $\text{CoPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Didymium** —,  $\text{Di}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_2 + 24\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Erbium** —,  $\text{Er}_3[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 18\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Ferrous** —,  $\text{FePt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Ferric** —,  $\text{Fe}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_2 + 6\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Lanthanum** —,  $\text{La}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_2 + 24\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Lead** —, basic,  $\text{PbPt}(\text{NO}_2)_2\text{I}_2$ ,  $\text{Pb}(\text{OH})_2$ .Insol. in  $\text{H}_2\text{O}$ .**Lithium** —,  $\text{Li}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 6\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ .**Magnesium** —,  $\text{MgPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Manganese** —,  $\text{MnPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Mercurous** —, basic,  $2\text{Hg}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$ ,  
 $\text{Hg}_2\text{O} + 9\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$ .**Nickel** —,  $\text{NiPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .**Potassium** —,  $\text{K}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  in all proportions.

Very sol. in alcohol.

**Rubidium** —,  $\text{Rb}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .

**Silver platiodonitrite**,  $\text{Ag}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$ .  
Insol. in  $\text{H}_2\text{O}$ .

**Sodium** —,  $\text{Na}_2\text{Pt}(\text{NO}_2)_2\text{I}_2 + 4\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ .

**Strontium** —,  $\text{SrPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .

**Thallium** —,  $\text{Tl}_2\text{Pt}(\text{NO}_2)_2\text{I}_2$ .  
Insol. in  $\text{H}_2\text{O}$ .

**Yttrium** —,  $\text{Y}_2[\text{Pt}(\text{NO}_2)_2\text{I}_2]_3 + 27\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .

**Zinc** —,  $\text{ZnPt}(\text{NO}_2)_2\text{I}_2 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .

**Triplatoctonitrosylic acid**,  $\text{H}_2\text{Pt}_3\text{O}(\text{NO}_2)_8$ .  
(Nilson, J. pr. (2) 16. 241.)

**Potassium triplatoctonitrosylate**.  
See under Platonitrite, potassium.

**Platonitrous acid**,  $\text{H}_2\text{Pt}(\text{NO}_2)_4$ .  
Sol. in  $\text{H}_2\text{O}$  or alcohol. (Lang. J. pr. 83. 419.)  
Is called "Platotetranitrosylic acid" by Nilson.

**Aluminum platonitrite**,  $\text{Al}_2[\text{Pt}(\text{NO}_2)_4]_3 + 14\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .  
 $\text{Al}_2(\text{OH})_6[\text{Pt}(\text{NO}_2)_4]_3\text{O}_2 + 10\text{H}_2\text{O}$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  and alcohol. (Nilson, B. 9. 1727.)

**Ammonium platonitrite**,  $(\text{NH}_4)_2\text{Pt}(\text{NO}_2)_4 + 2\text{H}_2\text{O}$ .  
Moderately sol. in cold  $\text{H}_2\text{O}$ . (Nilson, B. 9. 1724.)

**Barium platonitrite**,  $\text{BaPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sl. sol. in cold, very sol. in hot  $\text{H}_2\text{O}$ . (Lang.)

**Cadmium platonitrite**,  $\text{CdPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Cæsium platonitrite**,  $\text{Cs}_2\text{Pt}(\text{NO}_2)_4$ .  
Resembles K salt.

**Calcium platonitrite**,  $\text{CaPt}(\text{NO}_2)_4 + 5\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Cerium platonitrite**,  $\text{Ce}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Chromium diplatonitrite**,  
 $\text{Cr}_2(\text{OH})_2[\text{Pt}(\text{NO}_2)_4]_2\text{O}_2 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Cobalt platonitrite**,  $\text{CoPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Copper platonitrite**,  $\text{CuPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Nilson.)  
 $3\text{CuPt}(\text{NO}_2)_4$ ,  $\text{CuO} + 12\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Nilson.)

**Didymium platonitrite**,  $\text{Di}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$ .  
Deliquescent; sol. in  $\text{H}_2\text{O}$ .

**Erbium platonitrite**,  $\text{Er}_2[\text{Pt}(\text{NO}_2)_4]_3 + 9$ , and  $21\text{H}_2\text{O}$ .  
Deliquescent; sol. in  $\text{H}_2\text{O}$ .

**Glucinum diplatonitrite**,  $\text{Gl}^2\text{Pt}(\text{NO}_2)_4]_2\text{O} + 9\text{H}_2\text{O}$ .  
Sl. sol. in cold  $\text{H}_2\text{O}$ .

**Indium diplatonitrite**,  $\text{In}(\text{OH})_2[\text{Pt}(\text{NO}_2)_4]_2\text{O}_2 + 10\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ .

**Fernic diplatonitrite**,  $\text{Fe}_2[\text{Pt}(\text{NO}_2)_4]_2\text{O}_2 + 30\text{H}_2\text{O}$ .  
Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

**Lanthanum platonitrite**,  $\text{La}_2[\text{Pt}(\text{NO}_2)_4]_3 + 18\text{H}_2\text{O}$ .  
Deliquescent; sol. in  $\text{H}_2\text{O}$ .

**Lead platonitrite**,  $\text{PbPt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Lithium platonitrite**,  $\text{Li}_2\text{Pt}(\text{NO}_2)_4 + 3\text{H}_2\text{O}$ .  
Sl. deliquescent; easily sol. in  $\text{H}_2\text{O}$ .

**Magnesium platonitrite**,  $\text{MgPt}(\text{NO}_2)_4 + 5\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ .

**Manganese platonitrite**,  $\text{MnPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .

**Mercurous platonitrite**,  $\text{Hg}_2\text{Pt}(\text{NO}_2)_4$ ,  $\text{Hg}_2\text{O}$ .  
Nearly insol. in  $\text{H}_2\text{O}$ . (Lang, J. pr. 83. 415.)  
 $+ \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Nickel platonitrite**,  $\text{NiPt}(\text{NO}_2)_4 + 8\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Potassium platonitrite**,  $\text{K}_2\text{Pt}(\text{NO}_2)_4$ .  
Sol. in 27 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ ; more easily sol. in warm  $\text{H}_2\text{O}$ . (Lang, J. pr. 83. 415.)  
 $+ 2\text{H}_2\text{O}$ . Efflorescent. (Lang.)  
 $\text{K}_2\text{H}_2\text{Pt}_2\text{O}(\text{NO}_2)_8 + 3\text{H}_2\text{O}$ . Very sl. sol. in cold (0.01 mol. in 1 l. at  $16^\circ$ ), but very easily in hot  $\text{H}_2\text{O}$ . (Véles, A. ch. (6) 29. 162.)  
 $\text{K}_4\text{Pt}_2\text{O}(\text{NO}_2)_8 + 2\text{H}_2\text{O}$ . Sl. sol. in warm  $\text{H}_2\text{O}$ . (Nilson.)

**Potassium platinitrite bromide.**

See *Platibromonitrite and platobromonitrite, potassium.*

**Potassium platinitrite chloride.**

See *Plati- and platochloronitrite, potassium.*

**Potassium platinitrite hydrogen chloride,**

Sol. in  $H_2O$ . (Miolati, Att. Linc. Rend. 1896, (5) 5, II, 358.)

**Potassium platinitrite iodide.**

See *Plati- and platiodonitrite, potassium.*

**Potassium platinitrite nitrogen dioxide,**

Violently decomp. by  $H_2O$ . (Miolati, Atti Linc. Rend. 1896, (5) 5, II, 356.)

**Rubidium platinitrite,  $Rb_2(Pt)(NO_2)_4$ , and  $+2H_2O$ .**

Very slowly sol. in cold, more easily in warm  $H_2O$ . (Nilson.)

**Silver platinitrite,  $Ag_2Pt(NO_2)_4$ .**

Very sl. sol. in cold, easily in hot  $H_2O$ .

**Silver diplatinitrite,  $Ag_2Pt_2(NO_2)_8O$ .**

Insol. in  $H_2O$ . (Nilson.)

**Sodium platinitrite,  $Na_2Pt(NO_2)_4$ .**

Easily sol. in  $H_2O$ .

**Strontium platinitrite,  $SrPt(NO_2)_4 \cdot 3H_2O$ .**

Somewhat sl. sol. in cold  $H_2O$ , but easily sol. in warm  $H_2O$ .

**Thallium platinitrite,  $Tl_2Pt(NO_2)_4$ .**

Very sl. sol. in  $H_2O$ . (Nilson.)

**Yttrium platinitrite,  $Y_2[Pt(NO_2)_4]_2 \cdot 9$ , or  $21H_2O$ .**

Sol. in  $H_2O$ .

**Zinc platinitrite,  $ZnPt(NO_2)_4 \cdot 8H_2O$ .**

Sol. in  $H_2O$ .

**Platodioxamine chloride,**

Easily sol. in  $H_2O$ . (Alexander, A. 246. 239.)

**— chloroplatinite,  $Pt(NH_2O.NH_2OCl)_2$ ,  $PtCl_2$ .**

Sol. in warm  $HCl + Aq$ . Insol. in cold  $H_2O$  or alcohol; very sl. sol. in hot  $H_2O$ . (Alexander.)

**— hydroxide,  $Pt(NH_2O.NH_2O)_2(OH)_2$ .**

Insol. in  $H_2O$  or alcohol. Easily sol. in  $HCl$  or  $HNO_3 + Aq$ . Difficultly sol. in hot dil.  $H_2SO_4 + Aq$ . (Alexander.)

**Platodioxamine oxalate,**

Insol. in cold  $H_2O$ , alcohol, or organic acids. (Alexander.)

**— phosphate,  $Pt_3(NH_2O.NH_2O)_{12}(PO_4)_2 + 3H_2O$ .**

Ppt. (Alexander.)

**— sulphate,  $Pt(NH_2O.NH_2O)SO_4 + H_2O$ .**

Sl. sol. in  $H_2O$ . (Alexander.)

**Platosamine bromide,  $Pt(NH_2Br)_2$ .**

Sl. sol. even in hot  $H_2O$ . (Cleve.)

**— chloride,  $Pt(NH_2Cl)_2$ .**

"Reiset's second chloride." Sol. in 140 pts.  $H_2O$  at  $100^\circ$ . (Peyrone, A. 61. 180.)

Sol. in 130 pts.  $H_2O$  at  $100^\circ$ , and 4472 pts. at  $0^\circ$ . (Cleve.)

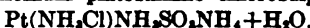
Easily sol. in  $NH_4OH + Aq$ ,  $HNO_3$ , or aqua regia, with decomp. Sol. in  $KCN + Aq$  with evolution of  $NH_3$ . (Cleve.)

**— ammonium chloride,  $Pt(NH_2Cl)_2$ ,  $2NH_4Cl$ .**

Sl. sol. in cold, easily in hot  $H_2O$ ; insol. in alcohol; sol. in  $NH_4OH$  or  $(NH_4)_2CO_3 + Aq$ . (Grimm, A. 99. 75.)

**Platosamine chlorosulphurous acid,**

Easily sol. in  $H_2O$  without decomp. (Cleve.)

**Ammonium platosamine chlorosulphite,**

Sol. in  $H_2O$ . (Peyrone, A. 61. 180.)

**Platosamine cyanide,  $Pt(NH_2CN)_2$ .**

Quite easily sol. in  $H_2O$  or  $NH_4OH + Aq$ . (Buckton.)

**— hydroxide,  $Pt(NH_2OH)_2$ .**

"Reiset's second base." Very sol. in  $H_2O$ . (Odling, B. 3. 685.)

**— iodide,  $Pt(NH_2I)_2$ .**

Very sl. sol. in  $H_2O$ . Sol. in cold  $NH_4OH + Aq$  to form platodiamine iodide. (Cleve.)

**— nitrate,  $Pt(NH_2NO_3)_2$ .**

Moderately sol. in hot  $H_2O$ . Sol. in  $NH_4OH + Aq$  with combination. (Reiset, A. ch. (3) 11. 26.)

**— nitrite,  $Pt(NH_2NO_2)_2$ .**

Very sl. sol. in cold, easily in hot  $H_2O$ . Insol. in alcohol. (Lang.)

**Platosamine platinous nitrite**,  $\text{Pt}(\text{NH}_2\text{NO}_2)_2$ ,  
 $\text{Pt}(\text{NO}_2)_2$ .

Slowly and sl. sol. in cold, more easily sol. in hot  $\text{H}_2\text{O}$ .

Extremely sl. sol. even in conc. acids; more sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Lang.)

— **oxide**,  $\text{Pt}(\text{NH}_3)_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Reiset.)

— **oxalate**,  $\text{Pt}(\text{NH}_3)_2\text{H}_2(\text{C}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$ .

Ppt. (Cleve.)

— **sulphate**,  $\text{Pt}(\text{NH}_3)_2\text{SO}_4 + \text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

— **sulphite**,  $\text{Pt}(\text{NH}_3)_2\text{SO}_3 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

— **sulphocyanide**,  $\text{Pt}(\text{NH}_3\text{SCN})_2$ .

Insol. in  $\text{H}_2\text{O}$ ; can be cryst. from alcohol; not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Buckton.)

Very sol. in hot  $\text{H}_2\text{O}$ . (Cleve.)

— **silver sulphocyanide**,

$\text{Pt}(\text{NH}_3)_2\text{Ag}_4(\text{SCN})_6$ .

(Cleve.)

**Platosamine sulphurous acid**,

$\text{Pt}(\text{NH}_3\text{SO}_3\text{H})_2$ .

Exists only in its salts.

See **Platosamine sulphite**.

**Ammonium platosamine sulphite**,

$\text{Pt}(\text{NH}_3\text{SO}_3\text{NH}_4)_2$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

**Barium platosamine sulphite**,

$\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Ba} + 3\text{H}_2\text{O}$ .

Ppt. (Cleve.)

**Cobalt** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Co} + 6\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ .

**Copper** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Cu} + 5\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ .

**Lead** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Pb} + \text{H}_2\text{O}$ .

Ppt.

**Manganese** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Mn} + 4\text{H}_2\text{O}$ .

Ppt. Sl. sol. in  $\text{H}_2\text{O}$ .

**Nickel** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Ni} + 7\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

**Sodium platosamine sulphite**,

$\text{Pt}(\text{NH}_3\text{SO}_3\text{Na})_2 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . 100 ccm. sat. solution at  $20^\circ$  contains 5.52 g. cryst. salt. (Haberland and Hanekop, A. 245. 235.)

**Silver** — — —,  $\text{Pt}(\text{NH}_3\text{SO}_3\text{Ag})_2 + \text{H}_2\text{O}$ .

Ppt.

**Uranyl** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{UO}_2 + \text{H}_2\text{O}$ .

Ppt.

**Zinc** — — —,  $\text{Pt}(\text{NH}_3)_2(\text{SO}_3)_2\text{Zn} + 6\text{H}_2\text{O}$ .

Ppt. Very sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Platososiamine potassium chloride**,

$\text{Pt}\begin{smallmatrix} \text{NH}_3\text{Cl} \\ \text{Cl} \end{smallmatrix}$ ,  $\text{KCl} + \text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Cossa, B. 23. 2507.)

**Platosoxamine chloride**,  $\text{Pt}\begin{smallmatrix} \text{NH}_3\text{OCl} \\ \text{NH}_3\text{OCl} \end{smallmatrix}$ .

Sol. in  $\text{H}_2\text{O}$ . Much less sol. in  $\text{H}_2\text{O}$  than platodioxamine chloride. (Alexander, A. 246. 239.)

**Platosoxamine amine chloride**,

$\text{Pt}\begin{smallmatrix} \text{NH}_3\text{O.NH}_3\text{Cl} \\ \text{NH}_3\text{O.NH}_3\text{OCl} \end{smallmatrix}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and conc.  $\text{HCl} + \text{Aq}$ . (Alexander, A. 246. 239.)

— **chloroplatinite**,  $\text{Pt}\begin{smallmatrix} \text{NH}_3\text{O.NH}_3\text{Cl} \\ \text{NH}_3\text{O.NH}_3\text{OCl} \end{smallmatrix}\text{PtCl}_2$ .

Ppt.

**Platosulphurous acid**.

**Ammonium platosulphite**,  $(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_4 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Birnbaum, A. 139. 170.)

$(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Liebig, Pogg. 17. 108.)

**Ammonium platosulphite chloride**,

$(\text{NH}_4)_2\text{Pt}(\text{SO}_3)_2 \cdot 2\text{NH}_4\text{Cl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Birnbaum.)

$\text{PtClSO}_3\text{H} \cdot 2\text{NH}_4\text{Cl}$ . Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Birnbaum, A. 152. 143.)

See also **Chloroplatosulphite**, **ammonium**.

**Potassium platosulphite**,  $\text{K}_2\text{Pt}(\text{SO}_3)_4 + 4\text{H}_2\text{O}$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Much more sol. than the Na salt. (Birnbaum, A. 139. 168.)

$+ 3\text{H}_2\text{O}$ . (Lang, J. pr. 83. 415.)

$6\text{K}_2\text{O} \cdot 2\text{PtO} \cdot 10\text{SO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Claus, J. B. 1847-48. 453.)

Does not exist. (Lang.)

$\text{K}_2\text{Pt}(\text{SO}_3)_2$ . Sol. in  $\text{H}_2\text{O}$ .

**Silver platotsulphite,  $\text{Ag}_2\text{Pt}(\text{SO}_3)_4$ .**

Ppt. Very sol. in cold  $\text{NH}_4\text{OH} + \text{Aq.}$  (Lang. J. pr. 83. 415.)

**Sodium platotsulphite,  $\text{Na}_2\text{Pt}(\text{SO}_3)_4$ .**

Very sl. sol. in cold, somewhat more easily in hot  $\text{H}_2\text{O}$ . Not decomp. by boiling  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$  Gradually sol. in  $(\text{NH}_4)_2\text{S}$  or  $\text{K}_2\text{S} + \text{Aq.}$  Insol. in  $\text{NaCl} + \text{Aq.}$  or alcohol. (Litton and Schnedermann, A. 42. 316.)

+  $1\frac{1}{2}\text{H}_2\text{O}$ .

+  $7\text{H}_2\text{O}$ .

$\text{Na}_2\text{Pt}(\text{SO}_3\text{H})_4$ . Moderately sol. in  $\text{H}_2\text{O}$ . (Litton and Schnedermann.)

**Platothiosulphuric acid.****Sodium platothiosulphate,  $\text{Na}_2\text{Pt}(\text{S}_2\text{O}_3)_4 + 10\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  (Schottländer, A. 140. 200.)

$\text{PtS}_2\text{O}_3, 4\text{Na}_2\text{S}_2\text{O}_3 + 10\text{H}_2\text{O}$ .

$\text{PtS}_2\text{O}_3, 6\text{Na}_2\text{S}_2\text{O}_3 + 19\text{H}_2\text{O}$ .

$2\text{PtS}_2\text{O}_3, 7\text{Na}_2\text{S}_2\text{O}_3 + 18\text{H}_2\text{O}$ . (Jochem, C. C. 1885. 642.)

**Plumbic acid.****Barium plumbate,  $\text{Ba}_2\text{PbO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq.}$  with evolution of  $\text{Cl}$ . Sol. in acids in presence of a reducing substance. (Kassner, Arch. Pharm. 228. 109.)

**Calcium plumbate.**

Insol. in  $\text{H}_2\text{O}$ .  $\text{HNO}_3 + \text{Aq.}$  dissolves out  $\text{CaO}$ . (Crum, A. 55. 218.)

$\text{Ca}_2\text{PbO}_4$ . Properties as  $\text{Ba}_2\text{PbO}_4$ . (Kassner, Arch. Pharm. 228. 109.)

+  $4\text{H}_2\text{O}$ . Easily decomp. by  $\text{HNO}_3$ . (Kassner, Arch. Pharm. 1894, 232. 378.)

**Calcium hydrogen plumbate,  $\text{H}_2\text{CaPb}_2\text{O}_4$ .**

Fairly stable; slowly sol. in  $\text{HNO}_3$  in the cold. (Kassner.)

**Calcium lead orthoplumbate,  $\text{CaPbPbO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ .  $\text{HNO}_3$ , acetic and other acids cause a separation of  $\text{PbO}_2$ . (Kassner, Arch. Pharm. 1903, 241. 147.)

**Copper metaplumbate,  $\text{CuPbO}_3$ .**

Decomp. by acids. Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Acetic acid dissolves  $\text{Cu}$ . (Hoehnel, Arch. Pharm. 1896, 234. 399.)

**Lead metaplumbate,  $\text{PbPbO}_3$ .**

Identical with lead sesquioxide. (Hoehnel, Arch. Pharm. 1896, 234. 399.)

**Manganese metaplumbate.**

Decomp. by acids. (Hoehnel, Arch. Pharm. 1896, 234. 399.)

**Potassium plumbate,  $\text{K}_2\text{PbO}_3 + 3\text{H}_2\text{O}$ .**

Very deliquescent. Decomp. by pure  $\text{H}_2\text{O}$  into  $\text{PbO}_2$  and  $\text{KOH}$ . Sol. in  $\text{KOH} + \text{Aq.}$  without decomp. (Fremy, J. Pharm. (3) 3. 32.)

**Silver metaplumbate,  $\text{Ag}_2\text{PbO}_3$ .**

Ppt. (Grützner, Arch. Pharm. 1895, 233. 518.)

**Sodium plumbate.**

Sol. in  $\text{H}_2\text{O}$  with decomposition. Sl. sol. in alkalis +  $\text{Aq.}$  (Fremy, A. ch. (3) 12. 490.)

**Sodium metaplumbate,  $\text{Na}_2\text{PbO}_3 + 4\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in alcohol. (Hoehnel, Arch. Pharm. 1894, 232. 224.)

**Strontium plumbate,  $\text{Sr}_2\text{PbO}_4$ .**

Properties as  $\text{Ba}_2\text{PbO}_4$ . (Kassner, Arch. Pharm. 228. 109.)

**Zinc metaplumbate,  $\text{ZnPbO}_3 + 2\text{H}_2\text{O}$ .**

Decomp. by dil. acids; insol. in  $\text{H}_2\text{O}$ . (Hoehnel, Arch. Pharm. 1896, 234. 398.)

**Plumbous acid.****Calcium plumbite.**

Sl. sol. in  $\text{H}_2\text{O}$ . (Karsten, Scher. J. 5. 575.)

**Potassium plumbite,  $\text{PbO}, x\text{K}_2\text{O}$ .**

Known only in solution.

**Silver plumbite,  $\text{Ag}_2\text{PbO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH} + \text{Aq.}$  and  $\text{KOH} + \text{Aq.}$ ; sol. in  $\text{HNO}_3$  and acetic acid; and in conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HI}$ , and  $\text{HF}$ . (Bullnheimer, B. 1898, 31. 1288.)

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Decomp. on air. (Kratwig, B. 15. 264.)

**Sodium plumbite.**

Known only in solution.

**Potassium,  $\text{K}_2$ .**

Violently decomposes  $\text{H}_2\text{O}$  or alcohol. Insol. in hydrocarbons. Sol. with violent action in acids.

**Solubility in fused  $\text{KOH}$  at  $t^\circ$ .**

$t^\circ$	G. K sol. in 100 g. fused $\text{KOH}$
480	7.8—8.9
600	3 — 4
650	2 — 2.7
700	0.5—1.3

(Hevesy, Z. Elektrochem. 1909, 15. 534.)

Sol. in liquid  $\text{NH}_3$ . (Seely, C. N. 23. 169); (Franklin, Am. Ch. J. 1898, 20. 829.)

1 gram atom of  $\text{K}_2$  dissolves in 4.74 mol.

liquid  $\text{NH}_3$  at  $0^\circ$ ; in 4.79 mol. at  $-50^\circ$ ; in 4.82 mol. at  $-100^\circ$ . (Ruff, B. 1906, 39. 839.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Slowly sol in ethylene diamine. Insol. in ethyl amine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, 29. 1561.)

**Potassium acetylide,  $\text{K}_2\text{C}_2$ .**

(Moissan, C. R. 1898, 127. 917.)

**Potassium acetylide acetylene,  $\text{K}_2\text{C}_2$ ,  $\text{C}_2\text{H}_2$ .**

(Moissan, C. R. 1898, 127. 915.)

**Potassium amalgams.**

$\text{Hg}_9\text{K}$ ,  $\text{Hg}_8\text{K}$ ,  $\text{Hg}_7\text{K}$ ,  $\text{Hg}_{10}\text{K}$ ,  $\text{Hg}_{11}\text{K}$  and  $\text{Hg}_{12}\text{K}$ . (Guntz, C. R. 1900, 131. 183.)

$\text{Hg}_{11}\text{K}$ . Stable up to  $0^\circ$ . Can be cryst. from Hg without decomp. below  $0^\circ$ .

$\text{Hg}_{12}\text{K}$ . Stable from  $0^\circ$  to  $71^\circ$  or  $73^\circ$ . Can be cryst. from Hg without decomp. at any temp. between these limits.

$\text{Hg}_{10}\text{K}$ . Stable from  $71^\circ$  or  $73-75^\circ$ . Can be cryst. from Hg without decomp. at any temp. between these limits. (Kerp, Z. anorg. 1900, 25. 68.)

**Potassium amide,  $\text{KH}_2\text{N}$ .**

Decomp. by water or alcohol. Insol. in hydrocarbons.

**Potassium ammonickelate,  $\text{Ni}_2\text{N}_2\text{K}_4$ ,  $6\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in liquid  $\text{NH}_3$ . (Bohart, J. phys. Chem. 1915, 19. 559.)

**Potassium ammonoargentate,  $\text{AgNHK}$ ,  $\text{NH}_3$  or  $\text{AgNH}_3$ ,  $\text{KNH}_3$ .**

Ppt., decomp. in the air. Decomp. by  $\text{H}_2\text{O}$  or by liquid  $\text{NH}_3$  solutions of acids. (Franklin, J. Am. Chem. Soc. 1915, 37. 855.)

**Potassium ammonobarate,  $\text{BaNK}$ ,  $2\text{NH}_3$ .**

Hydrolyzed by  $\text{H}_2\text{O}$ . Insol. in liquid  $\text{NH}_3$ . Decomp. and dissolved in a solution of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1915, 37. 2297.)

**Potassium ammonocadmiate,  $\text{Cd}(\text{NHK})_2$ ,  $2\text{NH}_3$ .**

Ppt. (Franklin, Am. Ch. J. 1912, 47. 310.)  $\text{Cd}(\text{NHK})_2$ ,  $2\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Insol. in liquid  $\text{NH}_3$ . (Bohart, J. phys. Chem. 1915, 19. 542.)

**Potassium ammonocalciate,  $\text{CaNK}$ ,  $2\text{NH}_3$ .**

Hydrolyzed by  $\text{H}_2\text{O}$ . Readily sol. in a solution of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1915, 37. 2300.)

**Potassium ammonocuprite,  $\text{CuNK}_2$ ,  $3\text{NH}_3$ .**

Very sol. in liquid  $\text{NH}_3$ .

$\text{CuNK}_2$ ,  $2\text{NH}_3$ .

$\text{CuNK}_2$ ,  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1912, 34. 1503.)

$\text{CuNK}_2$ ,  $2\frac{1}{2}\text{NH}_3$ . Ppt. (Franklin, Am. Ch. J. 1912, 47. 311.)

**Potassium ammonomagnesate,  $\text{Mg}(\text{NHK})_2$ ,  $2\text{NH}_3$ .**

Sl. sol. in liquid  $\text{NH}_3$ . Rapidly hydrolyzed by  $\text{H}_2\text{O}$ . (Franklin, J. Am. Chem. Soc. 1913, 35. 1463.)

**Potassium ammonoplumbite,  $\text{PbNK}$ ,  $2\frac{1}{2}\text{NH}_3$ .**

Completely hydrolyzed by action of water vapor. Violently decomp. by  $\text{H}_2\text{O}$  or dil. acids. Sol. in liquid  $\text{NH}_3$ . (Franklin, J. phys. Chem. 1911, 15. 519.)

**Potassium ammonostannate,  $\text{Sn}(\text{NK})_2$ ,  $4\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Readily sol. in  $\text{HCl} + \text{Aq}$ . Sl. sol. in liquid  $\text{NH}_3$ . Readily sol. in a solution of  $\text{NH}_4\text{I}$  in liquid  $\text{NH}_3$ . (Fitzgerald, J. Am. Chem. Soc. 1907, 29. 1696.)

**Potassium ammonostrontiate,  $\text{SrNK}$ ,  $2\text{NH}_3$ .**

Hydrolyzed vigorously by  $\text{H}_2\text{O}$ . Sol. in solutions of  $\text{NH}_4\text{NO}_3$  in liquid  $\text{NH}_3$ . Insol. in liquid  $\text{NH}_3$ . (Franklin, J. Am. Chem. Soc. 1915, 37. 2299.)

**Potassium ammonothallate,  $\text{TlNK}$ ,  $4\text{NH}_3$ .**

Sensitive to action of air or moisture. Violently decomp. by  $\text{H}_2\text{O}$  or dil. acids. Moderately sol. in liquid  $\text{NH}_3$  at  $20^\circ$ , more sol. at higher temp. and much less sol. at lower temp. Decomp. by liquid  $\text{NH}_3$  solutions of acids. (Franklin, J. phys. Chem. 1912, 16. 689.)

**Potassium ammonotitanate, (N)  $\text{TiNHK}$ .**

Vigorously hydrolyzed by  $\text{H}_2\text{O}$ . Insol. in liquid  $\text{NH}_3$  solutions of either potassium amide or  $\text{NH}_4\text{Br}$ . (Franklin, J. Am. Chem. Soc. 1912, 34. 1500.)

**Potassium ammonozincate,  $\text{Zn}(\text{NHK})_2$ ,  $2\text{NH}_3$ .**

Decomp. by water. Sl. sol. in liquid  $\text{NH}_3$ . (Fitzgerald, J. Am. Chem. Soc. 1907, 29. 663.) Decomp. by  $\text{H}_2\text{O}$ . Sol. in dilute acids. Sl. sol. in liquid  $\text{NH}_3$ . Sol. in solutions of ammonium salts in liquid  $\text{NH}_3$ . (Franklin, Z. anorg. 1907, 55. 195.)

**Potassium arsenide,  $\text{K}_3\text{As}$ .**

(Hugot, C. R. 1899, 129. 604.)

$\text{K}_2\text{As}_4$ . (Hugot.)

**Potassium arsenide, ammonia,  $\text{AsK}_2$ ,  $\text{NH}_3$ .**

Nearly insol. in liquid  $\text{NH}_3$ . (Hugot.)

$\text{K}_2\text{As}_4$ ,  $\text{NH}_3$ . (Hugot.)

**Potassium azoimide, KN<sub>3</sub>.**

Stable in aq. solution.

46.5 pts. are sol. in 100 pts. H<sub>2</sub>O at 10.5°.48.9 " " " " 100 " H<sub>2</sub>O " 15.5.49.6 " " " " 100 " H<sub>2</sub>O " 17.

0.1375 " " " " 100 " abs. alcohol at 16°.

Insol. in pure ether. (Curtius, J. pr. 1898, (2) 58. 280.)

**Potassium bromide, KBr.**Solubility of KBr in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. KBr	t°	Pts. KBr
0	53.48	60	85.35
20	64.52	80	93.46
40	74.63	100	102.0

(Kremers, Pogg. 97. 151.)

Solubility of KBr in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. KBr	t°	Pts. KBr
-13.4	46.17	43.15	77.0
-6.2	49.57	45.45	77.73
0	53.32	50.5	80.33
+3.4	55.60	54.8	82.78
5.2	56.63	60.15	85.37
12.65	61.03	66.75	88.22
13.0	61.17	71.45	90.69
13.3	61.45	74.85	92.25
18.3	64.11	86.5	97.28
26.05	68.31	97.9	102.9
30.0	70.35	110.0	110.3
37.9	74.46	...	...

Solubility is represented by a straight line of the formula  $54.43 + 0.5128t$ . (Coppet, A. ch. (5) 30. 416.)

100 pts. KBr+Aq sat. at 15-16° contain 39.06 pts. KBr. (v. Hauer, J. pr. 96. 137.)

Solubility of KBr in 100 pts. H<sub>2</sub>O at high temp.

t°	Pts. KBr
140	120.9
181	145.6

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

Sat. solution boils at 112°. (Kremers.)

Sat. KBr+Aq contains at:

-12°	-10°	+3°	32°	39°
31.0	31.5	35.7	41.6	47.7% KBr,
55°	77°	140°	173°	220°
45.5	48.7	54.1	58.5	61.6% KBr.

(Étard, A. ch. 1894, (7) 2. 539.)

If solubility S=pts. KBr in 100 pts. solution,  $S = 34.5 + 0.2420t$  from 0° to 40°,  $S =$ 

41.5 + 0.1378t from 30° to 120°. (Étard, C. R. 98. 1432.)

Solubility of KBr in 100 g. H<sub>2</sub>O at t°.

t°	G. KBr.	t°	G. KBr.
10.5	62.1	-11	44.9
10	60.7	-10.5	41.8
3.5	55.5	-10	39.7
0	52.6	-8.5	35.7
-5	50.1	-8	31.2
-8	47.5	-6.5	25.0
-11.5	45.3	...	...

(Meusser, Z. anorg. 1905, 44. 80.)

68.74 g. KBr are sol. in 100 g. H<sub>2</sub>O at 25°. (Amadori and Pampanini, Rend. Ac. Linc. 1911, V, 20. 473.)

Sp. gr. of KBr+Aq at 19°.

% KBr	Sp. gr.	% KBr	Sp. gr.
5	1.037	30	1.256
10	1.075	35	1.309
15	1.116	40	1.366
20	1.159	45	1.432
25	1.207	...	...

(Gerlach, Z. anal. 8. 285.)

Sp. gr. of KBr+Aq at 15° containing:

5	10	20	30	36% KBr.
1.0357	1.074	1.1583	1.2553	1.3198

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of KBr+Aq at t°.

G. KBr dissolved in 100 g. H <sub>2</sub> O	G. KBr in 100 g. of the solution	t°	Sp. gr.
4.166	4	14.5	1.0291
11.111	10	15.7	1.0753
25.000	20	16.5	1.1625
42.867	30	16.0	1.2580

(de Lannoy, Z. phys. Ch. 1895, 18. 460.)

KBr+Aq containing 6.99% KBr has sp. gr. 20°/20° = 1.0521. (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 278.)

Sp. gr. of KBr+Aq at 20.5°.

Normality of KBr+Aq.	G. KBr in 100 g. of solution	Sp. gr. t°/4°
4.29	37.97	1.3449
3.01	28.83	1.2407
2.00	20.49	1.1629
1.00	11.03	1.0615

(Oppenheimer, Z. phys. Ch. 1898, 27. 452.)

Solubility of  $\text{KBr} + \text{NH}_4\text{Br}$  at  $25^\circ$ .

% KBr	% $\text{NH}_4\text{Br}$	Sp. gr.
55.81	0.0	1.3756
55.42	0.64	1.3745
53.65	2.46	1.3733
51.68	5.13	1.3721
44.12	15.29	1.3711
34.73	26.22	1.3715
26.23	34.76	1.3753
26.03	38.14	1.3753
23.22	41.78	1.3766
22.23	43.25	1.3777
17.99	48.08	1.3766
0.0	57.73	1.3763

(Fock, Z. Kryst. Min. 1897, 23. 357.)

Solubility in  $\text{KNO}_3 + \text{Aq.}$ 

1 litre of the solution contains

at $14.5^\circ$		at $25.2^\circ$	
Mol. $\text{KNO}_3$	Mol. KBr	Mol. $\text{KNO}_3$	Mol. KBr
0.0	4.332	0.0	4.761
0.362	4.156	0.131	4.72
0.706	4.093	0.527	4.61
1.235	3.939	0.721	4.54
...	...	1.090	4.475
...	...	1.170	4.44
...	...	1.504	4.375

(Touren, C. R. 1900, 130. 911.)

See also under  $\text{KNO}_3$ .

100 pts.  $\text{KBr} + \text{KCl} + \text{Aq}$  sat. at  $15-16^\circ$  contain 37.55 pts. of the two salts; 10.0 pts.  $\text{KBr} + \text{KI} + \text{Aq}$  sat. at  $15-16^\circ$  contain 57.96 pts. of the two salts; 100 pts.  $\text{KBr} + \text{KCl} + \text{KI} + \text{Aq}$  sat. at  $15-16^\circ$  contain 57.88 pts. of the three salts. (v. Hauer, J. pr. 98. 137.)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

% KBr	% KCl	Sp. gr.
55.81	0.00	1.3756
53.15	2.34	1.3700
50.36	4.66	1.3648
45.46	8.26	1.3544
37.96	13.66	1.3320
32.48	16.69	1.3119
21.80	21.39	1.2689
14.07	25.09	1.2455
4.75	29.17	1.1977
0.00	31.13	1.1756

(Fock, Z. Kryst. Min. 1897, 23. 357.)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains		
	% KCl	% KBr	% total salt
-14	10.7	18.8	29.5
-13.7	...	...	29.4
-13.5	...	...	29.5
-7	10.7	19.8	30.5
+5.2	...	...	34.4
+6	11.3	22.6	33.9
10	11.0	23.7	34.7
21	10.8	...	35.3
26	11.2	25.5	36.7
30	...	...	39.4
32	11.9	26.6	38.5
39	...	...	39.8
47	11.0	30.8	41.8
52	11.0	31.2	42.2
55	11.9	29.9	41.8
71	12.0	31.7	43.7
73	11.8	32.9	44.7
102	12.8	35.8	48.6
152	13.2	40.6	53.8
160	12.5	42.3	54.8
168	...	...	55.0
225	14.7	45.0	59.7

(Étard, A. ch. 1894, (7) 3. 281.)

Solubility of  $\text{KBr} + \text{KCl}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .G. per 100 g.  $\text{H}_2\text{O}$ .

KBr	KCl
68.47	0.0
62.26	5.43
58.50	8.46
52.45	12.48
45.42	17.17
38.70	21.23
26.62	25.88
12.94	31.02
0.0	36.12

(Amadori and Pampanini, Att. Acc. Linc. 1911, 20, II. 475.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25.2^\circ$ .

1 litre of the solution contains

Mol. KCl	Mol. KBr
0.0	4.761
0.67	4.22
0.81	4.15
1.35	3.70
1.48	3.54
1.61	3.42
1.70	3.34
2.46	2.50
3.775	0.525

(Touren, C. R. 1900, 130. 1252.)

See also under KCl.



By repeatedly heating  $\text{KBr} + \text{Aq sat.}$  at  $15-16^\circ$  with  $\text{KI}$  and cooling to  $15^\circ$ , nearly all the  $\text{KBr}$  can be separated. (v. Hauer.)

100 pts.  $\text{H}_2\text{O}$  sat. with  $\text{KBr}$  at  $16^\circ$  dissolve 13.15 pts.  $\text{KI}$ , but on addition of more  $\text{KI}$ ,  $\text{KBr}$  is pptd. (van Melckebeke, C. C. 1872. 586.)

#### Solubility in $\text{KI} + \text{Aq}$ at $t^\circ$ .

$t^\circ$	Sat. solution contains		
	% $\text{KBr}$	% $\text{KI}$	% total salt
-22	8.3	42.6	50.9
-19	9.5	42.8	52.3
-6	9.3	44.7	54.0
-1.5	...	...	55.3
+3	10.3	45.9	56.2
13.6	10.1	46.2	55.9
25	10.8	48.0	58.8
44.2	11.1	50.1	61.2
51	12.1	50.0	62.1
66	10.8	53.1	63.9
70	11.6	51.9	63.5
80	12.3	52.5	64.8
93	13.0	53.7	66.7
116	13.2	54.6	67.8
125	13.7	54.8	68.5
150	15.1	55.1	70.2
175	16.0	57.2	73.2
175	...	...	72.7
195	16.7	56.5	73.2
220	17.6	57.0	74.6

(Étard, A. ch. 1894, (7) 3. 279.)

#### Solubility of $\text{KBr} + \text{KI}$ in $\text{H}_2\text{O}$ at $25^\circ$ .

G. per 100 g. $\text{H}_2\text{O}$ .	
$\text{KBr}$	$\text{KI}$
53.21	35.92
42.32	66.63
34.14	95.36
30.08	119.59
29.62	119
22.15	127.10
21.88	127.31
18.54	130.61
0.0	149.28

(Amadori and Pampanini, Att. Acc. Line. 1911, 20, II. 475.)

#### Solubility of $\text{KBr}$ in $\text{KOH} + \text{Aq}$ .

G. per 1000 g. $\text{H}_2\text{O}$		G. per 1000 g. $\text{H}_2\text{O}$	
$\text{KOH}$	$\text{KBr}$	$\text{KOH}$	$\text{KBr}$
36.4	558.4	277.6	248.1
113.5	433.6	434.7	137.1
177.2	358.1	579.6	64.8
231.1	281.2	806.9	33.4

(Ditte, C. R. 1897, 124. 30.)

Sol. in  $\text{Br}_2$  at  $15^\circ$ . (Walden, Z. anorg. 1900, 25. 220.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in liquid  $\text{NH}_3$ . 45 pts. are sol. in 100 pts. liquid  $\text{NH}_3$  at  $-50^\circ$ . (Joannis, C. R. 1905, 140. 1244.)

Attacked by liquid  $\text{NO}_2$  with liberation of  $\text{Br}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Sol. in  $\text{SO}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Sol. in  $\text{SO}_2\text{Cl}(\text{OH})$ . (Walden, Z. anorg. 1902, 29. 382.)

Difficultly sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $\text{SbCl}_3$ . (Walden, Z. anorg. 1900, 25. 220.)

Sol. in liquid  $\text{SO}_2$ . (Walden, Z. anorg. 1902, 30. 160.)

Hydrazine dissolves 56.4 pts.  $\text{KBr}$  at  $12.5-13^\circ$ . (de Bruyn, R. t. c. 1899, 18. 297.)

Sl. sol. in alcohol. (Ballard.)

Sol. in 200 pts. cold, and 16 pts. boiling 80% alcohol.

Sol. in 180 pts. 90% alcohol. (Hager.)

Sol. in 750 pts. abs. alcohol at  $15^\circ$ . (Eder, Dingl. 221. 89.)

100 pts. absolute methyl alcohol dissolve 1.51 pts. at  $25^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 0.13 pt. at  $25^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

#### Solubility of $\text{KBr}$ in methyl alcohol + $\text{Aq}$ at $25^\circ$ .

P = % by wt. of alcohol in alcohol +  $\text{Aq}$ .

S = Sp. gr. of alcohol +  $\text{Aq}$  sat. with  $\text{KBr}$ .

L = millimols  $\text{KBr}$  in 100 ccm. of the solution.

P	S $25^\circ/4^\circ$	L
0	1.3797	471
10.6	1.300	389
30.8	1.159	252
47.1	1.058	162
64.0	0.9801	87
78.1	0.8906	44
98.9	0.8411	23
100	0.8047	14.2

(Hers and Anders, Z. anorg. 1907, 55. 273.)

100 g.  $\text{KBr} + \text{CH}_3\text{OH}$  contain 0.2 g.  $\text{KBr}$  at the critical temp. (Centnerswer, Z. phys. Ch 1910, 72. 437.)

Solubility of KBr in ethyl alcohol+Aq.

Wt. % alcohol	Temp. =-30°		Temp. =-40°	
	G. KBr. per 100 g.		G. KBr per 100 g.	
	Solution	Solvent	Solution	Solvent
0	41.62	71.30	43.40	76.65
5	38.98	67.25	40.85	72.70
10	36.33	63.40	38.37	69.00
20	31.09	56.40	33.27	62.30
30	25.98	50.15	28.32	56.45
40	21.24	44.95	23.22	50.46
50	16.27	38.85	18.11	44.25
60	11.50	32.50	13.02	37.40
70	6.90	24.70	7.98	28.90
80	3.09	15.95	3.65	18.95
90	0.87	8.80	1.03	10.45

(Taylor, J. phys. Ch. 1896, 1. 724.)

At room temp., 1 pt. KBr by weight is sol. in:

52 pts. methyl alcohol,  $D_{15}^{20}$  0.7990.  
350 " ethyl "  $D_{15}^{20}$  0.8100.  
1818 " propyl "  $D_{15}^{20}$  0.8160

(Rohland, Z. anorg. 1898, 18. 325.)

Solubility of KBr in ethyl alcohol at 0°.

Conc. of alcohol in mol. g. per l. H <sub>2</sub> O	G. KBr in 1 l. H <sub>2</sub> O	Mol. solubility
—	536.75	4.51
$\frac{1}{4}$	529.25	4.45
$\frac{1}{2}$	502.85	4.22
1	491.75	4.13
2	455.25	3.82

(Armstrong and Eyre, Proc. R. Soc. 1910, [A] 84. 127.)

100 g. methyl alcohol dissolve 2.17 g. KBr at 25°.

100 g. ethyl alcohol dissolve 0.142 g. KBr at 25°.

100 g. propyl alcohol dissolve 0.035 g. KBr at 25°.

100 g. isoamyl alcohol dissolve 0.003 g. KBr at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

0.055 g. is sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Sol. in 5000 pts. ether (sp. gr. 0.729 at 15°.) (Eder, l. c.)

Sol. in 1700 pts. alcohol-ether (1 : 1) at 15°.

(Eder, l. c.)

100 pts. acetone dissolve 0.023 pt. KBr at 25°.

(Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Solubility of KBr in acetone+Aq at 25°.

A=cc. acetone in 100 cc. acetone+Aq.  
KBr=millimols KBr in 100 cc. of the solution.

A	KBr	Sp. gr.
0	481.3	1.3793
20	366.7	1.2688
30	310.5	1.2118
40	259.0	1.1558
50	202.9	1.0918
60	144.9	1.0275
70	95.3	0.9591
80	46.5	0.89415
90	10.1	0.8340

(Herz and Knoch, Z. anorg. 1905, 45. 262.)

Solubility of KBr in glycerine+Aq at 25°.

G=g. glycerine in 100 g. glycerine+Aq.  
KBr= millimols KBr in 100 cc. of the solution.

G	KBr	Sp. gr.
0	481.3	1.3793
13.28	444.3	1.3704
25.98	404.0	1.3655
45.36	340.5	1.3594
54.23	310.4	1.3580
83.84	219.25	1.3603
100	172.65	1.3691

(Herz and Knoch, Z. anorg. 1905, 45. 267.)

100 g. 95% formic acid dissolve 23.2 g. KBr at 18.5°. (Aschan, Chem. Ztg. 1913, 37. 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

100 ccm. of a sat. solution of KBr in furfural at 25° contain 0.139 pts. by wt. KBr. (Walden, Z. phys. Ch. 1906, 55. 713.)

Insol. in CS<sub>2</sub>. (Arctowski, Z. anorg. 1894, 6. 257.)

Potassium rhodium bromide.

See Bromorhodite, potassium.

Potassium ruthenium tribromide.

See Bromoruthenite, potassium.

Potassium ruthenium tetrabromide.

See Bromoruthenate, potassium.

Potassium selenium bromide.

See Bromoselenate, potassium.

**Potassium tellurium bromide.**

See Bromotellurate, potassium.

**Potassium thallic bromide,  $\text{KBr}$ ,  $\text{TlBr}_3 + 2\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . $3\text{KBr}$ ,  $2\text{TlBr}_3 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ram-melsberg.)**Potassium thorium bromide.**Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Potassium tin (stannous) bromide,  $\text{KBr}$ ,  $\text{SnBr}_2 + \text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Benas, C. C. 1884. 958.)Can be recryst. from  $\text{HBr}$  or  $\text{KBr} + \text{Aq}$ . (Richardson, Am. Ch. J. 14. 95.) $2\text{KBr}$ ,  $\text{SnBr}_2 + 2\text{H}_2\text{O}$ . Cannot be recryst. from  $\text{HBr} + \text{Aq}$ . (Richardson.)**Potassium tin (stannic) bromide,  $2\text{KBr}$ ,  $\text{SnBr}_4$ .**

See Bromostannate, potassium.

**Potassium uranous bromide,  $\text{KUBr}_3$ .**Very sol. in  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1899, (3) 21. 264.)**Potassium uranyl bromide,  $2\text{KBr}$ ,  $\text{UO}_2\text{Br}_2 + 2\text{H}_2\text{O}$ .**Very easily sol. in  $\text{H}_2\text{O}$ . (Sendtner.)**Potassium zinc bromide,  $\text{KBr}$ ,  $\text{ZnBr}_2 + 2\text{H}_2\text{O}$ .**

Not hygroscopic. (Ephraim, Z. anorg. 1908, 59. 60.)

 $2\text{KBr}$ ,  $\text{ZnBr}_2 + 2\text{H}_2\text{O}$ . Not hygroscopic. (Ephraim.)**Potassium bromide ammonia,  $\text{KBr}$ ,  $4\text{NH}_3$ .**

(Joannis, C. R. 1905, 140. 1244.)

**Potassium bromide ruthenium dihydronitro-sochloride,  $(\text{NO})\text{Ru}_2\text{H}_2\text{Cl}_2$ ,  $2\text{HCl}$ ,  $3\text{KBr}$ .**Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Brizard, A. ch. 1900, (7) 21. 359.)**Potassium bromoiodide,  $\text{KBr}_2\text{I}$ .**

Decomp. rapidly on air. (Wells and Wheeler, Sill. Am. J. 143. 475.)

**Potassium carbonyl,  $\text{K}_2\text{C}_2\text{O}_3$ .**Decomp. by  $\text{H}_2\text{O}$  with explosion. (Joannis, C. R. 116. 158.)**Potassium chloride,  $\text{KCl}$ .**Sol. in  $\text{H}_2\text{O}$  with absorption of heat.30 pts.  $\text{KCl} + 100$  pts.  $\text{H}_2\text{O}$  at  $13.2^\circ$  lower the temp.  $12.6^\circ$ . (Rüdorff, B. 2. 68.)100 pts.  $\text{H}_2\text{O}$  dissolve 29.31 pts.  $\text{KCl}$  at  $0^\circ$ . (Gay-Lussac); 28.5 pts.  $\text{KCl}$  at  $0^\circ$  (Mulder; Gerardin.)The saturated solution contains 58.5%, and boils at  $107.6^\circ$  (Mulder); contains 59.40%, and boils at  $108.3^\circ$  (Legrand); contains 59.26%, and boils at  $109.6^\circ$  (Gay-Lussac); boils at  $110^\circ$ . (Kremers.)Sol. in 3.016 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach); in 3.03 pts. at  $17.5^\circ$  or 100 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 33 pts.  $\text{KCl}$ . (Schiff.)100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts.  $\text{KCl}$ :

$t^\circ$	Pts. $\text{KCl}$	$t^\circ$	Pts. $\text{KCl}$	$t^\circ$	Pts. $\text{KCl}$
0	29.21	52.39	43.59	109.60	59.26
19.35	34.53	79.58	50.93	....	....

(Gay-Lussac, A. ch. (2) 11. 308.)

100 pts.  $\text{H}_2\text{O}$  dissolve 34.6 pts.  $\text{KCl}$  at  $11.8^\circ$ ; 34.9 pts. at  $13.8^\circ$ ; 35 pts. at  $15.6^\circ$ . (Kopp.)100 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 33.24 pts.  $\text{KCl}$ , and sp. gr. of solution is 1.635. (Karsten.)100 pts.  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 32 pts., and at  $100^\circ$ , 59.4 pts. (Otto-Graham.)Sol. in 3 pts.  $\text{H}_2\text{O}$  at ord. temp., and 3 pts. boiling  $\text{H}_2\text{O}$  (Bergmann); in 3.33 pts. hot or cold  $\text{H}_2\text{O}$  (Fourcroy); in 3 pts. at  $15^\circ$ , and 1.68 pts. at  $110^\circ$  (M. R. and F.)Sol. in 3.5 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and in less than 1 pt. hot  $\text{H}_2\text{O}$  (Schubarth); 100 pts.  $\text{H}_2\text{O}$  at  $17.5^\circ$  dissolve 30.7-33.0 pts.  $\text{KCl}$  (Ure's Dict.).100 pts.  $\text{H}_2\text{O}$  dissolve 35.405 pts.  $\text{KCl}$  at  $15^\circ$ , and solution has sp. gr. = 1.1809. (Michel and Krafft, A. ch. (3) 41. 478.)100 pts.  $\text{H}_2\text{O}$  dissolve at:

18° 30° 40° 57°

33.6 37.8 40.1 45.0 pts.  $\text{KCl}$ .

(Gerardin, A. ch. (4) 5. 139.)

100 pts.  $\text{H}_2\text{O}$  dissolve 33.06-32.08 pts.  $\text{KCl}$  at  $15.6^\circ$  and sp. gr. of solution = 1.171. (Page and Keightley, Chem. Soc. (2) 10. 566.)Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{KCl}$	$t^\circ$	Pts. $\text{KCl}$	$t^\circ$	Pts. $\text{KCl}$
0	28.5	17	33.9	34	38.5
1	28.7	18	34.2	35	38.7
2	29.0	19	34.4	36	39.0
3	29.3	20	34.7	37	39.3
4	29.5	21	35.0	38	39.6
5	30.0	22	35.3	39	39.9
6	30.5	23	35.5	40	40.1
7	31.0	24	35.8	41	40.3
8	31.5	25	36.1	42	40.6
9	31.7	26	36.4	43	40.9
10	32.0	27	36.6	44	41.2
11	32.3	28	36.9	45	41.5
12	32.5	29	37.2	46	41.7
13	32.8	30	37.4	47	42.0
14	33.1	31	37.7	48	42.3
15	33.4	32	38.0	49	42.5
16	33.6	33	38.2	50	42.8

Solubility in 100 pts., etc.—Continued.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
51	43.1	71	48.5	91	54.1
52	43.4	72	48.8	92	54.4
53	43.6	73	49.1	93	54.6
54	43.9	74	49.4	94	54.9
55	44.2	75	49.6	95	55.2
56	44.4	76	49.9	96	55.5
57	44.7	77	50.2	97	55.7
58	44.9	78	50.5	98	56.0
59	45.2	79	50.8	99	56.3
60	45.5	80	51.0	100	56.6
61	45.8	81	51.3	101	56.9
62	46.1	82	51.5	102	57.2
63	46.3	83	51.8	103	57.4
64	46.6	84	52.1	104	57.7
65	46.9	85	52.4	105	58.0
66	47.2	86	52.6	106	58.2
67	47.5	87	52.9	107	58.5
68	47.7	88	53.2	107.65	58.5
69	48.0	89	53.5	...	...
70	48.3	90	53.8	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. 1864. 41.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
-11°	24.46	25.7	36.10	64.95	47.17
-6.4	25.78	29.25	37.31	71.65	48.76
0	27.9	38.0	39.71	74.25	49.27
+3.9	29.37	41.45	40.67	80.75	51.24
9.4	30.84	46.15	42.34	86.6	52.53
11.4	32.19	48.8	42.86	91.4	53.49
14.95	32.66	55.1	44.51	...	...
19.0	34.32	60.55	45.90	...	...

(Coppet, A. ch. (5) 30. 414.)

Solubility is represented by a straight line, of which the formula is  $28.51 + 0.2837t$ . (Coppet.)

100 pts. H<sub>2</sub>O dissolve 29.33 pts. KCl at 4°, 45.5 pts. at 60°. (Andreae, J. pr. (2) 29. 456.)

100 pts. H<sub>2</sub>O dissolve at:

0° 100° 130° 180°  
29.2 56.5 66 78 pts. KCl.

(Tilden and Shenstone, Lond. R. Soc. Proc. 35. 345.)

Solubility of KCl in 100 pts. H<sub>2</sub>O at high temp.

t°	Pts. KCl	t°	Pts. KCl	t°	Pts. KCl
125	59.6	147	70.8	180	77.5
188	69.3	175	75.2	...	...

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

If solubility S=pts. KCl in 100 pts. solution,  $S = 20.5 + 0.1445t$  from -90° to 110°. (Étard, C. R. 98. 1432.)

Sat. KCl + Aq contains at:

142° 150° 175° 180°  
38.6 38.8 41.2 41.8% KCl.

190° 200° 242° 732° (mpt.)  
43.2 42.9 47.6 100% KCl.

(Étard, A. ch. 1894, (7) 2. 256.)

100 g. H<sub>2</sub>O dissolve 0.488 gram-equivalent KCl at 25°. (van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, 49. 315.)

Solubility of KCl in H<sub>2</sub>O at t°.

G. KCl per 100 G. H<sub>2</sub>O.

t°	KCl	Sp. gr.
0.70	28.29	1.1540
19.55	34.37	1.1738
32.80	38.32	1.1839
59.85	45.84	1.1980
74.80	49.58	1.2032
89.45	53.38	1.2069
108.0*	58.11	1.2118

\* Bpt. of sat. solution.

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203, A. 189.)

Solubility of KCl in 100 g. H<sub>2</sub>O at t°.

t°	g. KCl	t°	g. KCl
+18.5	33.3	-4.5	25.9
11.5	31.2	-9	23.9
10	30.8	-8.5	21.5
7.5	29.8	-8	20.0
2.5	28.4	-7	17.5
0	27.5	-6	15.7
-1	27.2	-5.5	14.3

(Meusser, Z. anorg. 1905, 44. 80.)

Sat. KCl + Aq at 25° contains 26.46% KCl. (Foote, Am. Ch. J. 1906, 35. 238.)

28.01 g. KCl are contained in 100 g. solution sat. at 30°. (de Waal, Dissert. 1910.)

36.12 g. KCl are sol. in 100 g. H<sub>2</sub>O at 25°. (Amadori and Pampanini, Rend. Acc. Linc. 1911, V. 20. 473.)

4.272 g. mol. are contained in 1 l. solution sat. at 25°. (Herz. Z. anorg. 1911, 73. 274.)

Solubility of KBr at 6° = 23.06%; 28.4° = 26.91%; 62.6° = 31.57°. (Süss, Z. Krist. 1912, 51. 262.)

Solubility at 22° = 25.68%. (Brönstedt, Z. phys. Ch. 1912, 80. 208.)

100 mol. H<sub>2</sub>O dissolve at:  
19.3° 29.7° 40.1° 54.5°  
8.2 8.99 9.75 10.39 mol. KCl.

(Sudhaus, Miner. Jahrb. Beil.-Bd. 1914, 37. 18.)

KCl+Aq sat. at 16° has sp. gr. = 1.077.  
(Stolba, J. pr. 97. 503.)

Sp. gr. of KCl+Aq at 17.5°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
1	1.0062	9	1.0586	17	1.1152
2	1.0125	10	1.0655	18	1.1225
3	1.0189	11	1.0725	19	1.1298
4	1.0254	12	1.0795	20	1.1372
5	1.0319	13	1.0866	21	1.1446
6	1.0385	14	1.0937	22	1.1521
7	1.0451	15	1.1008	23	1.1596
8	1.0518	16	1.1080	24	1.1673

(Schiff, A. 110. 76.)

Sp. gr. of KCl+Aq at 19.5°.

% KCl	Sp. gr.	% KCl	Sp. gr.
5.98	1.0382	21.31	1.1436
11.27	1.0733	25.133	1.1720
16.27	1.1075	...	...

(Kremers, Pogg. 96. 119.)

Sp. gr. of KCl+Aq at 15°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
1	1.00650	10	1.06580	19	1.12894
2	1.01300	11	1.07271	20	1.13608
3	1.01950	12	1.07962	21	1.14348
4	1.02600	13	1.08654	22	1.15088
5	1.03250	14	1.09345	23	1.15828
6	1.03916	15	1.10036	24	1.16568
7	1.04582	16	1.10750	24.9*	1.17234
8	1.05248	17	1.11465	...	...
9	1.05914	18	1.12179	...	...

\* Mother liquor.

(Gerlach, Z. anal. 8. 281.)

Sp. gr. of KCl+Aq at 20°, containing mols.  
KCl to 100 mols. H<sub>2</sub>O.

Mols. KCl	Sp. gr.	Mols. KCl	Sp. gr.
0.5	1.01310	4.0	1.09415
1.0	1.02568	5.0	1.11445
2.0	1.04959	...	...

(Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of KCl+Aq at 18°.

% KCl	Sp. gr.	% KCl	Sp. gr.	% KCl	Sp. gr.
5	1.0308	15	1.0978	25	1.1408
10	1.0638	20	1.1335	...	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of KCl+Aq at 0°. S = pts. salt in 100  
pts. of solution; S<sub>1</sub> = mols. salt in 100  
mols. solution.

S	S <sub>1</sub>	Sp. gr.
20.7840	5.954	1.1489
17.7214	4.940	1.1258
14.4707	3.922	1.1018
11.0757	2.918	1.0769
7.5440	1.931	1.0521
4.4968	1.123	1.0308

(Charpy, A. ch. (6) 29. 23.)

Sp. gr. of KCl+Aq at 25°.

Concentration of KCl+Aq	Sp. gr.
1-normal	1.0466
1/2 " "	1.0235
1/4 " "	1.0117
1/8 " "	1.0069

(Wagner, Z. phys. Ch. 1890, 5. 36.)

KCl+Aq containing 5.05% KCl has sp. gr.  
20°/20° = 1.0327.

KCl+Aq containing 20.55% KCl has sp.  
gr. 20°/20° = 1.1393.

(Le Blanc and Rohland, Z. phys. Ch. 1896,  
19. 272.)

Sp. gr. of KCl+Aq.

g. KCl in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.7140	1.000464
1.5042	1.000975
3.0724	1.001991
8.3165	1.005391

(Dijken, Z. phys. Ch. 1897, 24. 109.)

Sp. gr. of KCl+Aq at 20.1°, when p = per  
cent strength of solution; d = observed  
density, and w = volume conc. in g. per  
cc.  $\left(\frac{pd}{100}\right) = w$

p	d	w
36.43	1.853	0.43171
31.12	1.1554	0.35954
24.79	1.1215	0.27887
18.06	1.0866	0.19610
13.17	1.0617	0.13980
8.412	1.0386	0.06736
6.610	1.0297	0.06806
4.419	1.0193	0.4505
3.456	1.0148	0.03507
1.197	1.0040	0.01202

(Barnes, J. phys. Ch. 1898, 2. 544.)

Sp. gr. of KCl+Aq at t°.

t°	Normality of KCl+Aq.	g. KCl in 100 g. of solution	Sp. gr. t°/4°
20.5	3.74	23.93	1.1617
"	2.65	17.66	1.1166
"	1.87	12.82	1.0829
"	0.93	6.64	1.0424

(Oppenheimer, Z. phys. Ch. 1898, 27. 450.)

Sp. gr. of KCl+Aq at 18°/4°.

g. KCl in 100 g. of solution	Sp. gr.
0.24963	1.0003
0.12459	0.9995
0.08342	0.99929
0.062343	0.99912

(Jahn, Z. phys. Ch. 1900, 33. 559.)

KCl+Aq containing 1 pt. KCl in 58.923 pts. H<sub>2</sub>O at 17° has sp. gr. = 1.0096. (Hittorf, Z. phys. Ch. 1902, 39. 628.)

Sp. gr. 20°/4° of a normal solution of KCl = 1.0443. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of sat. KCl+Aq at t°.

t°	g. KCl sol. in 100 g. H <sub>2</sub> O	Sp. gr.
-10°	24.98	1.139
0	28.50	1.156
10	31.23	1.168
20	34.11	1.177
30	37.28	1.183
40	40.12	1.190
50	42.86	1.195
60	45.48	1.199
70	48.30	1.203

(Tschernaj, J. Russ. phys. Chem. Soc. 1912, 44. 1565.)

Sp. gr. of dil. KCl+Aq at 20.004°.

Conc. = g. equiv. KCl per l. at 20.004°. Sp. gr. compared with H<sub>2</sub>O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,004,8
0.0002	1.000,009,7
0.0005	1.000,024,2
0.0010	1.000,048,5
0.0026	1.000,097,1
0.0050	1.000,242,6
0.0100	1.000,483,6

(Lamb and Lee, J. Am. Chem. Soc., 1913, 35. 1687.)

KCl+Aq containing 10% KCl boils at 101.1°; containing 20%, at 103.4°. (Gerlach.) Sat. KCl+Aq containing 52.7 pts. KCl to 100 pts. H<sub>2</sub>O forms a crust at 107.7°; highest temp. observed, 108.5°. (Gerlach, Z. anal. 26. 426.)

B-pt. of KCl+Aq containing pts. KCl to 100 pts. H<sub>2</sub>O. G = according to Gerlach (Z. anal. 26. 438); L = according to Legrand (A. ch. (2) 59. 426).

B-pt.	G	L	B-pt.	G	L
100.5°	4.9	4.7	105°	36.2	37.8
101.0	9.2	9.0	105.5	39.3	41.0
101.5	13.1	13.2	106	42.4	44.2
102	16.7	17.1	106.5	45.5	47.4
102.5	20.1	20.9	107	48.4	50.5
103	23.4	24.5	107.5	51.5	53.7
103.5	26.7	28.0	108	54.5	56.9
104	29.9	31.4	108.3	...	59.4
104.5	33.1	34.6	108.5	57.4	...

Precipitated from aqueous solution by HCl +Aq. Much less sol. in very dil. HCl+Aq than in H<sub>2</sub>O. (Fresenius.)

Nearly insol. in conc. HCl+Aq.

100 cc. sat. HCl+Aq dissolve 1.9 g. KCl at 17°. (Ditte, A. ch. 1881, (5) 24. 226.)

Solubility of KCl in HCl+Aq at 0°.

G. per 100 cc. of solution	
HCl	KCl
0.0	25.73
1.42	22.69
2.41	20.84
2.59	20.51
4.05	17.71
8.39	11.93
12.40	7.46
14.95	5.60
23.88	1.49
54.20	1.52

(Engel, A. ch. 1888, (6) 33. 377.)

Solubility of KCl in HCl+Aq.

t°	Concentration of HCl g. mol. per 1000 g. H <sub>2</sub> O	Wt. KCl per 1000 g. H <sub>2</sub> O	Mol. solubility
0	0	283.55	3.81
"	1/4	267.25	3.59
"	1/2	250.00	3.36
"	1	214.25	2.88
25	0	359.25	4.82
"	1/4	341.55	4.59
"	1/2	324.30	4.35
"	1	289.60	3.89

(Armstrong and Eyre, Proc. R. Soc. 1910 (A) 84. 127.)

100 g. sat. HCl+Aq dissolve 1.9 g. KCl at 20°. (Stoltzenberg, B. 1912, 45. 2248.)

Solubility in HCl+Aq at 25°.

Millimoles HCl in 10 ccm.	Millimoles KCl in 10 ccm.
...	42.72
5.66	37.49
10.20	33.79
15.90	28.68
20.94	24.74
32.52	17.39

(Herz, Z. anorg. 1912, 73. 275.)

Solubility of KCl in HBr+Aq at 25°.

Millimoles HBr in 10 ccm.	Millimoles KCl in 10 ccm.
...	42.72
6.61	37.80
34.15	19.57

(Herz, Z. anorg. 1912, 73. 275.)

Sol. in sat.  $\text{NH}_4\text{Cl}$ +Aq with pptn. of  $\text{NH}_4\text{Cl}$ . When action has ceased, the solution at 18.75° contains 31.6% of the mixed salt; or 100 pts.  $\text{H}_2\text{O}$  dissolve 46.1 pts. of the mixed salt, viz. 16.27 pts. KCl and 29.83 pts.  $\text{NH}_4\text{Cl}$ . (Karsten.)

Solubility of KCl in  $\text{NH}_4\text{Cl}$ +Aq at 25°.

Dissolved in 1000 mols $\text{H}_2\text{O}$	
Mols KCl	Mols $\text{NH}_4\text{Cl}$
74.2	23.8
67.9	32.5
61.4	52.2
55.5	65.9
50.2	74.4
43.0	96.3
37.6	110.0
37.0	107.5
37.5	109.4
22.6	118.2

(Biltz, Z. anorg. 1911, 71. 174.)

See also  $\text{NH}_4\text{Cl}$ .

Sol. in sat.  $\text{BaCl}_2$ +Aq with pptn. of  $\text{BaCl}_2$  until a state of equilibrium is reached, when 100 pts.  $\text{H}_2\text{O}$  at 16.8° dissolve 45.9 pts. mixed salts, viz. 18.2 pts.  $\text{BaCl}_2$  and 27.7 pts. KCl.

See also  $\text{BaCl}_2$ .

Solubility of KCl in  $\text{MgCl}_2$ +Aq of given percentage composition.

t°	30%	21.2%	15%	11%
10	1.9%	5.3%	9.9%	14.3%
20	2.6	6.5	11.3	15.9
30	3.4	7.6	12.7	17.5
40	4.2	8.8	14.2	19.0
50	5.0	10.0	15.6	20.5
60	5.8	11.2	17.0	21.9
70	6.5	12.4	18.3	23.2
80	7.3	13.6	19.5	24.5
90	8.1	14.7	20.8	25.8
100	8.9	15.9	22.1	27.1

(Precht and Wittgen, B. 14. 1667.)

Solubility of KCl+NaCl in 20%  $\text{MgCl}_2$ +Aq.

t°	% KCl	% NaCl	t°	% KCl	% NaCl
10	4.2	5.7	60	8.9	6.3
20	5.1	5.8	70	9.9	6.4
30	6.0	5.9	80	10.9	6.6
40	6.9	6.0	90	11.9	6.7
50	7.9	6.1	100	13.0	6.9

(P. and W.)

Sol. in sat.  $\text{KNO}_3$ +Aq with pptn. of  $\text{KNO}_3$ .

1 litre of the solution contains

at 14.5°		at 25.2°	
Mol. KCl	Mol. $\text{KNO}_3$	Mol. KCl	Mol. $\text{KNO}_3$
3.865	0.0	4.18	0.0
3.810	0.204	4.11	0.136
3.782	0.318	4.07	0.318
3.710	0.615	3.93	0.902
3.667	0.818	3.85	1.212
3.629	0.910	3.81	1.397
3.597	1.176	3.70	1.805
3.582	1.220	...	...

(Touren, C. R. 1900, 130. 909.)

Solubility of KCl in  $\text{KNO}_3$ +Aq.

t°	Concentration of $\text{KNO}_3$ in g. mol. per 1000 g. $\text{H}_2\text{O}$	Wt. KCl in 1000 g. $\text{H}_2\text{O}$	Mol. solubility
0	0	283.55	3.81
"	$\frac{1}{4}$	284.25	3.81
"	$\frac{1}{2}$	283.60	3.81
"	1	287.60	3.86
25	0	364.15	4.89
"	$\frac{1}{4}$	355.00	4.90
"	$\frac{1}{2}$	361.65	4.86
"	1	358.80	4.81
"	$1\frac{1}{2}$	355.20	4.77

(Armstrong and Eyre, Proc. R. Soc. 1910 [A], 84. 127.)

See also  $\text{KNO}_3$ .

Sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  without causing pptn. (See  $\text{NaNO}_3$ .)

Sol. in sat.  $\text{Ba}(\text{NO}_3)_2 + \text{Aq}$  without causing pptn.

Solubility in  $\text{KBr} + \text{Aq}$  at  $25.2^\circ$ .

1 litre of the solution contains

Mol. KBr	Mol. KCl
0.0	4.18
0.49	3.85
0.85	3.58
1.31	3.19
1.78	2.91
2.25	2.58
2.69	2.33

(Touren, C. R. 1900, 130. 1252.)

See also KBr.

100 pts.  $\text{H}_2\text{O}$  dissolve 133.2 pts. KI and 10.4 pts. KCl at  $21.5^\circ$ , no matter how prepared. (Rüdorff, B. 6. 484.)

100 pts.  $\text{KCl} + \text{Aq}$  sat. at  $15-16^\circ$  contain 25.26-25.37 pts. KCl. 100 pts.  $\text{KCl} + \text{KI} + \text{Aq}$  sat. at  $15-16^\circ$  contain 57.80 pts. of the two salts. KCl is pptd. by KI. (v. Hauer, J. pr. 98. 137.)

Solubility in  $\text{KI} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains		
	% KCl	% KI	% total salt
0	4.8	50.8	56.6
8	5.1	51.1	56.2
18	...	...	57.9
30	4.2	54.6	58.8
41	4.7	55.0	59.7
49	5.7	56.0	61.7
60	...	...	62.5
75	4.4	59.5	63.9
82	5.0	59.6	64.6
96	...	...	66.2
102	...	...	66.8
140	...	63.3	...
155	7.6	64.8	72.4
182	8.7	65.4	74.1
190	8.6	66.0	74.6
245	10.0	66.5	76.5

(Étard, A. ch. 1894, (7) 3. 281.)

Solubility of  $\text{KCl} + \text{KI}$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

G. per 100 g.  $\text{H}_2\text{O}$

KCl	KI	KCl	KI
0	149.26	19.64	68.22
4.06	144.03	23.75	43.89
7.63	137.79	29.56	23.83
11.36	132.60	31.38	14.83
11.74	133.90	33.68	7.00
15.10	105.91	36.12	0.00

(Amadori and Pampanini, Att. Acc. Linc. 1911, 20, II. 475.)

Solubility of KCl in  $\text{KOH} + \text{Aq}$  at  $0^\circ$ .

G. per 100 cc. solution

KCl	KOH
26.83	0.0
23.44	1.33
21.39	2.64
17.39	5.56
13.89	8.46
10.91	11.23
8.64	13.83
6.78	16.43
4.74	19.72

(Engel, Bull. Soc. 1891, (3) 6. 16.)

Solubility in  $\text{KOH} + \text{Aq}$  at  $20^\circ$ .

G. KOH in 1 litre	G. KCl in 1 litre	Sp. gr.	Degrees Baumé
10	293	1.185	22.5
20	285	1.185	22.5
30	276	1.190	23.0
40	265	1.192	23.0
50	255	1.195	23.5
60	245	1.200	24.0
70	236	1.200	24.0
80	226	1.205	24.5
90	219	1.205	24.5
100	211	1.210	25.0
110	205	1.210	25.0
120	199	1.215	25.5
130	192	1.215	25.5
140	185	1.220	26.0
150	178	1.225	26.5
160	171	1.225	26.5
170	165	1.230	27.0
180	159	1.235	27.5
190	153	1.240	28.0
200	148	1.245	28.5
210	142	1.250	29.0
220	137	1.255	29.5
230	133	1.260	30.0
240	128	1.265	30.5
250	124	1.270	30.8
260	120	1.275	31.3
270	115	1.280	31.7
280	112	1.285	32.0
290	108	1.290	32.5
300	104	1.295	33.0
310	100	1.300	33.5
320	96	1.305	34.0
330	93	1.310	34.2
340	89	1.315	34.6
350	85	1.320	35.0
360	81	1.325	35.5
370	78	1.330	36.0
380	74	1.335	36.3
390	71	1.340	36.7
400	68	1.345	37.1
410	64	1.350	37.5



## Solubility in KOH+Aq at 20°.—Continued.

G. KOH in 1 litre	G. KCl in 1 litre	Sp. gr.	Degrees Baumé
420	61	1.355	38.0
430	58	1.360	38.5
440	55	1.365	38.9
450	53	1.370	39.2
460	50	1.375	39.5
470	47	1.380	40.0
480	44	1.385	40.2
490	42	1.390	40.6
500	40	1.397	41.0
510	38	1.405	41.5
520	35	1.410	42.0
530	33	1.415	42.3
540	31	1.420	42.6
550	29	1.425	43.0
560	27	1.430	43.5
570	25	1.435	43.7
580	24	1.440	44.0
590	23	1.445	44.3
600	22	1.450	44.6
610	21	1.455	45.0
620	20	1.460	45.5
630	18	1.465	45.9
640	17	1.470	46.2
650	16	1.475	46.5
660	15	1.480	46.8
670	15	1.485	47.0
680	15	1.490	47.5
690	15	1.495	47.9
700	14	1.500	48.2
710	14	1.505	48.5
720	13	1.510	48.8
730	13	1.515	49.1
740	13	1.520	49.5
750	13	1.525	49.7
760	12	1.530	50.0
770	12	1.535	50.3
780	12	1.540	50.6
790	11	1.545	51.0
800	11	1.550	51.3
810	10	1.560	51.5
820	10	1.565	51.8
830	9	1.570	52.2
840	9	1.575	52.6
850	9	1.580	53.0

(Winteler, Z. Elektrochem, 1900, 7. 360.)

## KCl+NaCl.

100 pts. KCl+NaCl+Aq sat. at 13-16° contain 30.18 pts. of the two salts. (v. Hauer.)

100 pts. H<sub>2</sub>O dissolve 13.92 pts. KCl and 30.65 pts. NaCl at 15.6°, and solution has sp. gr.=1.233. (Page and Keightley.)

100 pts. H<sub>2</sub>O dissolve 10.11 pts. KCl, 32.15 pts. NaCl, and 4.69 pts. K<sub>2</sub>SO<sub>4</sub>, and solution has sp. gr.=1.250. (P. and K.)

100 pts. H<sub>2</sub>O dissolve 29.9 pts. NaCl and 15.7 pts. KCl at 18.8°. (Rüddorf.)

Solubility of KCl+NaCl in H<sub>2</sub>O at t°. 100 pts. H<sub>2</sub>O dissolve pts. KCl and pts. NaCl.

t°	Pts. KCl	Pts. NaCl	t°	Pts. KCl	Pts. NaCl
10	12.5	29.7	60	24.6	27.2
20	14.7	29.2	70	27.3	26.8
30	17.2	28.7	80	30.0	26.4
40	19.5	28.2	90	32.9	26.1
50	22.0	27.7	100	34.7	25.8

(Precht and Wittgen, B. 14. 1667.)

100 pts. H<sub>2</sub>O dissolve 13.99 pts. KCl+30.54 pts. NaCl=44.53 pts. mixed salts at 20°. (Nicol, Phil. Mag. (5) 31. 385.)

## Solubility of KCl in NaCl+Aq at 20°.

G. per 100 g. H <sub>2</sub> O	
NaCl	KCl
0.0	34.52
6.5	29.37
13.0	4.71
19.5	0.42

(Nicol, Phil. Mag. 1891, 31. 369.)

## Solubility of KCl+NaCl at t°.

t°	G. per 100 g. H <sub>2</sub> O	
	KCl	NaCl
25	15.8	14.5
"	29.0	31.3
80	30.0	25.2
"	26.4	34.0

(Soch, J. phys. Ch. 1898, 2. 46.)

## Solubility of KCl+NaCl at ?°

G. salts in 100 g. H <sub>2</sub> O		
NaCl	KCl	Solid phase
9.89	28.34	KCl
18.35	22.75	"
29.88	16.28	KCl+NaCl
31.57	10.91	NaCl
33.17	5.65	"

(Uyeda, Mem. Col. Sc. Kioto, 1910, 2. 245.)

100 g. H<sub>2</sub>O sat. with NaCl dissolve 0.216 gram-equivalent KCl at 25°.

100 g. H<sub>2</sub>O sat. with K<sub>2</sub>SO<sub>4</sub> dissolve 0.466 gram-equivalent KCl at 25°. (Euler, Z. phys. Ch. 1904, 49. 315.)

Solubility in NaCl+Aq at 20°, 30°, 40° and 91°. Tables given in the original show that each salt diminishes the solubility of the other. (Leather, Chem. Soc. 1915, 108. (2) 13.)

Solubility of KCl+NaCl in HCl+Aq at 25°.

% HCl	% NaCl	% KCl
0	19.95	10.90
8.61	10.65	7.58
17.16	3.56	3.80
20.65	2.03	2.86
32.78	0.18	1.27

(Hicks, J. Am. Chem. Soc. 1915, **37**, 846.)

See also under NaCl.

KCl+SrCl<sub>2</sub>.

100 pts. H<sub>2</sub>O dissolve 11.2 pts. KCl and 48.6 pts. SrCl<sub>2</sub> at 14.5°. (v. Hauer.)

If SrCl<sub>2</sub>+Aq. sat. at 14.5 is sat. with KCl at same temp., 100 pts. H<sub>2</sub>O dissolve:

KCl	33.2	11.2	...
SrCl <sub>2</sub>	...	48.6	50.7
		59.8	

(Mulder, Scheik. Verhandel. 1864.)

KCl+(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>.

Sat. solution of KCl+(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> at b.pt. when cooled to 14° has different composition from sat. solution of (NH<sub>4</sub>)Cl and K<sub>2</sub>SO<sub>4</sub>, and its composition is changed by warming it with either KCl or (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>. (Rüdorff.)

KCl+K<sub>2</sub>SO<sub>4</sub>.

100 pts. H<sub>2</sub>O contain the following amounts salt at 18.75°: (1) sat. with KCl alone; (2) sat. first with KCl then with K<sub>2</sub>SO<sub>4</sub>; (3) sat. with K<sub>2</sub>SO<sub>4</sub> and KCl together; (4) sat. first with K<sub>2</sub>SO<sub>4</sub> then with KCl; (5) sat. with K<sub>2</sub>SO<sub>4</sub> alone.

	1	2	3	4	5
KCl	34.5	32.96	33.12	33.12	...
K <sub>2</sub> SO <sub>4</sub>	...	1.79	1.75	1.83	10.8

(Karsten.)

100 pts. H<sub>2</sub>O sat. with both K<sub>2</sub>SO<sub>4</sub> and KCl contain the following amounts.

	At 14.8°		
KCl	33.5	28.2	...
K <sub>2</sub> SO <sub>4</sub>	...	2.0	10.3

	At 15.8°		
KCl	33.6	27.9	...
K <sub>2</sub> SO <sub>4</sub>	...	2.3	10.4

	At 16.1°		
KCl	33.6	27.1	...
K <sub>2</sub> SO <sub>4</sub>	...	3.3	10.4

(Kopp, A. **34**, 264.)

Sat. K<sub>2</sub>SO<sub>4</sub>+Aq dissolves KCl only with pptn. of K<sub>2</sub>SO<sub>4</sub>, but sat. KCl+Aq dissolves some K<sub>2</sub>SO<sub>4</sub> without any separation. (Karsten.)

Solubility of KCl+K<sub>2</sub>SO<sub>4</sub>: 100 pts. H<sub>2</sub>O dissolve at t°.

t°	Pts. KCl	Pts. K <sub>2</sub> SO <sub>4</sub>	t°	Pts. KCl	Pts. K <sub>2</sub> SO <sub>4</sub>
10	30.9	1.32	60	43.8	1.94
20	33.4	1.43	70	46.5	2.06
30	36.1	1.57	80	49.2	2.21
40	38.7	1.68	90	52.0	2.38
50	41.3	1.82	100	54.5	2.53

(Precht and Wittgen.)

100 g. H<sub>2</sub>O dissolve 34.76 g. KCl+2.93 g. K<sub>2</sub>SO<sub>4</sub> at 25°. (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1898, **27**, 75.)

Sol. in 20% KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. (Stromeyer.) Quickly attacked by liquid NO<sub>2</sub> in the presence of traces of moisture, with evolution of Cl<sub>2</sub>. (Frankland, Chem. Soc. 1901, **79**, 1361.)

Sl. sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, **20**, 829.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, **46**, 2.)

100 g. hydrazine dissolves 8.5 pts. KCl at 12.5-13°. (de Bruyn, R. t. c. 1899, **18**, 297.)

100 g. anhyd. hydroxylamine dissolve 12.3 g. KCl at 17-18°. (de Bruyn, Z. phys. Ch. 1892, **10**, 782.)

100 pts. alcohol of 0.900 sp. gr. dissolve 4.62 pts.; 0.872, 1.66 pts.; 0.834, 0.38 pt.; 0.817, 0.00 pt. KCl. (Kirwan.)

Sol. in 48 pts. boiling alcohol. (Wensel.) Insol. in absolute alcohol containing LiCl. (Mitscherlich.)

At 15°, 100 pts. alcohol of p percentage by volume (S=sp. gr.) dissolve pts. KCl as follows:

p	10	20	30	40
S	0.984	0.972	0.958	0.940
KCl	19.8	14.7	10.7	7.7

p	50	60	80
S	0.918	0.896	0.848
KCl	5.0	2.8	0.45

(Schiff, A. **118**, 365.)

100 pts. of a mixture of 40% alcohol with 60% H<sub>2</sub>O dissolve 9.2 pts. KCl at 15°. (Schiff.)

Insol. in absolute alcohol or in 96% alcohol at 15° or below. At 20°, 100 pts. of the latter dissolve 0.04 pt.; at 25°, 0.06 pt.; at 30°, 0.20 pt. KCl. Dilute alcohol dissolves less KCl than the contained H<sub>2</sub>O would dissolve by itself.

Solubility in dil. alcohol. D = sp. gr. of alcohol; S = solubility in 100 pts. alcohol at t°.

D = 0.9904		D = 0.9848		D = 0.9793		D = 0.9726	
t°	S	t°	S	t°	S	t°	S
0	23.2	4	20.9	4	16.4	3	12.2
4	24.8	20	25.5	21	20.3	5	12.7
22	29.4	27	26.6	28	22.0	16	15.4
25	30.2	30	27.5	43	25.6	20	16.1
34	32.8	37	29.0	..	..	25	17.3
52	37.5	60	35.2	..	..	34	19.0

D = 0.9673		D = 0.9390		D = 0.8967		D = 0.8244	
t°	S	t°	S	t°	S	t°	S
10	8.8	2	4.2	12	2.87	4	0.00
11	9.0	7	5.1	31	4.35	15	0.00
17	10.3	16	6.4	47	4.88	20	0.04
30	12.5	30	8.5	65	5.65	25	0.08
40	13.9	38	9.6	..	..	32	0.20
60	16.7	57	11.3	..	..	..	..

(Gerardin, A. ch. (4) 5. 140.)

Solubility of KCl in dil. alcohol at 14.5°

Sp. gr.	100 ccm. contain		
	Alcohol	Water	KCl
1.1720	...	88.10	29.10
1.1542	2.79	85.78	26.85
1.1365	4.98	84.00	24.67
1.1075	10.56	79.63	20.56
1.1085	15.57	75.24	17.24
1.0645	20.66	70.52	14.27
1.0455	24.25	67.05	13.25
0.9695	40.42	50.18	6.35
0.9315	48.73	40.60	3.82
0.8448	68.63	15.55	0.30

(Bodländer, Z. phys. Ch. 7. 316.)

Solubility of KCl in ethyl alcohol.

(G. KCl per 100 g. alcohol + Aq.)

Wt. % alcohol	at 30°		Wt. % alcohol	at 30°		at 40°
	at 30°	at 40°		at 30°	at 40°	
0	38.9	41.8	43.1	11.1	13.1	
5.28	33.9	35.9	55.9	6.8	8.2	
9.43	30.2	33.3	65.9	3.6	4.1	
16.9	24.9	27.6	78.1	1.3	1.6	
25.1	19.2	21.8	86.2	0.4	0.5	
34.1	15.6	17.2	...	...	...	

(Bathrick, J. phys. Ch. 1896, 1. 160.)

Solubility of KCl in ethyl alcohol at 0°.

Concentration of alcohol per 1000 g. H <sub>2</sub> O	Mol. g. alcohol per 1000 g. H <sub>2</sub> O	Solubility in 1000 g. H <sub>2</sub> O	Molecular solubility
...	...	285.15	3.80
0.25	...	277.95	3.73
0.50	...	271.10	3.64
1.00	...	265.50	3.45
3.00	...	208.80	2.81

(Armstrong and Eyre, Proc. Roy. Soc. 1910, (A) 84. 127.)

Solubility of KCl in ethyl alcohol + Aq at 25°.

Wt. % alcohol	G. KCl per 100 cc. sat. solution	Wt. % alcohol	G. KCl per 100 cc. sat. solution
0	31.18	60	4.18
10	23.93	70	2.27
20	17.89	80	0.93
30	13.27	90	0.81
40	9.40	100	0.08
50	6.26		

(McIntosh, J. phys. Ch. 1903, 7. 350.)

100 pts. absolute methyl alcohol dissolve 0.5 pt. at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.034 pt. at 18.5°. (de Bruyn, Z. phys. Ch. 10. 783.)

100 pts. 40% wood alcohol dissolve 9.2 pts. KCl. (Schieff.)

Solubility of KCl in methyl alcohol + Aq at 25°.

P = % by wt. of alcohol in alcohol + Aq.  
S = Sp. gr. alcohol + Aq sat. with KCl.

L = millimols KCl in 100 ccm. of the solution.

P	S 25°/4°	L
0	1.1782	417.4
10.6	1.125	329
30.8	1.033	183
47.1	0.9679	102
64.0	0.9064	46.1
78.1	0.8607	20.6
98.9	0.8242	9.9
100	0.7937	5.7

(Hers and Anders, Z. anorg. 1907, 55. 273.)

Solubility of KCl in methyl alcohol.

t°	Concentration of alcohol. Mol. g. alcohol per 1000 g. H <sub>2</sub> O	Solubility in 1000 g. H <sub>2</sub> O	Molecular solubility
0	...	283.55	3.81
"	0.25	280.00	3.76
"	0.50	276.35	3.71
"	1.00	267.85	3.60
"	3.00	238.10	3.18
25	...	364.15	4.89
"	0.25	361.90	4.86
"	0.50	357.10	4.79
"	1.00	348.70	4.67
"	3.00	324.15	4.35

(Armstrong and Eyre, Proc. Roy. Soc. 1910 (A) 84. 127.)

At room temp. 1 pt. by weight is sol. in:  
200 pts. methyl alcohol, D<sup>15</sup> 0.7990.  
750 " ethyl " D<sup>15</sup> 0.8035.

Insol. in propyl alcohol. (Rohland, Z. anorg. 1899, 18. 325.)

100 g. methyl alcohol dissolve 0.53 g. KCl at 25°.

100 g. ethyl alcohol dissolve 0.022 g. KCl at 25°.

100 g. propyl alcohol dissolve 0.004 g. KCl at 25°.

100 g. isoamyl alcohol dissolve 0.0008 g. KCl at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Insol. in propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Solubility of KCl in propyl alcohol.

t°	Concentration of alcohol. Mol. g. per 1000 g. H <sub>2</sub> O	Solubility in 1000 g. H <sub>2</sub> O	Molecular solubility
0	...	283.55	3.81
"	0.25	274.10	3.68
"	0.50	265.45	3.56
"	1.00	248.0	3.33
25	...	365.10	4.90
"	0.25	355.40	4.77
"	0.50	347.70	4.67
"	1.00	331.50	4.45

(Armstrong and Eyre, Proc. Roy. Soc. 1910, (A) 84. 127.)

Insol. in fusel-oil. (Gooch, Am. Ch. J. 9. 53.)

Very al. sol. in mixture of equal pts. absolute alcohol and ether. (Berzelius.)

500 mg. KCl treated with 10 g. of above mixture yield only 0.3 mg. to the liquid. (Lawrence Smith, Am. J. Sci. 16. 56.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184; Eidmann, C. C. 1899, II. 1014.)

Solubility of KCl in acetone+Aq at t°

t°	% acetone	100 g. of the solution contain		
		G. H <sub>2</sub> O	G. acetone	G. KCl
30	0	72.73	0.00	27.27
	5	71.15	3.74	25.11
	9.09	69.62	6.96	23.42
	20	64.88	16.22	18.90
	30	59.49	25.45	15.06
	40	53.17	35.52	11.31
	50	45.98	45.98	8.04
	60	37.97	56.91	5.12
	70	29.22	68.18	2.60
	80	19.82	79.43	0.76
	90	9.98	89.88	0.13
	100	0.00	100.00	0.00
40	0	71.31	0.00	28.69
	5	69.62	3.67	26.72
	9.09	67.88	6.79	25.33
	15	65.15	11.51	32.34
	20	62.97	15.75	21.28
	30	59.49	25.45	15.06
	40	53.17	35.52	11.31
	50	45.98	45.98	8.04
	60	37.97	56.91	5.12
	70	29.22	68.18	2.60
	80	19.82	79.43	0.76
	90	9.98	89.88	0.13
	100	0.00	100.00	0.00

Since there is but one liquid phase here, these figures represent the solubility of KCl in acetone+Aq at 30° and 40°.

(Snell, J. phys. Chem. 1898, 2. 494.)

The addition of KCl to mixtures of acetone and H<sub>2</sub>O will cause a division into two layers. The following table gives the temp. at which sat. solutions of KCl in acetone+Aq of varying concentrations separate into two layers and also the compositions of the sat. solutions of KCl in acetone+Aq.

% acetone	Temp. of division	100 g. of solution contain		
		G. H <sub>2</sub> O	G. acetone	G. KCl
26	46.5°	...	...	...
30	40.0	59.36	25.44	15.20
40	34.2	53.21	35.47	11.32
50	32.6	45.97	45.97	8.06
60	33.3	37.86	56.80	5.34
70	35.5	29.09	68.25	2.66
75	39.0	...	...	...
80	45.6	19.80	79.20	1.00

(Snell.)

The following table gives the compositions of the solutions of KCl in acetone+Aq at the points at which the solution just divides into two layers. Temp. = 40°.

100 g. of the solution contain		
G. H <sub>2</sub> O	G. acetone	G. KCl
56.68	28.63	14.68
53.05	35.67	11.29
50.34	39.82	9.83
47.60	43.83	8.58
44.35	48.36	7.29
42.68	50.75	6.57
38.53	56.26	5.21
36.59	58.84	4.57
32.37	64.18	3.45
30.62	66.43	2.95
28.12	69.45	2.44

(Snell.)

The addition of KCl to aqueous acetone causes the separation of the liquid into two layers. The following table gives the composition of these layers at 40°.

Upper layer contains per 100 g. of solution		
G. H <sub>2</sub> O	G. acetone	G. KCl
55.20	31.82	12.99
54.27	36.69	12.03
53.27	35.44	11.29
51.69	37.76	10.55
51.23	48.50	10.27
50.34	39.88	9.77
49.08	41.67	9.26
48.02	43.18	8.79
47.62	43.73	8.64
46.49	45.34	8.17
45.65	46.52	7.83
45.64	46.57	7.79
58.99	25.24	15.77

Lower layer contains per 100 g. of solution

G. H <sub>2</sub> O	G. acetone	G. KCl
28.14	69.42	2.44
29.45	67.83	2.72
30.96	65.97	3.07
31.83	64.83	3.33
32.64	63.79	3.56
34.07	62.01	3.92
35.27	60.49	4.24
37.44	57.67	4.89
38.00	56.96	5.04
38.68	56.17	5.25
39.98	54.36	5.66
40.41	53.78	5.81
28.66	74.91	1.43

(Snell.)

Solubility in acetone+Aq at 20°.

A = ccm. acetone in 100 ccm. acetone+Aq.  
KCl = millimols KCl in 100 ccm. of the solution.

A	KCl
0	410.5
10	351.7
20	286.6
30	223.7
40	166.5
50	115.4
60	71.2
70	38.5
80	12.9
90	2.0
100	...

(Hers and Knoch, Z. anorg. 1904, 41. 317.)

Solubility of KCl in glycerine+Aq at 25°.

G = g. glycerine in 100 g. glycerine+Aq.  
KCl = millimols KCl in 100 cc. of the solution.

G	KCl	Sp. gr.
0	424.5	1.1800
13.28	383.4	1.1848
25.98	339.3	1.1935
45.36	271.4	1.2106
54.23	238.5	1.2189
83.84	149.0	1.2590
100	110.6	1.2860

(Hers and Knoch, Z. anorg. 1905, 45. 267.)

Insol. in CS<sub>2</sub>. (Baeyer; Arctowski, Z. anorg. 1894, 6. 257.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Solubility of KCl in organic compounds + Aq at 25°.

Compound	G. comp. per l. H <sub>2</sub> O	G. KCl per 100 g. sat. solution
Water	.....	26.89
Acetaldehyde	11.01	27.05
Paraldehyde	11.07	26.42
Glycerol	13.01	25.58
Glycol	15.51	26.43
"	62.05	25.26
Mannitol	45.53	24.86
"	136.59	24.46

(Armstrong and Eyre, Proc. Roy. Soc. 1913, A, 88. 234.)

Solubility in pyridine+Aq at 10°.

Solvent		100 g. of the solution contain g. KCl
H <sub>2</sub> O	Pyridine	
100	0	23.79
90	10	19.76
80	20	16.37
70	30	13.19
60	40	10.05
50	50	6.34
40	60	3.335
30	70	1.245
20	80	0.24
10	90	0.039
0	100	...

(Schroeder, J. pr. 1908, (2) 77. 268.)

Insol. in anhydrous pyridine and in 97% pyridine+Aq.

Very sl. sol. in 95% pyridine+Aq.

Sl. sol. in 93% pyridine+Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

100 ccm. of a sat. solution of KCl in furfural at 25° contain 0.085 pts. by wt. KCl. (Walden, Z. phys. Ch. 1906, 55. 713.)

100 g. H<sub>2</sub>O dissolve 246.5 g. sugar+44.8 g. KCl at 31.25°; 100 g. sat. solution contain 62.28 g. sugar+11.33 g. KCl. (Köhler, Z. Ver. Zuckerind, 1897, 47. 447.)

Solubility in glucose+Aq at 25°.

Concentration of glucose in 9. mol. per 1000 g H <sub>2</sub> O	Solubility in 1000 g. H <sub>2</sub> O	Molecular solubility
...	362.70	4.86
0.25	366.10	4.91
0.50	369.85	4.96
1.0	376.25	5.04
3.0	402.25	5.39

(Armstrong and Eyre, Proc. Roy. Soc. 1910, 84. 127.)

Potassium manganic chloride, K<sub>2</sub>MnCl<sub>4</sub>.

Sol. in H<sub>2</sub>O; less sol. in NH<sub>4</sub>Cl+Aq; unstable. (Neuman, M. 1894, 15. 492.)

Potassium rhodium chloride.

See Chlororhodite, potassium.

Potassium ruthenium sesquichloride.

See Chlororuthenite, potassium.

Potassium ruthenium tetrachloride.

See Chlororuthenate, potassium.

Potassium tellurium chloride.

See Chlorotellurate, potassium.

Potassium thallic chloride, 3KCl, TiCl<sub>3</sub>+2H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. Not decomp. by boiling H<sub>2</sub>O. (Rammelsberg.)

Potassium thorium chloride, KCl, 2ThCl<sub>4</sub>+18H<sub>2</sub>O.

Deliquescent; sol. in H<sub>2</sub>O and alcohol. (Berzelius.)

Potassium tin (stannous) chloride (Potassium chlorostannite), KCl, SnCl<sub>2</sub>+H<sub>2</sub>O.

Decomp. by H<sub>2</sub>O; sol. in hot HCl or KCl+Aq. (Remsen and Richardson, Am. Ch. J. 14. 90.)

2KCl, SnCl<sub>2</sub>+H<sub>2</sub>O. Partially decomp. by dissolving in H<sub>2</sub>O. (Rammelsberg, Pogg. 94. 507.)

+2H<sub>2</sub>O. Very sol. in hot, and but slightly in cold HCl+Aq or KCl+Aq. (Remsen and Richardson.)

4KCl, SnCl<sub>2</sub>+3H<sub>2</sub>O. (Poggiale, C. R. 20. 1182.)

Does not exist. (Remsen and Richardson.)

Potassium tin (stannic) chloride, 2KCl, SnCl<sub>4</sub>.

See Chlorostannate, potassium.

Potassium tungsten chloride, K<sub>2</sub>(OH)WCl<sub>6</sub>.

Decomp. by moisture. Insol. in organic solvents. (Olsson, B. 1913, 46. 581.)

K<sub>2</sub>W<sub>2</sub>Cl<sub>6</sub>. Sol. in H<sub>2</sub>O. Nearly insol. in most organic solvents. (Olsson.)

Potassium uranium chloride, UCl<sub>4</sub>, 2KCl.

Very hygroscopic; sol. in H<sub>2</sub>O with decomp.; sol. in acetic acid. Decomp. by alcohol. Nearly insol. in ether. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

Potassium uranyl chloride, K<sub>2</sub>(UO<sub>2</sub>)Cl<sub>4</sub>.

Very sol. in H<sub>2</sub>O. Moderately sol. in dil. alcohol. (Aloy, Dissert. 1901.)

+2H<sub>2</sub>O. Very sol. in H<sub>2</sub>O and alcohol. (Arrvedson.)

Sol. in H<sub>2</sub>O, with decomp. and separation of KCl, unless H<sub>2</sub>O is acidulated with HCl. (Peligot, A. ch. (3) 5. 37.)

Solubility in H<sub>2</sub>O at t°.

t°	100 pts. of the solution contain			Solid phase
	Pts. UO <sub>2</sub>	Pts. Cl	Pts. K	
0.8	38.57	13.59	3.86	UO <sub>2</sub> Cl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O +KCl
14.9	33.71	13.51	...	"
17.5	37.36	14.50	5.27	"
25.0	35.01	15.26	...	"
41.5	35.27	15.92	7.39	"
50.0	34.18	16.56	...	"
60.0	34.19	17.25	9.14	UO <sub>2</sub> Cl <sub>2</sub> , 2KCl, 2H <sub>2</sub> O
71.5	33.55	17.44	9.28	"
78.5	35.26	18.24	9.95	"

(Rimbach, B. 1904, 37. 463.)

Potassium uranyl chloride is decomp. by  $H_2O$  at temp. below  $60^\circ$ . Above  $60^\circ$ , it is sol. in  $H_2O$  without decomp.

**Potassium vanadium chloride,  $VK_2Cl_5 + H_2O$ .**

Difficultly sol. in  $H_2O$  and alcohol. (Stähler, B. 1904, 37. 4412.)

**Potassium yttrium chloride.**

Sol. in  $H_2O$  with evolution of heat.

**Potassium zinc chloride,  $2KCl, ZnCl_2$ .**

Very deliquescent. Sol. in 1 pt. cold, and in all proportions of hot  $H_2O$ . (Pierre, A. ch. (3) 16. 248.)

+ $H_2O$ . Not very deliquescent. Can be recryst. (Ephraim, Z. anorg. 1908, 59. 58.)

$KCl, ZnCl_2 + 2H_2O$ . Not deliquescent. Cannot be recryst. without decomp. (Ephraim.)

**Potassium chloriodide,  $KCl_2I$ .**

Very unstable. (Wells and Wheeler, Sill. Am. J. 143. 475.)

$KCl_2I$ . Sol. in  $H_2O$  with decomp. Ether dissolves out  $ICl_3$ . (Filhol, J. Pharm. 25. 433.)

**Potassium fluoride, KF or  $K_2F_2$ .**

Very deliquescent. Very sol. in  $H_2O$ . Sl. sol. in HF+Aq. Easily sol. in conc.  $K_2C_2H_3O_2$  +Aq. Insol. in alcohol. (Berselius.) Sol. in dilute alcohol. (Stromeyer, A. 100. 83.)

Sp. gr. of aqueous solution of KF at  $18^\circ$  containing—

	5	10	20	30	40% KF.
	1.041	1.084	1.117	1.272	1.378

(Kohlrausch, W. Ann. 1879. 1.)

Solubility in HF+Aq at  $21^\circ$ .

(G. per 100 g.  $H_2O$ .)

HF	KF	HF	KF
0.0	96.3	13.95	31.4
1.21	72.0	15.98	33.4
1.61	61.0	17.69	35.6
3.73	40.4	20.68	38.4
4.03	32.5	28.60	46.9
6.05	30.4	41.98	61.8
9.25	29.9	53.71	74.8
11.36	29.6	74.20	105.0
12.50	30.5	119.20	169.5

(Ditte, C. R. 1896, 123. 1282.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, 46. 2.)

Very sl. sol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

KF will "salt out" acetone from aqueous solution. The table shows the composition of the solutions at the points at which inhomogeneous solutions of KF, acetone and  $H_2O$  just become homogeneous at  $20^\circ$ .

100 g. of the solution contain:

G. KF	G. $H_2O$	G. acetone	G. KF	G. $H_2O$	G. acetone
5.75	58.91	35.34	0.61	31.95	67.44
5.00	56.28	38.72	0.50	29.92	69.58
3.84	52.25	43.91	28.42	69.76	1.82
3.06	49.05	47.89	25.74	71.24	3.02
2.61	46.84	50.55	22.35	72.99	4.66
2.22	44.79	52.99	20.28	73.80	5.90
14.95	73.66	11.39	18.71	74.10	7.19
11.46	70.77	17.77	16.31	73.97	9.72
9.17	67.30	23.53	12.40	72.01	15.59
7.72	64.01	28.27	33.86	65.73	0.397
7.07	62.03	30.90	29.97	68.54	1.50
6.43	60.50	33.07	22.05	73.41	4.54
1.38	40.55	58.06	17.82	74.01	8.16
0.979	36.42	62.60	14.34	73.29	12.37
0.693	32.69	66.61	44.24	55.52	0.240
0.57	31.50	67.93	33.34	65.66	1.00
0.89	35.74	63.36	29.86	68.54	1.60
0.75	33.84	65.41	24.38	72.16	3.45

At the first quadruple point where the hydrate, acetone, water and vapor are in equilibrium the upper layer contains 98% acetone, while the lower layer contains in 100 g., 46.3 g. KF. A sat. solution of KF will thus dehydrate acetone to the extent of 98%.

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, 36. 1115.)

Similar data are given for KF in ethyl and propyl alcohol by Frankforter and Frary. (J. phys. Ch. 1913, 17. 402.)

+ $2H_2O$ . Very deliquescent. (Guntz, A. ch. (6) 3. 20.)

Sat. aq. solution at  $18^\circ$  contains 45.3% KF. (de Forcrand, C. R. 1911, 152. 1210.)

Sp. gr. of solution sat. at  $18^\circ = 1.502$ , and contains 48% KF. (Mylus and Funk, B. 1897, 30. 1718.)

+ $4H_2O$ . Not deliquescent. (de Forcrand, C. R. 1911, 152. 1075.)

Sat. aq. solution at  $18^\circ$  contains 35.96% KF. (de Forcrand, C. R. 1911, 152. 1210.)

**Potassium hydrogen fluoride, KF, HF = KHF<sub>2</sub>.**

Easily sol. in  $H_2O$ . Sl. sol. in  $H_2O$  containing HF. Easily sol. in conc.  $K_2C_2H_3O_2$  +Aq. Sol. in dil. alcohol, but insol. in absolute alcohol.

KF, 2HF. Deliquescent. Decomp. by  $H_2O$  with absorption of heat. (Moissan, C. R. 106. 547.)

KF, 3HF. As above. (Moissan.)

**Potassium manganic fluoride.**

*See Fluomanganate, potassium.*

**Potassium scandium fluoride,  $K_2ScF_6$ .**

Sol. in  $H_2O$ . Decomp. by acids. (R. J. Meyer, Z. anorg. 1914, 86. 275.)

**Potassium silicon fluoride.**

*See Fluosilicate, potassium.*

**Potassium tantalum fluoride.**

*See Fluotantalate, potassium.*

**Potassium tellurium fluoride,  $KF, TeF_4$ .**

Decomp. by  $H_2O$ . (Hägbom, Bull. Soc. (2) 35. 60.)

**Potassium thallic fluoride,  $2TlF_3, KF$ .**

Decomp. by moisture. Insol. in HF. (Gewecke, A. 1909, 366. 226.)

**Potassium thorium fluoride,  $2KF, ThF_4 + 4H_2O$ .**

Nearly insol. in  $H_2O$ . Sol. in  $HF + Aq.$   $KF, ThF_4$ . Precipitate. (Chydenius.)

**Potassium tin (stannous) fluoride,  $2KF, 3SnF_2 + H_2O$ .**

Sol. in  $H_2O$ . (Wagner, B. 19. 896.)

**Potassium tin (stannic) fluoride.**

*See Fluostannate, potassium.*

**Potassium titanium tetrafluoride.**

*See Fluotitanate, potassium.*

**Potassium titanium sesquifluoride,  $4KF, Ti_2F_6$ .**

Precipitate. Very sl. sol. in  $H_2O$ . Sol. in dil. acids. (Piccini, C. R. 97. 1064.)

*See also Fluosesquitanate, potassium.*

**Potassium titanyl fluoride.**

*See Fluoxypertitanate, potassium.*

**Potassium tungstyl fluoride.**

*See Fluoxytungstate, potassium.*

**Potassium uranium fluoride,  $KF, UF_4$ .**

Insol. in  $H_2O$  and dil. acids. Difficultly sol. in conc.  $HCl + Aq.$  Sol. in conc.  $H_2SO_4$ . (Bolton, J. B. 1866. 212.)

**Potassium uranyl fluoride.**

*See Fluoxyuranate, potassium.*

**Potassium vanadium sesquifluoride.**

*See Fluovanadate, potassium.*

**Potassium vanadium tetrafluoride (?).**

Easily sol. in  $H_2O$ . Insol. in alcohol. (Berzelius.)

**Potassium zinc fluoride,  $KF, ZnF_2$ .**

Sol. in  $H_2O$ . (R. Wagner.)

$2KF, ZnF_2$ . Sol. in  $H_2O$ . (Berzelius.)

**Potassium zirconium fluoride.**

*See Fluozirconate, potassium.*

**Potassium fluoride hydrogen peroxide,  $KF, H_2O_2$ .**

Not hygroscopic. Very sol. in  $H_2O$ . Is not decomp. at  $70^\circ$  and only partially so at  $110^\circ$ . (Tanatar, Z. anorg. 1901, 28. 255.)

**Potassium fluoride vanadic acid.**

*See Fluoxyvanadate, potassium.*

**Potassium hydride,  $KH$ .**

Decomp. by  $H_2O$ . Insol. in oil of turpentine, benzene, ether and  $CS_2$ . (Moissan, C. R. 1902, 134. 18.)

**Potassium hydrosulphide,  $KSH$ .**

Very deliquescent, and sol. in  $H_2O$  with gradual decomp. Crystallizes with  $\frac{1}{2}H_2O$ . Sol. in alcohol.

**Potassium hydroxide,  $KOH$ .**

Very deliquescent, and sol. in  $H_2O$  with evolution of much heat. 100 pts.  $KOH$ , exposed over  $H_2O$  at  $16-20^\circ$  take up 460 pts.  $H_2O$  in 56 days. (Mulder.)

1 pt.  $KOH$  dissolves in 0.5 pt. cold  $H_2O$  (Lowitz); in 0.47 pt. cold  $H_2O$  (Bineau, C. R. 41. 509); in 1 pt.  $H_2O$ . (Abl.)

Solubility of  $KOH$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	G. $KOH$ per 100 g.		Solid phase
	$H_2O$	solution	
-22	3.7	3.6	Ice
-20.7	22.5	18.4	"
-65.2	44.5	30.8	"
-36.2	36.2	26.6	$KOH.4H_2O$
-32.7	77.94	43.8	"
-33	80	44.4	$KOH.4H_2O + KOH.$ $2H_2O$
-23.2	85	45.9	$KOH.2H_2O$
0	97	49.2	"
10	103	50.7	"
15	107	51.7	"
20	112	52.8	"
30	126	55.76	"
32.5	135	57.44	$KOH.2H_2O + KOH.$ $H_2O$
50	140	58.33	$KOH.H_2O$
100	178	64.03	"
125	213	68.06	"
143	311.7	75.73	"

(Pickering, Chem. Soc. 1893, 63. 908.)

100 pts.  $KOH$  are sol. in 93.4 pts.  $H_2O$  at  $15^\circ$  or 100 pts.  $H_2O$  dissolve 107 pts.  $KOH$  at  $15^\circ$ . Sp. gr. = 1.5355 at  $15^\circ$ .



All higher values found in solubility tables are incorrect. (Ferchland, Z. anorg. 1902, 30. 133.)

100 g. sat. aq. solution at 15° contain 50.48 g. KOH. (de Forcrand, C. R. 1909, 149. 719.)

Sat. KOH+Aq boils at 157.7° (Griffiths); 340° (Gerlach).

B.-pt. of KOH+Aq containing pts. KOH to 100 pts. H<sub>2</sub>O.

B.-pt.	Pts. KOH	B.-pt.	Pts. KOH
105°	20.5	215°	210.5
110	34.5	220	219.8
115	46.25	225	230.0
120	57.5	230	240.9
125	67.5	235	251.9
130	76.8	240	263.1
135	85.0	245	274.4
140	92.5	250	285.7
145	99.8	255	298.5
150	106.5	260	312.5
155	114.05	265	328.0
160	121.7	270	343.5
165	129.35	275	359.0
170	137.0	280	375.0
175	144.8	285	391.0
180	152.6	290	408.2
185	160.4	295	425.5
190	168.2	300	444.4
195	176.5	310	484.0
200	185.0	320	526.3
205	193.5	330	571.5
210	202.0	340	623.6

(Gerlach, Z. anal. 26. 464.)

Sp. gr. and b.-pt. of KOH+Aq according to Dalton.

% K <sub>2</sub> O	Sp. gr.	B.-pt.	% K <sub>2</sub> O	Sp. gr.	B.-pt.
4.7	1.06	100.56°	36.8	1.44	123.89°
9.5	1.11	101.11	39.6	1.47	129.44
13.0	1.15	101.66	42.9	1.52	135.56
16.2	1.19	103.33	46.7	1.60	143.33
19.5	1.23	104.44	51.2	1.68	160.00
23.4	1.28	106.66	56.8	1.78	188.22
26.3	1.33	109.44	63.6	1.88	215.56
29.4	1.36	112.22	72.4	2.00	235.56
32.4	1.39	115.56	84.0	2.2	red heat
34.4	1.42	118.89	100	2.4	..

Sp. gr. of KOH+Aq at 15°.

% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.
0.568	1.0050	10.750	1.1059	20.935	1.2268
1.697	1.0153	11.882	1.1182	21.509	1.2342
2.829	1.0260	13.013	1.1308	22.632	1.2493
3.961	1.0369	14.145	1.1437	23.764	1.2648
5.002	1.0478	15.277	1.1568	24.895	1.2805
6.224	1.0589	16.408	1.1702	26.027	1.2966
7.355	1.0703	17.540	1.1839	27.158	1.3131
8.487	1.0819	18.671	1.1979	28.290	1.3300
9.619	1.0938	19.803	1.2122	..	..

(Zimmerman, N. J. Pharm. 18, 2. 5.

Sp. gr. of KOH+Aq.

% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.
2.44	1.02	23.14	1.22	37.97	1.42
4.77	1.04	24.77	1.24	40.17	1.44
7.02	1.06	26.34	1.26	42.31	1.46
9.20	1.08	27.86	1.28	44.40	1.48
11.28	1.10	29.34	1.30	46.45	1.50
13.30	1.12	30.74	1.32	48.46	1.52
15.38	1.14	32.14	1.34	50.09	1.54
17.40	1.16	33.46	1.36	51.58	1.56
19.34	1.18	34.74	1.38	53.06	1.58
21.25	1.20	35.99	1.40	..	..

(Richter.)

Sp. gr. of KOH+Aq at 15°. a = sp. gr. if % is K<sub>2</sub>O; b = sp. gr. if % is KOH.

%	a	b	%	a	b
1	1.010	1.009	31	1.370	1.300
2	1.020	1.017	32	1.385	1.311
3	1.030	1.025	33	1.403	1.324
4	1.039	1.033	34	1.418	1.336
5	1.048	1.041	35	1.431	1.349
6	1.058	1.049	36	1.445	1.361
7	1.068	1.058	37	1.460	1.374
8	1.078	1.065	38	1.475	1.387
9	1.089	1.074	39	1.490	1.400
10	1.099	1.083	40	1.504	1.411
11	1.110	1.092	41	1.522	1.425
12	1.121	1.110	42	1.539	1.438
13	1.132	1.111	43	1.564	1.450
14	1.143	1.119	44	1.570	1.462
15	1.154	1.128	45	1.584	1.472
16	1.166	1.137	46	1.600	1.488
17	1.178	1.146	47	1.615	1.499
18	1.190	1.155	48	1.630	1.511
19	1.202	1.166	49	1.645	1.527
20	1.215	1.177	50	1.660	1.539
21	1.230	1.188	51	1.676	1.552
22	1.242	1.198	52	1.690	1.565
23	1.256	1.209	53	1.705	1.578
24	1.270	1.220	54	1.720	1.590
25	1.285	1.230	55	1.733	1.604
26	1.300	1.241	56	1.746	1.618
27	1.312	1.252	57	1.762	1.630
28	1.326	1.264	58	1.780	1.641
29	1.340	1.278	59	1.795	1.655
30	1.355	1.288	60	1.810	1.667

(Calculated by Gerlach, Z. anal. 8. 279, after Zimmermann, N. J. Pharm. 18, 2. 5, and Schiff, A. 107. 300.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
4.2	1.0382	21.0	1.2008
8.4	1.0776	25.2	1.2439
12.6	1.1177	29.4	1.2880
16.8	1.1588	...	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.
10	1.077	50	1.539
20	1.175	60	1.667
30	1.288	70	1.790
40	1.411	...	...

(Gerlach, Z. anal. 27. 275, calculated from Schiff, A. 107. 300.)

Sp. gr. of K<sub>2</sub>O+Aq at 15°.

% K <sub>2</sub> O	Sp. gr.	% K <sub>2</sub> O	Sp. gr.
5	1.054	30	1.358
10	1.111	35	1.428
15	1.171	40	1.500
20	1.231	45	1.576
25	1.294	..	...

(Hager, Adjumenta varia, Leipsic, 1876.)

Sp. gr. of KOH+Aq at 20° containing 2 mols. KOH to 100 mols. H<sub>2</sub>O = 1.05325. (Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of KOH+Aq at 15°.

% KOH	Sp. gr.	% KOH	Sp. gr.	% KOH	Sp. gr.
52	1.53822	34	1.33313	16	1.14925
51	1.52622	33	1.32236	15	1.13955
50	1.51430	32	1.31166	14	1.12991
49	1.50245	31	1.30102	13	1.12031
48	1.49067	30	1.29046	12	1.11076
47	1.47896	29	1.27997	11	1.10127
46	1.46733	28	1.26954	10	1.09183
45	1.45577	27	1.25918	9	1.08240
44	1.44429	26	1.24888	8	1.07302
43	1.43289	25	1.23866	7	1.06371
42	1.42150	24	1.22849	6	1.05443
41	1.41025	23	1.21838	5	1.04517
40	1.39906	22	1.20834	4	1.03593
39	1.38793	21	1.19837	3	1.02671
38	1.37686	20	1.18839	2	1.01752
37	1.36586	19	1.17855	1	1.00834
36	1.35485	18	1.16875	0	0.99918
35	1.34396	17	1.15898	..	...

(Pickering, Phil. Mag. 1894, (5) 37. 375.)

Sp. gr. of N solution at 18°/4° = 1.0481. (Loomis, W. Ann. 1896, 60. 550.)

Sp. gr. of KOH+Aq.

% KOH	6.87	12.10
Sp. gr. 20°/20°	1.0601	1.1025

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 272.)

KOH+Aq containing equal pts. of KOH and H<sub>2</sub>O freezes at -54°. (Guyton-Morveau, Gm.-K. 2, 1. 18.)

KOH is completely miscible with NaOH and with RbOH in both the liquid and the solid states. (Hevesy, Z. phys. Ch. 1910, 73. 667.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 828.)

Abundantly sol. in strong alcohol or wood-spirit.

See below under KOH+2H<sub>2</sub>O.

Readily sol. in glycerine.

Sol. in not less than 25 pts. of ether. (Boullay.) Sol. in much more than 25 pts. of ether. (Connell.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Insol. in acetone. Readily sol. in fusel oil.

Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in aqueous solution of mannite. (Favre, A. ch. (3) 11. 76.)

The composition of the hydrates formed by KOH at different dilutions is calculated from determinations of the lowering of the fr-pt. produced by KOH and of the conductivity and sp. gr. of KOH+Aq. (Jones, Am. Ch. J. 1905, 34. 337.)

+H<sub>2</sub>O.

+2H<sub>2</sub>O. Very deliquescent, and sol. in H<sub>2</sub>O with absorption of much heat.

100 g. sat. solution in H<sub>2</sub>O at 30° contain 55.75 g. anhyd. KOH. (de Waal, Dissert. 1910.)

Solubility of KOH+2H<sub>2</sub>O in alcohol+Aq at 30°.

% KOH	% alcohol	% H <sub>2</sub> O
55.75	0	44.25
54.81	0.43	44.76
...	...	...
31.0	57.50	11.50
28.99	65.07	5.94
27.67	69.92	2.41
27.20	73.01	negative
26.25	81.98	"

\*Separates into two layers.

(de Waal, Dissert. 1910.)

+4H<sub>2</sub>O.

**Potassium hydrogen titanium diimide,**  
**Ti(NH)NK.**

Decomp. by H<sub>2</sub>O and alcohol. Insol. in all ord. indifferent organic solvents. (Ruff, B. 1912, 45. 1371.)

**Potassium iodide, KI.**

Deliquescent only in very moist air. Very sol. in H<sub>2</sub>O with absorption of heat.

The temp. of H<sub>2</sub>O can be lowered 24° by dissolving KI. (Baup.)

140 pts. KI dissolved in 100 pts. H<sub>2</sub>O at 10.8° lower the temp. 22.5°. (Rüdorff, Pogg. 136. 276.)

100 pts. H<sub>2</sub>O dissolve 126.6 pts. KI at 0° (Kremers); 127.8 pts. KI at 0° (Mulder); 127.9 pts. KI at 0°. (Gerardin.)

By boiling, 100 pts. H<sub>2</sub>O dissolve 221 pts. KI at 120° (Baup); 222.2 pts. KI at 120° (Gay-Lussac); 222.6 pts. KI at 118.4° (Mulder); 223.58 pts. KI at 117° (Legrand); 223.6 pts. KI at 117°. (Gerardin.)

Between these temps. the solubility increases proportional to temp.

Sol. in 0.735 pt. H<sub>2</sub>O at 12.5°; in 0.709 pt. H<sub>2</sub>O at 16°; in 0.7 pt. H<sub>2</sub>O at 18°; in 0.45 pt. H<sub>2</sub>O at 120°. (Graham-Otto.)

100 pts. KI + Aq sat. at 15-16° contain 58.07 pts. KI. (v. Hauer, J. pr. 98. 137.)

100 pts. H<sub>2</sub>O at 12.5° dissolve 136 pts.; at 16°, 141 pts. KI. (Baup.)

100 pts. H<sub>2</sub>O at 18° dissolve 143 pts. KI; at 120°, 271 pts. (Gay-Lussac.)

Sol. in 0.79 pt. H<sub>2</sub>O at 0°; in 0.70 pt. H<sub>2</sub>O at 20°; in 0.63 pt. H<sub>2</sub>O at 48°; in 0.57 pt. H<sub>2</sub>O at 60°; in 0.53 pt. H<sub>2</sub>O at 80°; in 0.51 pt. H<sub>2</sub>O at 100°. (Kremers, Pogg. 97. 15.)

Sol. in 0.71 pt. H<sub>2</sub>O at 15°. (Eder, Dingl. 221. 89.)

**Solubility of KI in 100 pts. H<sub>2</sub>O at t°.**

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
0	127.9	19	143.4	38	159
1	128.7	20	144.2	39	160
2	129.6	21	145.1	40	160
3	130.4	22	145.9	41	161
4	131.2	23	146.7	42	162
5	132.1	24	147.5	43	163
6	132.9	25	148.3	44	164
7	133.7	26	149.1	45	164
8	134.5	27	149.9	46	165
9	135.3	28	150.7	47	166
10	136.1	29	151.5	48	167
11	137.0	30	152.3	49	168
12	137.8	31	153	50	168
13	138.6	32	154	51	169
14	139.4	33	155	52	170
15	140.2	34	156	53	171
16	141.0	35	156	54	172
17	141.8	36	157	55	172
18	142.6	37	158	56	173

**Solubility of KI in 100 pts., etc.—Continued.**

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
57	174	78	191	99	208
58	175	79	192	100	209
59	175	80	192	101	210
60	176	81	193	102	211
61	177	82	194	103	212
62	178	83	195	104	213
63	179	84	196	105	213
64	180	85	197	106	214
65	180	86	197	107	215
66	181	87	198	108	216
67	182	88	199	109	217
68	183	89	200	110	218
69	184	90	201	111	219
70	184	91	202	112	220
71	185	92	202	113	220
72	186	93	203	114	221
73	187	94	204	115	222
74	188	95	205	116	223
75	188	96	206	117	223.6
76	189	97	207	...	...
77	190	98	208	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. 1864. 63.)

**Solubility of KI in 100 pts. H<sub>2</sub>O at t°.**

t°	Pts. KI	t°	Pts. KI	t°	Pts. KI
-22.65	107.2	21.05	143.3	71.1	183.5
-22.35	106.6	25.6	146.6	74.75	185.6
-16.8	111.1	29.1	149.6	81.6	192.0
-11.35	116.3	37.3	156.7	86.35	194.6
-5.9	120.4	42.3	160.3	93.5	200.3
0	128.1	45.75	163.6	100.7	205.6
+3.25	130.1	51.8	167.6	110.2	216.1
9.55	134.0	55.05	169.1	113.7	218.8
12.75	137.1	60.55	173.4	...	...
12.9	137.9	65.0	178.3	...	...

(Coppet, A. ch. (5) 30. 417.)

Solubility is represented by a straight line of the formula  $126.23 + 0.8088t$ . (Coppet.)

**Solubility of KI in 100 pts. H<sub>2</sub>O at high temp.**

t°	Pts. KI	t°	Pts. KI
124	233.9	144	264.6
133	249.3	175	310.4

(Tilden and Shenstone, Phil. Trans. 1884. 23.)

If solubility  $S$  = pts. KI in 100 pts. solution,  $S = 55.8 + 0.122t$  from 0° to 165°. (Etard, C. R. 98. 1432.)

Sat. KI+Aq contains % KI at t°.

t°	% KI	t°	% KI
-21	50.7	78	64.8
-21	51.0	96	66.9
-21	51.2	150	70.6
-19	52.2	151	70.9
-15	53.2	175	71.6
-9	54.5	176	72.7
0	56.9	190	73.8
+21	59.3	193	74.5
44	60.8	213	75.7
72	64.3	...	...

(Étard, A. ch. 1894, (7) 2, 542.)

Solubility of KI in 100 g. H<sub>2</sub>O at t°.

t°	g. KI	t°	g. KI.
-1	122.2	-11.5	64.7
-5	119.8	-9.5	51.5
-4	117.4	-7	42.6
-10	115.1	-6	34.4
-14	75.8	-5	25.7

(Meusser, Z. anorg. 1905, 44. 80.)

102.70 pts. by weight are contained in 100 cc. KI+Aq sat. at 25°, or 59.54 pts. in 100 g. of solution; sp. gr. = 1.7254.

94.05 pts. by weight are contained in 100 cc. KI+Aq sat. at 0°, or 56.34 pts. in 100 g. of solution; sp. gr. = 1.6699. (Walden, Z. phys. Ch. 1906, 55. 715.)

Solubility of KI in H<sub>2</sub>O at low temperatures.

t°	% KI	Solid phase	t°	% KI	Solid phase
-12.5	38	Ice	-22	52.1	KI
-15	41.2	"	-20	52.6	"
-17.5	44.6	"	-15	53.5	"
-20	48	"	-10	54.5	"
-22.5	51.2	"	-5	55.4	"
-23.2	51.9	" + KI	0	56.4	"

(Kreman and Kerahbaum, Z. anorg. 1907, 56. 218.)

149.26 g. KI dissolve in 100 g. H<sub>2</sub>O at 25°. (Amadori and Pampanini, Rend. Acc. Linc. 1911, V, 20. 473.)

60.39 g. in 100 g. KI+Aq sat. at 25°. (Parsons and Whittemore, J. Am. Chem. Soc. 1911, 33. 1934.)

56.1 g. in 100 g. KI+Aq sat. at 0°; 60.35 g. in 100 g. KI+Aq sat. at 30°. (Van Dam and Donk, Chem. Weekbl. 1911, 8. 848.)

Sp. gr. of KI+Aq at 21°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
1	1.0075	21	1.1807	41	1.4224
2	1.0151	22	1.1911	42	1.4371
3	1.0227	23	1.2016	43	1.4520
4	1.0305	24	1.2122	44	1.4671
5	1.0384	25	1.2229	45	1.4825
6	1.0464	26	1.2336	46	1.4982
7	1.0545	27	1.2445	47	1.5142
8	1.0627	28	1.2556	48	1.5305
9	1.0710	29	1.2669	49	1.5471
10	1.0793	30	1.2784	50	1.5640
11	1.0877	31	1.2899	51	1.5810
12	1.0962	32	1.3017	52	1.5984
13	1.1048	33	1.3138	53	1.6162
14	1.1136	34	1.3262	54	1.6343
15	1.1226	35	1.3389	55	1.6528
16	1.1318	36	1.3519	56	1.6717
17	1.1412	37	1.3653	57	1.6911
18	1.1508	38	1.3791	58	1.7109
19	1.1605	39	1.3933	59	1.7311
20	1.1705	40	1.4079	60	1.7517

(Schiff, A. 110. 75.)

Sp. gr. of KI+Aq. S=according to Schiff (A. 106. 340) at 21°; K=according to Kremers (Pogg. 96. 62), interpolated by Gerlach (Z. anal. 8. 285.)

	5	10	15	20	25	30% KI,
S	1.038	1.079	1.123	1.171	...	1.279
K	1.038	1.078	1.120	1.166	1.218	1.271
	35	40	45	50	55	60% KI.
S			1.483	...	...	...
K	1.331	1.396	1.469	1.546	1.636	1.734

Sp. gr. of KI+Aq at 18°.

% KI	Sp. gr.	% KI	Sp. gr.	% KI	Sp. gr.
5	1.0363	30	1.273	55	1.630
10	1.0762	40	1.3966	..	...
20	1.1679	50	1.545	..	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of KI+Aq at 18°.

% KI	Sp. gr.
1.044	1.0062
5.0	1.0363

(Grottrian, W. Ann. 1883, 18. 191.)

Sp. gr. at 16°/4° of KI+Aq containing 32.4875% KI = 1.30238. (Schönrock, Z. phys. Ch. 1893, 11. 781.)

KI+Aq containing 9.35% KI has sp. gr. 20°/20° = 1.0726.

KI+Aq containing 11.35% KI has sp. gr. 20°/20° = 1.0892. (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 278.)

B.-pt. of KI+Aq containing pts. KI to 100 pts. H<sub>2</sub>O.

B.-pt.	Pts. KI	B.-pt.	Pts. KI	B.-pt.	Pts. KI
101°	15	108°	111.5	115	185°
102	30	109	123	116	195
103	45	110	134	117	205
104	60	111	145	118	215
105	74	112	155	118.5	220
106	87	113	165	...	...
107	99.5	114	175	...	...

(Gerlach, Z. anal. 26. 439.)

Sat. KI+Aq boils at 119°. (Kremers.)

Sat. KI+Aq forms a crust at 117.5°, and contains 210 pts. KI to 100 pts. H<sub>2</sub>O; highest temp. observed, 118.5°. (Gerlach, Z. anal. 26. 426.)

Solubility of KI in I<sub>2</sub>+Aq at 25°.

KI mol./l.	I g.-atoms/l.
6.15	0.00
6.23	3.64
6.40	11.11
6.36	13.16
6.33	13.2
6.24	17.03

(Abegg, Z. anorg. 1906, 50. 428.)

Solubility of KI+I<sub>2</sub> in H<sub>2</sub>O at 25°.

% KI	% I	Solid phase	% KI	% I	Solid phase
29.45	64.34	KI+KI <sub>2</sub>	25.88	68.79	KI <sub>2</sub> +I <sub>2</sub>
28.91	63.88	"	25.57	69.01	"
26.84	66.54	KI <sub>2</sub> +KI	27.86	66.56	KI <sub>2</sub>
27.18	67.14	"	27.27	66.91	"
27.14	66.60	"	26.95	67.17	KI <sub>2</sub>
			25.71	67.91	"

(Foote and Chalker, Am. Ch. J. 1908, 39. 564.)

See also under Iodine.

KI+Aq sat. at 14.5° containing 139.8 pts. KI to 100 pts. H<sub>2</sub>O dissolves 1.0 pt. K<sub>2</sub>SO<sub>4</sub> with separation of 2.2 pts. KI, so that solution contains 137.6 pts. KI and 1.0 pt. K<sub>2</sub>SO<sub>4</sub> to 100 pts. H<sub>2</sub>O. (Mulder, Rotterdam, 1864.)

100 pts. H<sub>2</sub>O dissolve 86.3 pts. KI and 2.1 pts. Na<sub>2</sub>SO<sub>4</sub> at 14.5°. (Mulder, J. B. 1866. 67.)

Sol. in AsCl<sub>3</sub>, SnCl<sub>4</sub> and POCl<sub>3</sub>. (Walden, Z. anorg. 1900, 25. 214.)

Attacked by dry liquid NO<sub>2</sub> with liberation of I<sub>2</sub>. (Frankland, Chem. Soc. 1901, 79. 1361.)

Sol. in liquid SO<sub>2</sub>. (Walden, B. 1899, 32. 2864.)

Solubility in SO<sub>2</sub> decreases with rise of temp. (Walden, Z. phys. Ch. 1903, 42. 456.)

Insol. in liquid CO<sub>2</sub>. (Büchner, Z. phys. Ch. 1906, 54. 674.)

Very easily sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Hydrazine dissolves 135.7 pts. KI at 12.5–13°. (de Bruyn, R. t. c. 1899, 18. 297.)

100 pts. alcohol of 0.85 sp. gr. dissolve 18 pts. KI at 12.5°. 100 pts. absolute alcohol dissolve 2.5 pts. KI at 13.5°. Much more sol. in hot alcohol. (Baup.)

100 pts. alcohol of D sp. gr. at 0° dissolve at 18°—

D 0.9904 0.9851 0.9726 0.9665 0.9528

130.5 119.4 100.1 89.9 76.9 pts. KI,

D 0.9390 0.9088 0.8464 0.8322

66.4 48.2 11.4 6.2 pts. KI.

That is, aqueous alcohol dissolves approximately the same amount of KI that the water present in the alcohol would dissolve, and it is therefore probable that KI is insol. in strictly absolute alcohol. (Gerardin.)

Solubility in 100 pts. alcohol of 0.9496 sp. gr. at:

8° 13° 25° 46° 55° 62°  
67.4 69.2 75.1 84.7 87.5 90.2 pts. KI.

(Gerardin, A. ch. (4) 5. 155.)

Sol. in 68.3 pts. absolute alcohol (Eder, Dingl. 321. 89); in 370 pts. ether (sp. gr. 0.729), (Eder, l. c.); in 120 pts. alcohol-ether (1:1), (Eder, l. c.)

Sol. in 10–12 pts. 90% alcohol, and 40 pts. absolute alcohol. (Hager, Comm. 1863.)

100 pts. absolute methyl alcohol dissolve 16.5 pts. at 20.5°; 100 pts. absolute ethyl alcohol dissolve 1.75 pts. at 20.5°. (de Bruyn, Z. phys. Ch. 10. 783.)

Solubility of KI in methyl alcohol+Aq at 25°.

P = % by wt. of alcohol in alcohol+Aq.

S = Sp. gr. of alcohol+Aq sat. with KI.

L = millimols KI in 100 ccm. of the solution.

P	S 25°/4°	L
0	1.7213	620
10.6	1.634	555
30.8	1.460	431
47.1	1.325	335
64.0	1.185	243
78.1	1.066	169
98.9	0.9700	113
100	0.9018	80

(Hers and Anders, Z. anorg. 1907, 55. 274.)

Solubility of KI in  $\text{CH}_3\text{OH}$ .

G = g. KI in 100 g. of the solution.  
 $t_1$  = temp. of complete solution.  
 $t_2$  = temp. at which salt begins to separate out.

G	$t_1$	$t_2$
8.64	...	266°
12.95	0°	...
14.2	20	...
14.6	...	262
14.97	25	...
19.2	85	256
26.8	115	242
28.9	144	229
29.6	188	196
33.0	...	...

(Centnerszwer, Z. phys. Ch. 1910, 72. 432.)

Solubility of KI in methyl alcohol at  $t^\circ$ .

$t^\circ$	g. KI in 100 g. alcohol	$t^\circ$	g. KI in 100 g. alcohol
15	14.50	180	30.7
30	16.20	200	29.1
50	18.9	220	27.5
80	22.5	240	24.8
100	25.0	245	22.6
120	27.2	247	21.0
140	29.2	250	13.8
160	30.6	252.5*	7.6

\*Critical temp. of solution.

(Tyrer, Chem. Soc. 1910, 97. 626.)

At room temp. 1 pt. KI by weight is sol. in

6 pts. methyl alcohol  $D^{18}$  0.7990.

16 " ethyl "  $D^{18}$  0.8322.

219 " propyl "  $D^{18}$  0.8160.

(Rohland, Z. anorg. 1898, 18. 325.)

Solubility in mixtures of methyl and ethyl alcohol at  $25^\circ$ .

P = % methyl alcohol in the solvent.

G = g. KI in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution at  $25^\circ$ .

P	G	S $25^\circ/4^\circ$
0.00	0.155	0.8015
4.37	0.191	0.8041
10.40	0.225	0.8071
41.02	0.494	0.8295
80.69	1.013	0.8794
84.77	1.072	0.8795
91.25	1.184	0.8908
100.00	1.316	0.9018

(Hers and Kuhn, Z. anorg. 1908, 60. 155.)

Solubility in mixtures of methyl and propyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g. KI in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S $25^\circ/4^\circ$
0	1.316	0.9018
11.11	1.096	0.8823
23.8	0.854	0.8629
65.2	0.262	0.8187
91.8	0.060	0.8045
93.75	0.058	0.8041
100	0.043	0.8041

(Hers and Kuhn.)

Solubility in mixtures of propyl and ethyl alcohol at  $25^\circ$ .

P = % propyl alcohol in the solvent.

G = g. KI in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S $25^\circ/4^\circ$
0	0.155	0.8015
8.1	0.146	0.7983
17.85	0.137	0.7991
56.6	0.075	0.7988
88.6	0.052	0.8022
91.2	0.049	0.8027
95.2	0.044	0.8029
100	0.043	0.8041

(Hers and Kuhn.)

100 g. methyl alcohol dissolve 18.04 g. KI at  $25^\circ$ .

100 g. ethyl alcohol dissolve 2.16 g. KI at  $25^\circ$ .

100 g. propyl alcohol dissolve 0.43 g. KI at  $25^\circ$ .

100 g. isoamyl alcohol dissolve 0.09 g. KI at  $25^\circ$ .

(Turner and Bissett, Chem. Soc. 1913, 108. 1909.)

0.455 g. is sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Alcoholic solution can be mixed with  $\frac{1}{2}$  vol. ether without pptn.

100 g. 95% formic acid dissolve 38.2 g. KI at  $18.5^\circ$ . (Aschan, Chem. Ztg. 1913, 37. 1113.)

Solubility in organic solvents at  $t^{\circ}$ .

C = pts. by wt. of KI in 100 ccm. of the sat. solution.

L = no. of litres which at the saturation temp. hold in solution 1 mol. KI.

S = sp. gr. of the solution at  $t^{\circ}$ , referred to  $H_2O$  at  $t^{\circ}$ .

p = pts. by wt. of KI in 100 g. of the solution.

Solvent	$t^{\circ}$	C	L	S	p
Water	25°	102.70	0.162	1.7254	59.54
"	0°	94.05	0.177	1.6699	56.32
Methyl alcohol	25°	13.48	1.231	0.9003	14.97
"	25°	14.26			
"	0°	11.61	1.430	0.8964	12.95
Ethyl alcohol	25°	1.530	10.92	0.7908	1.922
"	0°	1.197	13.87	0.8085	1.479
Glycol	25°	45.85	0.362	1.3888	33.01
"	25°	47.23	0.351		
"	0°	43.28	0.383	1.3954	31.03
Acetonitrile	25°	1.551	10.70		
"	25°	1.590	10.44	0.7936	2.003
"	0°	1.852	9.00	0.8198	2.259
Propionitrile	25°	0.316	52.53	0.7821	0.404
"	25°	0.355	46.76		
"	0°	0.344	48.26	0.8005	0.429
"	0°	0.412	40.29		
Benzonitrile	25°	0.051	325.5	1.0076	0.050
Nitromethane	25°	0.349	47.56	1.1367	0.307
"	25°	0.289	57.44		
"	0°	0.366	45.36	1.1627	0.315
"	0°	0.314	52.87		
Nitrobenzene	25°	0.0019	87.40		
Acetone	25°	1.038	16.0	0.7968	1.302
"	0°	1.732	9.58	0.8227	2.105
Furfural	25°	5.93	2.80	1.2014	4.94
"	0°	15.10	1.10		
Benzaldehyde	25°	0.343	48.4	1.0446	0.328
Salicylaldehyde	25°	0.549	30.24	1.1373	0.483
"	0°	1.257	13.21	1.1501	1.093
Anisaldehyde	25°	0.720	23.06	1.1180	0.644
"	0°	1.530	10.92	1.1223	1.355
Ethyl acetate	25°	0.0013	12.80		
Methyl cyanacetate	25°	2.459	6.75	1.1358	2.165
"	0°	3.256	5.10	1.1521	2.827
Ethyl cyanacetate	25°	0.888	18.7	1.0579	0.839
"	25°	1.090	15.23	1.0678	1.021

(Walden, Z. phys. Ch. 1906, 55. 715.)

Insol. in  $CS_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Sol. in ethyl acetate. (Casaseca, C. R. 30. 821.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in ethylamine. (Shinn, J. phys. Chem. 1907, 11. 538.)

100 pts. acetone dissolve 2.930 pts. KI at 25°. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Sol. in acetone, insol. in methylal. (Eidmann, C. C. 1899. 11. 1014.)

3.08 pts. sol. in 100 pts. acetone at  $-2.5^{\circ}$ .

2.38 " " " 100 " " "  $+22^{\circ}$ .

1.21 " " " 100 " " " 56°.

0.26 " " " 100 " pyridine " 10°.

0.11 " " " 100 " " " 119°.

(Laszczyński, B. 1894, 27. 2287.)

Freely sol. in glycerine. Insol. in acetic acid. (Berthelot.)

Sol. in 3 pts. glycerine; insol. in olive oil. (Cap and Garot.)

100 g. glycerol dissolve 40 g. KI at  $15.5^{\circ}$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

### Potassium triiodide, $KI_3$ .

Very deliquescent; very sol. in  $H_2O$  and alcohol. (Johnson, Chem. Soc. 1877, 1. 249.)

Solution of I in KI contains this salt (see KI). Decomp. by heat or shaking with  $CS_2$ , ether, chloroform. Sol. in alcohol, from which  $CS_2$  does not remove I. (Jørgensen, J. pr. (2) 2. 247.)

### Potassium periodide.

Solubility determinations show that the compds.  $KI_3$  and  $KI_5$  are the only periodides of potassium which form solids at  $25^{\circ}$ .

See under KI+I. (Foote and Chalker, Am. Ch. J. 1908, 39. 566.)

$KI_7$ . See above.

### Potassium mercuric iodide ammonia,

$K_2HgI_4 \cdot 2NH_3$ .

(Peters, Z. anorg. 1912, 77. 188.)

### Potassium silver iodide, KI, AgI.

Sol. in KI+Aq. Sol. in hot alcohol. (Boullay, A. ch. 34. 377.)

$2KI, AgI$ . Sol. in KI+Aq. Decomp. by  $H_2O$  (Boullay.)

Hygroscopic. (Hellwig, Z. anorg. 1900, 25. 180.)

$3KI, AgI$ . Decomp. by  $H_2O$ . (Ditte, C. R. 93, 415.)

$KI, 2AgI$ . Sol. in methylethylketone. (Marsh, Chem. Soc. 1913, 103. 783.)

### Potassium silver polyiodide, $AgK_2I_{11}, 3KI + 5H_2O$ .

Very deliquescent. (Johnson, Chem. Soc. 33. 183.)

### Potassium tellurium iodide.

See Iodotellurate, potassium.

### Potassium thallic iodide, $KI, TlI_3$ .

Decomp. by  $H_2O$ . Can be crystallised from alcohol. (Willm.)

$3KI, 2TlI_3 + 3H_2O$ . Partially decomp. by  $H_2O$ . (Rammelsberg.)

### Potassium (tin) stannous iodide, $KI, SnI_2 + 1\frac{1}{2}H_2O$ .

When treated with a small quantity of  $H_2O$ , KI dissolves out; but when more  $H_2O$  is added, the substance is completely dissolved. More sol. in warm than cold alcohol. (Boullay.)

**Potassium zinc iodide**,  $KI, ZnI_2$ .  
Very deliquescent. (Rammelsberg, Pogg. 43. 665.)  
 $K_2ZnI_4 + 2H_2O$ . Hygroscopic. (Ephraim, Z. anorg. 1910, 67. 382.)

**Potassium iodide sulphur dioxide**,  $KI, SO_2$ .  
(Péchar, C. R. 1900, 130. 1188.)  
 $KI, 4SO_2$ . (Walden, Z. phys. Ch. 1903, 42. 439.)  
 $KI, 14SO_2$ . (Walden.)

**Potassium nitride**,  $K_3N$ .  
Decomp. violently by  $H_2O$ . (H. Davy.)

**Potassium ruthenium dihydronitrosobromide**,  $Ru_2H_2, NOBr, 2HBr, 3KBr$ .  
Ppt. (Brizard, A. ch. 1900, (7) 21. 362.)

**Potassium ruthenium nitrosochloride**,  $Ru_2H_2, NOCl, 3KCl, 2HCl$ .  
Sl. sol. in  $H_2O$ . (Brizard, C. R. 1899, 129. 216.)

**Potassium suboxide**.  
Decomposes  $H_2O$ .  
Does not exist. (Lupton, Chem. Soc. 1876, 2. 565.)

**Potassium oxide**,  $K_2O$ .  
Very sol. in  $H_2O$  with much heat.  
See Potassium hydroxide.

**Potassium dioxide**,  $K_2O_2$ .  
Deliquescent. Sol. in  $H_2O$ .  
Forms compound  $K_2O_2, 2H_2O_2$ . (Schöne, A. 193. 241.)

**Potassium peroxide**,  $K_2O_4$ .  
Deliquescent. Very sol. with decomp. in  $H_2O$ .

**Potassium silicon oxyfluoride**,  $SiF_2(OK)$ , and  $SiO(F)OK$ .  
(Schiff and Bechi, A. Suppl. 4. 33.)

**Potassium tantalum oxyfluoride**,  $K_4Ta_2O_5F_{14}$ .  
Insol. in boiling water. Easily sol. in  $HF + Aq$ . (Marignac, A. ch. (4) 9. 268.)

**Potassium phosphide**,  $KP_3$ .  
Decomp. by  $H_2O$ . (Joannis, C. C. 1894, II. 834.)  
 $KP_3$ . Easily decomp. by  $H_2O$ . (Hugot, C. R. 1895, 121. 208.)

**Potassium hydrogen phosphide**,  $PH_2K$ .  
Decomp. by  $H_2O$ . (Joannis, C. R. 1894, 119. 558.)

**Potassium phosphoselenide**,  $KSeP = K_2Se, P_2Se$ .  
Sol. in cold  $H_2O$  with rapid decomp. Sol. in alcohol with slight decomp. (Hahn, J. pr. 93. 430.)

**Potassium phosphotriselenide**,  $2K_2Se, P_2Se_3$ .  
Deliquescent. Decomp. violently with  $H_2O$ . Sol. in alcohol or ether, or in a mixture of the two, with slight decomp., but decomp. gradually on the air. (Hahn, J. pr. 93. 430.)

**Potassium phosphopentaseelenide**,  $K_4P_2Se_7 = 2K_2Se, P_2Se_5$ .  
Deliquescent; immediately decomp. by  $H_2O$ , alcohol, or ether. (Hahn.)

**Potassium phosphosulphide**,  $4K_2S_2, P_2S_5$ .  
Deliquescent. Sol. in  $H_2O$  with decomp.

**Potassium selenide**,  $K_2Se$ .  
Sol. in  $H_2O$  with subsequent decomp. on the air.  
Insol. in liquid  $NH_3$ ; sol. in air free  $H_2O$  to a colorless liquid. (Hugot, C. R. 1899, 129. 299.)  
 $+ 2H_2O$ . Sol. in  $H_2O$  with decomp. (Clever, Z. anorg. 1895, 10. 143.)  
 $+ 9, 14$ , or  $19H_2O$ . (Fabre, C. R. 102. 613.)

**Potassium tetraselenide**,  $K_2Se_4$ .  
Easily sol. in  $H_2O$ . Decomp. on standing. Sol. in liquid  $NH_3$ . (Hugot, C. R. 1899, 129. 299.)

**Potassium monosulphide**,  $K_2S$ .  
Deliquescent. Sol. in  $H_2O$  and alcohol.  $H_2O$  solution decomp. on air.  
Sol. in 10 pts. glycerine. (Cap and Garot, J. Pharm. (3) 28. 81.)  
Moderately sol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)  
Insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)  
Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)  
 $+ 5H_2O$ . (Schöne, Pogg. 131. 380.)  
All potassium sulphides are sol. in glycerine; insol. in ether and ethyl acetate.

**Potassium disulphide**,  $K_2S_2$ .  
Sol. in  $H_2O$  and alcohol, with gradual decomp.

**Potassium trisulphide**,  $K_2S_3$ .  
Sol. in  $H_2O$  and alcohol, with gradual decomp. on the air.

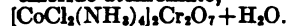
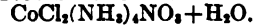
**Potassium tetrasulphide**,  $K_2S_4$ .  
Sol. in  $H_2O$  and alcohol.  
 $+ 2H_2O$ . Sol. in  $H_2O$ . Sl. sol. in alcohol.  
 $+ 8H_2O$ . Sol. in  $H_2O$ . Alcohol takes out water. (Schöne.)

**Potassium pentasulphide**,  $K_2S_5$ .  
Sol. in  $H_2O$  and alcohol.



**Potassium palladium sulphide.***See Sulphopalladate, potassium.***Potassium platinum sulphide.***See Sulphoplatinate, potassium.***Potassium silver sulphide,**Decomp. by  $\text{H}_2\text{O}$ . (Ditte, C. R. 1895, 120. 91.)**Potassium rhodium sulphide,  $3\text{K}_2\text{S}, \text{Rh}_2\text{S}_3$ .**Decomp. by  $\text{H}_2\text{O}$ . (Leidié.)**Potassium tellurium sulphide.***See Sulphotellurate, potassium.***Potassium thallium sulphide,  $\text{K}_2\text{S}, \text{Tl}_2\text{S}_3$ .**Not decomposed by  $\text{H}_2\text{O}$ , or hot  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . Decomp. by  $\text{HCl}$  or moderately conc.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Hot  $\text{HNO}_3 + \text{Aq}$  decomp. with separation of S. (Schneider, J. pr. 110. 168.)**Potassium tin (stannic) sulphide.***See Sulphostannate, potassium.***Potassium zinc sulphide,  $\text{K}_2\text{S}, 3\text{ZnS}$ .**Not attacked by  $\text{H}_2\text{O}$ , but easily decomp. by the most dil. acids. (Schneider, J. pr. (2) 8. 29.)**Potassium telluride,  $\text{K}_2\text{Te}$ .**Sol. in  $\text{H}_2\text{O}$ . (Demarçay, Bull. Soc. (2) 40. 99.)Sol. in  $\text{H}_2\text{O}$  and liquid  $\text{NH}_3$ . (Hugot, C. R. 1899, 129. 388.)**Praseocobaltic chloride,**Easily sol. in  $\text{H}_2\text{O}$ .Dil.  $\text{HCl} + \text{Aq}$  dissolves traces; conc.  $\text{HCl} + \text{Aq}$  dissolves more. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. Sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Rose.)— mercuric chloride,  $\text{Co}(\text{NH}_3)_4\text{Cl}_2, \text{HgCl}_2$ .Sl. sol. in cold  $\text{H}_2\text{O}$ ; insol. in  $\text{HgCl}_2 + \text{Aq}$ . (Vortmann, B. 15. 1892.)

— chloride dichromate,

Scarcely sol. in cold, easily sol. in warm  $\text{H}_2\text{O}$ . (Vortmann, B. 15. 1897.)**Praseocobaltic chloride nitrate,**Much less sol. in  $\text{H}_2\text{O}$  than the chloride. Precipitated from aqueous solution by dil.  $\text{HNO}_3 + \text{Aq}$ . (Vortmann, B. 15. 1896.)**Praseodymicotungstic acid.****Ammonium praseodymicotungstate,**Very sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by acids and alkalis. (E. F. Smith, J. Am. Chem. Soc. 1904, 26. 1478.)**Barium praseodymicotungstate,  $4\text{BaO}, \text{Pr}_2\text{O}_3, 16\text{WO}_3 + 7\text{H}_2\text{O}$ .**Ppt. Insol. in  $\text{H}_2\text{O}$ . $6\text{BaO}, \text{Pr}_2\text{O}_3, 16\text{WO}_3 + 9\text{H}_2\text{O}$ . Ppt. (E. F. Smith.)**Silver praseodymicotungstate,  $4\text{Ag}_2\text{O}, \text{Pr}_2\text{O}_3, 16\text{WO}_3 + 8\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . (E. F. Smith.)**Praseodymium, Pr.****Praseodymium bromide,  $\text{PrBr}_3 + 6\text{H}_2\text{O}$ .**Very sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HBr}$ . (von Schule, Z. anorg. 1898, 18. 353.)**Praseodymium carbide,  $\text{PrC}_2$ .**Decomp. by  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HNO}_3$ , decomp. by dil.  $\text{HNO}_3$ . (Moissan, C. R. 1900, 131. 597.)**Praseodymium chloride,  $\text{PrCl}_3$ .**Very sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{PCl}_3$  or  $\text{SnCl}_4$ . Sol. in alcohol. Insol. in ether and most organic solvents. (Matignon, C. R. 1902, 134. 427.)2.14 g.  $\text{PrCl}_3$  dissolve in 100 g. pyridine at  $15^\circ$ . (Matignon, Int. Cong. App. Chem. 1909, 2. 53.) $+ \text{H}_2\text{O}.$  $+ 3\text{H}_2\text{O}.$  $+ 7\text{H}_2\text{O}.$  100 g.  $\text{H}_2\text{O}$  dissolve 334.2 g.  $\text{PrCl}_3 + 7\text{H}_2\text{O}$  or 103.9 g. of the anhydrous salt at  $13^\circ$ . The aqueous solution sat. at  $14^\circ$  has a sp. gr.  $16^\circ/16^\circ = 1.687$ . At  $100^\circ$ , the solubility in  $\text{H}_2\text{O}$  is unlimited. (Matignon, A. ch. 1906, (8) 8. 388.)Sol. in conc.  $\text{HCl}$ . (von Schule, Z. anorg. 1898, 18. 352.)100 pts. of a solution of the salt in  $\text{HCl} + \text{Aq}$  contain at  $13^\circ$  41.05 pts. of anhydrous salt and 7.25 pts.  $\text{HCl}$ . Sp. gr. of this solution at  $16^\circ = 1.574$ . (Matignon, A. ch. 1906, (8) 8. 388.)**Praseodymium hydride,  $\text{PrH}_3$  (?).**

(Muthmann, A. 1904, 331. 59.)

**Praseodymium hydroxide.**

Sol. in citric acid. (Baskerville, J. Am. Chem. Soc. 1904, 26. 49.)

**Praseodymium nitride,  $\text{PrN}$ .**Decomp. in moist air with evolution of  $\text{NH}_3$ . (Muthmann, A. 1904, 331. 59.)

**Praseodymium oxide,  $\text{Pr}_2\text{O}_3$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (v. Welsbach, M. 8. 477.)

Decomp. by heating in the air. (Scheele, Z. anorg. 1898, 17. 322.)

**Praseodymium monoperoxide,  $\text{Pr}(\text{OH})_2\cdot\text{H}_2\text{O}$ .**

(Melikoff, Chem. Soc. 1902, 82. (2) 140.)

**Praseodymium superoxide,  $\text{Pr}(\text{OH})_2(\text{OOH})$ .**

Ppt. (Melikoff, C. C. 1902, I. 172.)

**Praseodymium trisuperoxide,  $\text{Pr}(\text{OOH})_3$ .**

Ppt. (Melikoff.)

**Praseodymium peroxide,  $\text{Pr}_2\text{O}_7$ .**

Sol. in acids with evolution of O. (v. Welsbach.)

**Praseodymium oxysulphide,  $\text{Pr}_2\text{SO}_3$ .**

(Biltz, Z. anorg. 1911, 71. 436.)

**Praseodymium disulphide,  $\text{PrS}_2$ .**

Decomp. by heat. (Biltz, Z. anorg. 1911, 71. 437.)

**Purpureocobaltic salts.**

For other purpureocobaltic salts, see—

Chloropurpureocobaltic salts.

Bromopurpureocobaltic salts.

Nitratopurpureocobaltic salts.

Sulphatopurpureocobaltic salts.

**Purpureocobaltic cobalticyanide,**

Insol. in  $\text{H}_2\text{O}$ .

**— ferrieyanide,  $\text{Co}(\text{NH}_3)_4\text{Fe}(\text{CN})_6$ .**

Insol. in cold  $\text{H}_2\text{O}$ . Probably belongs to roseo series.

**— mercuric hydroxychloride,**

Ppt. (Vortmann and Morgulis, B. 22. 2645.)

$\text{CoN}_3\text{H}_{11}(\text{HgOH})_4\text{Cl}_3$ . Ppt. (V. and M.)

**— mercuriiodide, basic,**

Ppt. Sl. sol. in acids. Sol. in  $\text{KI} + \text{Aq}$ . (Vortmann and Borsbach, B. 23. 2804.)

**— molybdate,  $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}, 7\text{MoO}_3 + 3\text{H}_2\text{O}$  (?).**

Insol. in  $\text{H}_2\text{O}$  or dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Carnot, C. R. 109. 109.)

**— sulphate.**

See Sulphatopurpureocobaltic salts.

**— tungstate,  $\text{Co}(\text{NH}_3)_4\text{O}(\text{WO}_3)$ .**

Scarcely sol. in cold or hot  $\text{H}_2\text{O}$ . (Gibbs.)

$\text{Co}_2\text{O}_3(\text{NH}_3)_{10}, 10\text{WO}_3 + 9\text{H}_2\text{O}$  (?). Insol.

in  $\text{H}_2\text{O}$ , or dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Carnot, C. R. 109. 147.)

**Purpureocobaltic vanadate,  $\text{Co}_2\text{O}_3(\text{NH}_3)_{10}, 5\text{V}_2\text{O}_5 + 9\text{H}_2\text{O}$  (?).**

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Carnot, C. R. 109. 147.)

**Purpureocobaltic octamine salts.**

See Octamine cobaltic purpureo salts.

**Pyrosulphuric acid,  $\text{H}_2\text{S}_2\text{O}_7$ .**

See Disulphuric acid.

**Radium, Ra.****Radium A.**

More sol. than Radium B and C in all solvents; sol. even in organic solvents, especially  $\text{CS}_2$ . (Ramstedt, Le Radium, 1913, 10. 159.)

**Radium B.**

More quickly sol. than Radium C in  $\text{H}_2\text{O}$  and acids; less quickly sol. in alkaline solutions; very sl. sol. in organic solvents. (Ramstedt, Le Radium, 1913, 10. 159.)

**Radium C.**

Sol. in common acids, less so in alkaline solutions and in  $\text{H}_2\text{O}$ , only very sl. sol. in organic solvents. (Ramstedt, Le Radium, 1913, 10. 159; Chem. Soc. 1913, 104. (2) 659.)

**Radium bromide.**

Less sol. in  $\text{H}_2\text{O}$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Radium chloride.**

Less sol. in  $\text{H}_2\text{O}$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Radium emanation.**

Coefficient of absorption for  $\text{H}_2\text{O} = 0.245$  at  $3^\circ$ ; 0.23 at  $20^\circ$ ; 0.17 at  $40^\circ$ ; 0.135 at  $60^\circ$ ; 0.12 at  $70^\circ$ ; 0.12 at  $80^\circ$ . (Hofmann, Phys. Zeit. 1905, 6. 339.)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

Coefficient of solubility = conc. of the emanation in the liquid: conc. of the emanation in the gas.

$t^\circ$	Coefficient of solubility
0	0.506
4.3	0.424
5.7	0.398
10.0	0.340
14.0	0.303
17.6	0.280
20.0	0.245
26.8	0.206
31.6	0.193
39.1	0.160

Coefficient of solubility in sea-water of sp. gr. at  $14^\circ = 1.022$  is 0.255.

(Boyle, Phil. Mag. 1911, (6) 22. 850.)

Solubility in  $H_2O$ .

Temp.	0.5°	17.5°	35°	41°	51°
Sol.	0.526	0.283	0.183	0.161	0.138

Temp.	60°	74°	79°	82°	91°
Sol.	0.127	0.112	0.111	0.111	0.108

(Kofler, M. 1913, **34**. 389.)

Coefficient of solubility of radium emanation at 14° in various solvents.

Ethyl alcohol	7.34
Amyl alcohol	9.31
Toluene	13.7
Sea water	0.255
Mercury	0

(Boyle, Phil. Mag. 1911, (6) **22**. 851.)

Coefficient of solubility emanation of radium in various solvents at t°.

Solvents	t = 18°	t = 0°	t = -18°
Ethyl acetate	7.35	9.41	13.6
Acetone	6.30	7.99	10.8
Absolute alcohol	6.17	8.28	11.4
Aniline	3.80	4.43	...
Benzene	12.82	16.54 at 3°	...
Chloroform	15.08	20.5	28.5
Cyclohexane	18.04 at 80°	...	...
Water	0.285	0.52	...
Ether	15.08	20.09	29.1
Glycerine	0.21	...	...
Hexane	16.56	23.4	35.2
Paraffine oil	9.2	12.6	...
Carbon-bisulphide	23.14	33.4	50.3
Toluene	13.24	18.4	27.7
Xylene	12.75	...	...

(Ramstedt, Le Radium, 1911, **8**. 255.)

## Solubility in various oils, etc., at t°.

Rape oil		Poppy seed oil		Oil of turpentine	
t°	Solubility	t°	Solubility	t°	Solubility
-3	51.2	-5	50.5	-21	42.5
10	35.3	16	30.2	0	23.1
20	26.1	40	19.1	18	16.6
100	6.2	65	12.4	50	7.5
200	3.3	90	8.4	6.5	4.08

Solubility in 10% dammar resin in oil of turpentine = 16.7 at 18°.

Solubility in 5% colophony in amyl alcohol = 11.2 at 20°.

Solubility in amyl alcohol = 10.6 at 18°.

Solubility in 20% colophony in amyl alcohol = 11.1 at 20°.

(Curie, Thesis. 1910.)

Coefficient of absorption for petroleum =

22.70 at -21°.

12.87 at +3°.

9.55 at 20°.

8.13 at 40°.

7.01 at 60°.

(Hofmann, Phys. Zeit. 1905, **6**. 339.)**Rhodicyanhydric acid,  $H_2Rh(CN)_4$ .**

Not known in the free state.

**Potassium rhodicyanide,  $K_2Rh(CN)_4$ .**Sol. in  $H_2O$ . Easily decomp. by acids.Very sol. in  $H_2O$ . (Leidié, C. R. 1900, **130**. 89.)**Rhodium, Rh.**

Insol. in all acids, including aqua regia.

Rhodium "sponge" is sol. in  $HNO_3 + Aq$ , and somewhat in  $HCl + Aq$  when exposed to air.**Rhodium ammonia compounds.**

See—

**Bromopurpureorhodium comps.,** $BrRh(NH_3)_4X_2$ .**Chloropurpureorhodium comps.,** $ClRh(NH_3)_4X_2$ .**Iodopurpureorhodium comps.,** $IRh(NH_3)_4X_2$ .**Luteorhodium comps.,  $Rh(NH_3)_4X_2$ .****Nitratopurpureorhodium comps.,** $(NO_3)Rh(NH_3)_4X_2$ .**Roseorhodium comps.,  $Rh(NH_3)_4(OH)_2X_2$ .****Xanthorhodium comps.,  $(NO_2)Rh(NH_3)_4X_2$ .****Rhodium tribromide,  $RhBr_3 + 2H_2O$ .**Very sol. in  $H_2O$ . (Goloubkine, Chem. Soc. 1911, **100**. (2) 45.)**Rhodium rubidium bromide.**

See Bromorhodite, rubidium.

**Rhodium sodium bromide.**

See Bromorhodite, sodium.

**Rhodium dichloride,  $RhCl_3$  (?)**Insol. in  $H_2O$ ,  $HCl$ , or  $HNO_3 + Aq$ . Not attacked by boiling  $KOH$  or  $K_2CO_3 + Aq$ . (Fellenberg.)Decomp. by boiling  $KOH + Aq$ . (Berzelius.)

Does not exist. (Leidié, C. R. 106. 1076.)

**Rhodium trichloride,  $RhCl_3$ .**Insol. in acids, even aqua regia. When boiled for a long time with  $KOH + Aq$ , it becomes sl. sol. in  $HCl + Aq$ .Insol. in  $H_2O$  and acids; sol. in alkalis +  $Aq$ . (Leidié, C. R. 1899, **129**. 1251.)+  $4H_2O$ . Very sl. deliquescent. Easily sol. in  $H_2O$ ,  $HCl + Aq$ , or alcohol. Insol. in ether. Decomp. by  $H_2SO_4$  only when boiling. (Claus, J. pr. **80**. 282.)

No definite amount of crystal  $H_2O$ . (Leidié A. ch. (6) 17. 271.)

**Rhodium chloride with  $MCl$ .**

See Chlororhodite, M.

**Rhodium dihydroxide,  $RhO_2$ ,  $2H_2O$ , or Rhodium rhodate,  $Rh_2O_3$ ,  $RhO_3+6H_2O$ .**

Sol. in  $HCl+Aq$ .

**Rhodium sesquihydroxide,  $Rh_2O_3.H_2O$ .**

Only sl. sol. in conc.  $HCl+Aq$ . (Claus.)  $+2H_2O$ . Easily sol. in  $HCl$ ,  $H_2SO_4$ ,  $H_2SO_3$ ,  $HNO_3$ , or  $HSCN+Aq$ ; also when moist, in  $HC_2H_3O_2+Aq$ . Sol. in conc.  $KOH+Aq$ ; very sl. sol. in  $H_3BO_3$ ,  $H_2PO_4$ ,  $H_2C_4H_4O_6$ , and  $HCN+Aq$ . Sol. in acid alkali oxalates  $+Aq$ . (Leidié, C. R. 107. 234.)

**Rhodium triiodide,  $RhI_3$ .**

Ppt. (Goloubkine, Chem. Soc. 1911, 100. (2) 45.)

**Rhodium monoxide,  $RhO$ .**

Not attacked by acids. (Deville and Debray, A. ch. (3) 61. 83.)

**Rhodium sesquioxide,  $Rh_2O_3$ .**

Insol. in  $H_2O$ , boiling  $KOH+Aq$ , or any acid, even aqua regia. (Claus.)

**Rhodium dioxide,  $RhO_2$ .**

Insol. in all acids or alkalies.

**Rhodium trioxide,  $RhO_3$ .**

"Rhodic acid." Known only in solution of "Potassium rhodate," which is very easily decomp. (Claus.)

**Rhodium oxybromide,  $Rh(OH)_2Br+2H_2O$ .**

Sol. in  $H_2O$ . (Goloubkine, Chem. Soc. 1911, 100. (2) 45.)

**Rhodium monosulphide,  $RhS$ .**

Insol. in aqua regia.

**Rhodium sesquisulphide,  $Rh_2S_3$ .**

Sol. in alkali sulphides  $+Aq$ . (Debray, C. R. 97. 1332.)

Insol. in alkali sulphides  $+Aq$ . Not attacked by  $HNO_3$ , aqua regia, or  $Br_2+Aq$ . (Leidié, Bull. Soc. (2) 50. 664.)

**Rhodium sodium sulphide,  $3Na_2S$ ,  $Rh_2S_3$ .**

Decomp. by  $H_2O$ . (Leidié.)

**Rhodium sesquisulphydride,  $Rh_2S_3.H_2$ .**

Easily sol. in aqua regia or  $Br_2+Aq$ . Insol. in alkali sulphides  $+Aq$  or acids. (Leidié, Bull. Soc. (2) 50. 664.)

**Rhodochromium bromide,**

$HOCr_2(NH_3)_{10}Br_3+H_2O$ .

Rather difficultly sol. in  $H_2O$ . Decomp. by boiling or standing. Sol. in  $NH_4OH+Aq$  or  $NaOH+Aq$ . Insol. in dil.  $HBr+Aq$ ,  $KBr+Aq$ , or alcohol. (Jørgensen, J. pr. (2) 25. 321.)

— bromide, basic,  $HOCr_2(NH_3)_{10}(OH)Br_4+H_2O$ .

Sl. sol. in  $H_2O$ . Sol. in  $NH_4OH$  or  $NaOH+Aq$ . Insol. in alcohol. (Jørgensen.)

— bromoplatinate,  $HOCr_2(NH_3)_{10}Br_3PtBr_3$ ,  $HOCr_2(NH_3)_{10}Br_3(PtBr_3)_2+4H_2O$ .

Ppt. (Jørgensen.)

— chloraurate,  $HOCr_2(NH_3)_{10}Cl_3(AuCl_4)_2+2H_2O$ .

Difficultly sol. but not insol. in  $H_2O$ . (Jørgensen.)

— chloride,  $HOCr_2(NH_3)_{10}Cl_3+H_2O$ .

Sol. in about 40 pts. of cold  $H_2O$ . Insol. in cold dil.  $HCl+Aq$ ,  $NH_4Cl+Aq$ , or alcohol. Sol. in  $NH_4OH+Aq$ . (Jørgensen, J. pr. (2) 25. 321.)

— chloriodide, basic,  $HOCr_2(NH_3)_{10}(OH)Cl_3I_2$ .

Sl. sol. in cold  $H_2O$ ; insol. in alcohol. (Jørgensen.)

— chloroplatinate,  $HOCr_2(NH_3)_{10}Cl_3PtCl_4$ ,  $HOCr_2(NH_3)_{10}Cl_3(PtCl_4)_2+4H_2O$ .

Precipitate. (Jørgensen.)

— dithionate,  $[HOCr_2(NH_3)_{10}]_2(S_2O_6)_2+2H_2O$ .

Nearly insol. in  $H_2O$ .

— dithionate, basic,  $HOCr_2(NH_3)_{10}OH(S_2O_6)_2+H_2O$ .

Insol. in  $H_2O$ , cold  $NH_4OH+Aq$ , or  $NaOH+Aq$ .

— iodide,  $HOCr_2(NH_3)_{10}I_3+H_2O$ .

Very difficultly sol. in  $H_2O$ . Insol. in very dil.  $HI+Aq$  or alcohol. Sl. sol. in  $NH_4OH$  or  $KOH+Aq$ . (Jørgensen.)

— nitrate,  $HOCr_2(NH_3)_{10}(NO_3)_3$ .

Rather difficultly sol. in  $H_2O$ , from which it is precipitated by a few drops of  $HNO_3+Aq$ . Sol. in hot dil.  $NH_4OH+Aq$ .

— nitrate chloroplatinate,  $HOCr_2(NH_3)_{10}(NO_3)_3(PtCl_4)_2+4H_2O$ .

Precipitate. (Jørgensen.)

**Rhodochromium sulphate,**

$[HOCr_2(NH_3)_{10}]_2(SO_4)_3+2H_2O$ .

Very sl. sol. in cold  $H_2O$ . Easily sol. in cold dil.  $H_2SO_4+Aq$ .

Almost insol. in a mixture of 3 vols.  $\text{H}_2\text{O}$ , 1 vol. alcohol, and  $\frac{1}{2}$  vol. dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Jørgensen.)

### Rhodonitrous acid.

**Ammonium rhodonitrite**,  $(\text{NH}_4)_3\text{Rh}_2(\text{NO}_2)_{11}$ .

Nearly insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . Insol. in conc.  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq.}$  Insol. in alcohol. (Leidié, C. R. 111. 108.)

**Barium rhodonitrite**,  $\text{Ba}_2\text{Rh}_2(\text{NO}_2)_{11}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . (Lamy.)

+  $12\text{H}_2\text{O}$ . Sol. in 50 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , and 6.5 pts. at  $100^\circ$ . (Leidié, C. R. 111. 108.)

**Potassium rhodonitrite**,  $\text{K}_4\text{Rh}_2(\text{NO}_2)_{11}$ .

Nearly insol. in cold, very sl. sol. in boiling  $\text{H}_2\text{O}$ . Completely insol. in  $\text{KNO}_3 + \text{Aq.}$ , and in  $\text{KCl} + \text{Aq.}$  (30%  $\text{KCl}$ ), or  $\text{KC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  (50%  $\text{KC}_2\text{H}_3\text{O}_2$ ). Insol. in alcohol. (Leidié, C. R. 111. 108.)

**Sodium rhodonitrite**,  $\text{Na}_2\text{Rh}_2(\text{NO}_2)_{11}$ .

Sol. in  $2\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $17^\circ$ , and 1 pt. at  $100^\circ$ . Insol. in alcohol. Decomp. by  $\text{HCl} + \text{Aq.}$  (Leidié, C. R. 111. 107.)

### Rhodosochromium bromide.

Sol. in  $\text{H}_2\text{O}$ ; insol. in dil.  $\text{HBr} + \text{Aq.}$  (1 : 1). (Jørgensen, J. pr. (2) 45. 260.)

— **chloraurate**,  $\text{Cr}_2(\text{NH}_3)_6(\text{HO})_2\text{Cl}_3$ ,  $2\text{AuCl}_3 + 2\text{H}_2\text{O}$ .

Not insol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.)

— **chloride**,  $\text{Cr}_2(\text{NH}_3)_6(\text{HO})_2\text{Cl}_3 + 2\text{H}_2\text{O}$ .

Sol. in 10.6 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ ; decomp. by boiling. Pptd. by  $\frac{1}{2}$  to 1 vol. dil.  $\text{HCl} + \text{Aq.}$  Sol. in cold dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Jørgensen, J. pr. (2) 45. 260.)

— **chloroplatinate**,  $2\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

$\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2\text{Cl}_3$ ,  $2\text{PtCl}_4 + 2\text{H}_2\text{O}$ . Insol. in 95% alcohol. (Jørgensen.)

— **chromate**,  $[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2]_2(\text{CrO}_4)_3 + 7\text{H}_2\text{O}$ . (Jørgensen.)

Very sl. sol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

— **iodide**,  $\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2\text{I}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HI} + \text{Aq.}$  (Jørgensen.)

— **nitrate**,  $\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2(\text{NO}_3)_3 + \text{H}_2\text{O}$ .

Much less sol. in cold  $\text{H}_2\text{O}$  than the chloride. Insol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Jørgensen.)

— **oxalate**,

$[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2]_2(\text{C}_2\text{O}_4)_3(\text{HC}_2\text{O}_4)_4 + 2\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ , but not very easily. (Jørgensen.)

### Rhodosochromium sulphate,

$[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$ .

Very sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Jørgensen.)

$[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2]_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{H}_2\text{SO}_4$  and above compound. (Jørgensen.)

— **persulphide**,  $[\text{Cr}_2(\text{NH}_3)_6(\text{OH})_2]_2\text{S}_{11} + 4\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Jørgensen.)

### Rhodosulphuric acid.

**Potassium rhodosulphate**,  $\text{K}_4\text{Rh}_2(\text{SO}_4)_4$ .

Two modifications:

(a) Slowly sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

(b) Insol. in  $\text{H}_2\text{O}$ .

Does not exist. (Leidié, C. R. 107. 234.)

**Sodium rhodosulphate.**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia. (Claus.)

Does not exist. (Leidié.)

$\text{Na}_2\text{Rh}_2(\text{SO}_4)_4$ . Insol. in  $\text{H}_2\text{O}$ . (Seubert and Kobbé, B. 23. 2560.)

### Rhodosulphurous acid.

**Potassium rhodosulphite**,  $\text{K}_4\text{Rh}_2(\text{SO}_3)_4 + 6\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Slowly sol. in acids. Not decomp. by boiling  $\text{KOH} + \text{Aq.}$  (Claus.)

**Sodium rhodosulphite,**

$\text{Na}_4\text{Rh}_2(\text{SO}_3)_4 + 4\frac{1}{2}\text{H}_2\text{O} = 3\text{Na}_2\text{SO}_3$ ,  $2\text{RbSO}_3$ .

Insol. in cold, very sl. sol. in hot  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq.}$  (Seubert and Kobbé, B. 23. 2558.)

### Roseochromium bromide.

$\text{Cr}(\text{NH}_3)_4\text{Br}_3 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HBr} + \text{Aq.}$  (Christensen, J. pr. (2) 23. 26.)

— **bromochromate**,  $\text{Cr}(\text{NH}_3)_4\text{Br}(\text{CrO}_4)$ .

Somewhat sol. in  $\text{H}_2\text{O}$ , but decomp. on standing. (Jørgensen, J. pr. (2) 25. 398.)

— **bromoplatinate**,  $\text{Cr}(\text{NH}_3)_4\text{Br}(\text{PtBr}_6) + 2\text{H}_2\text{O}$ .

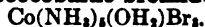
Precipitate. Difficultly sol. in  $\text{H}_2\text{O}$ . (Christensen, l. c.)

— **chloride**,  $\text{Cr}(\text{NH}_3)_4\text{Cl}_3 + \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  with subsequent decomp. Insol. in alcohol. (Christensen, J. pr. (2) 23. 26.)

— **mercuric chloride**,  $\text{Cr}(\text{NH}_3)_4\text{Cl}_3$ ,  $3\text{HgCl}_2 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  with decomposition. (Christensen, l. c.)

**Roseochromium dithionate, basic,**  
 $\text{Cr}(\text{NH}_3)_3(\text{OH})_2\text{S}_2\text{O}_8 + \text{H}_2\text{O}$ .Easily sol. in very dil.  $\text{HCl} + \text{Aq}$ . (Jørgensen, J. pr. (2) 25. 398.)— **iodide**,  $\text{Cr}(\text{NH}_3)_3\text{I}_3$ .Easily sol. in  $\text{H}_2\text{O}$ ; decomp. by boiling. (Christensen, l. c.)— **nitrate**,  $\text{Cr}(\text{NH}_3)_3(\text{NO}_3)_3 + \text{H}_2\text{O}$ .Rather easily sol. in  $\text{H}_2\text{O}$ . (Christensen, l. c.) $\text{Cr}(\text{NH}_3)_3(\text{NO}_3)_2(\text{OH})_2$ ,  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Jørgensen, J. pr. (2) 44. 63.)— **sulphate**,  $[\text{Cr}(\text{NH}_3)_3]_2(\text{SO}_4)_3 + 5\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ . Precipitated by alcohol. (Christensen, l. c.)— **sulphate bromoplatinate**,  
 $[\text{Cr}(\text{NH}_3)_3(\text{SO}_4)]_2\text{PtBr}_3$ .Difficultly sol. in  $\text{H}_2\text{O}$ . (Christensen, l. c.)— **sulphate chloroplatinate**,  
 $[\text{Cr}(\text{NH}_3)_3(\text{SO}_4)]_2\text{PtCl}_4$ .Difficultly sol. in  $\text{H}_2\text{O}$ . (Christensen, l. c.)**Roseocobaltic bromide,**Sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HBr} + \text{Aq}$ . (Jørgensen, J. pr. (2) 31. 49.)— **bromoplatinate**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Br}_3$ ,  
 $\text{PtBr}_4 + \text{H}_2\text{O}$ .Somewhat sol. in  $\text{H}_2\text{O}$  or dil. alcohol. Insol. in strong alcohol. (Jørgensen.) $2\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Br}_3$ ,  $3\text{PtBr}_4 + 4\text{H}_2\text{O}$ . Ppt. (Jørgensen.)— **bromosulphate**,  
 $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Br}(\text{SO}_4)$ .Sol. in  $\text{H}_2\text{O}$ . (Krok.)— **bromosulphate bromaurate**,  
 $\text{Co}(\text{NH}_3)_4(\text{OH})_2(\text{SO}_4)\text{Br}$ ,  $\text{AuBr}_3$ .— **carbonate**.Very sol. in  $\text{H}_2\text{O}$ .— **chloraurate**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ ,  $\text{AuCl}_3$ .Moderately sol. in cold  $\text{H}_2\text{O}$ .— **chloride**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ .Sol. in 4.8 pts.  $\text{H}_2\text{O}$  at  $10.1^\circ$ , but decomp. on heating.100 pts.  $\text{H}_2\text{O}$  dissolve 16.12 pts. at  $0^\circ$ , and 24.87 pts. at  $16.19^\circ$ . (Kurnakoff, J. russ. Soc. 24. 269.)Sl. sol. in 1000 pts. fuming  $\text{HCl} + \text{Aq}$ , more easily in 20%  $\text{HCl} + \text{Aq}$ . (Rose.)**Roseocobaltic mercuric chloride,**

More easily sol. in solvents than the anhydrous purpureo salt. (Carstanjen.)

 $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ ,  $\text{HgCl}_2$ . Sol. in  $\text{HCl} + \text{Aq}$  with decomp. into above salt. (Jørgensen.)— **chloroplatinate**,Decomp. by  $\text{H}_2\text{O}$ . (Jørgensen.) $2\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ ,  $\text{PtCl}_4 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . $2\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Cl}_3$ ,  $3\text{PtCl}_4 + 6\text{H}_2\text{O}$ . Notdifficultly sol. in warm  $\text{H}_2\text{O}$ . (Gibbs.) $\text{Co}(\text{NH}_3)_4\text{Cl}_3$ ,  $\text{PtCl}_4 + \text{H}_2\text{O}$ . (Gibbs.)— **chlorosulphate**,  $\text{Co}(\text{NH}_3)_4\text{Cl}(\text{SO}_4)$ .Easily sol. in  $\text{H}_2\text{O}$ .— **chlorosulphate mercuric chloride**,  
 $\text{Co}(\text{NH}_3)_4\text{Cl}(\text{SO}_4)$ ,  $\text{HgCl}_2 + 3\text{H}_2\text{O}$ .Sol. in hot  $\text{H}_2\text{O}$ , and can be recrystallized without decomp. (Krok.)— **dichromate**,

Can be recrystallized out of weak acetic acid.

— **cobalticyanide**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{Co}(\text{CN})_6$ .Nearly absolutely insol. in cold  $\text{H}_2\text{O}$ . (Jørgensen.) $+ \text{H}_2\text{O}$ . (Gibbs and Gentile.)— **dithionate**,  $\text{Co}(\text{NH}_3)_4(\text{S}_2\text{O}_8)(\text{OH})$ .Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 58. 296.) $\text{Co}(\text{NH}_3)_4(\text{OH})_2(\text{S}_2\text{O}_8) + 2\text{H}_2\text{O}$ . Ppt. (Jørgensen.)— **hydroxide**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_3$ .

Known only in aqueous solution.

— **mercuric hydroxychloride**,  
 $\text{CoN}_5\text{H}_{11}(\text{HgOH})\text{Cl}_2$ .

Ppt. Sol. in dil. acids. (Vortmann and Morgulis, B. 22. 2646.)

 $\text{CoN}_5\text{H}_{11}(\text{HgOH})_2\text{Cl}_2(\text{OH})$ . Ppt. Sol. in dil. acids. (Vortmann and Morgulis.)— **iodide**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{I}_3$ .Less sol. in  $\text{H}_2\text{O}$  than bromide. Insol. in  $\text{HI} + \text{Aq}$ . (Jørgensen.)— **iodosulphate**,  $\text{Co}(\text{NH}_3)_4(\text{OH})_2\text{I}(\text{SO}_4)$ .Easily sol. in  $\text{H}_2\text{O}$ . (Krok.)— **mercuriodide**,  $[\text{CoN}_5\text{H}_{11}]_2(\text{HgI})_2\text{I}_3$ .

Ppt. (Vortmann and Borsbach, B. 23. 2805.)

 $\text{CoN}_5\text{H}_{11}(\text{HgI})_2\text{I}_3$ . Ppt. (Vortmann and Borsbach.) $\text{CoN}_5\text{H}_{11}(\text{HgI})_2\text{I}_2(\text{OH})$ . Ppt.

**Roseocobaltic nitrate,**  
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_2$ .

Three modifications:

$\alpha$ . Sol. in 20 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Jörgensen.)  
 $\beta$ . Known only in solution. Insol. in cold  $\text{HNO}_3$  + Aq. (Gibbs.)

$\gamma$ . Easily sol. in hot  $\text{H}_2\text{O}$ . (Gibbs.) (Purpureo salt?)

$\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_2$ ,  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Jörgensen, J. pr. (2) 44. 63.)

— **nitrate chloroplatinate,**  
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_2\text{Cl}_2$ ,  $\text{PtCl}_4 + \text{H}_2\text{O}$ .  
 Ppt. (Jörgensen.)

— **nitratosulphate,**  
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)(\text{SO}_4)$ .  
 Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ .

— **oxalate,**  $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{C}_2\text{O}_4)_2 + 2\text{H}_2\text{O}$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_5]_2(\text{C}_2\text{O}_4)_2$ ,  $4\text{H}_2\text{C}_2\text{O}_4$ .

— **oxalochloroplatinate,**  
 $[\text{Co}(\text{NH}_3)_5]_2\text{C}_2\text{O}_4\text{Cl}_2$ ,  $\text{PtCl}_4$ .  
 Sol. in hot  $\text{H}_2\text{O}$ .

— **oxalosulphate,**  $[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_4)_2\text{C}_2\text{O}_4$ ,  
 $\text{H}_2\text{C}_2\text{O}_4 + 2\text{H}_2\text{O}$ .  
 Sol. in hot  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_4)_2(\text{C}_2\text{O}_4)(\text{OH})_2 + 6\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .

— **orthophosphate,**  
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{PO}_4\text{H})(\text{OH}) + x\text{H}_2\text{O}$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ .  
 $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{PO}_4\text{H})_2 + 4\text{H}_2\text{O}$ . Very sl. sol. in cold  $\text{H}_2\text{O}$ ; easily in  $\text{H}_2\text{O}$  containing  $\text{HCl}$ . (Jörgensen.)

— **pyrophosphate,**  
 $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{P}_2\text{O}_7)_2 + 12\text{H}_2\text{O}$ .  
 Insol. in  $\text{H}_2\text{O}$ . (Jörgensen.)  
 $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{P}_2\text{O}_7\text{Na}) + 12\text{H}_2\text{O}$ . Nearly insol. in cold, easily sol. in hot  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{OH}$ . (Jörgensen, J. pr. (2) 23. 252.)

— **sulphate,**  $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .  
 Three modifications:  
 $\alpha$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . Sol. in 58 pts. at  $27^\circ$  (Gibbs); 83.5 pts. at  $20.2^\circ$ , and 94.6 pts at  $17.2^\circ$  (Jörgensen); more easily sol. in hot  $\text{H}_2\text{O}$ , and still more easily in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
 $\beta$ . Sol. in 1–2 pts.  $\text{H}_2\text{O}$ . (Gibbs.)  
 $\gamma$ . Less sol. than luteosulphate. (Jörgensen.)  
 $+ 2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Vortmann.)

**Roseocobaltic sulphate, acid,**  
 $[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_4)_2 \cdot 2\text{H}_2\text{SO}_4 + 3\text{H}_2\text{O}$ .  
 (Fremy), or  $4[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_4)_2$ ,  $9\text{H}_2\text{SO}_4 + 11\text{H}_2\text{O}$  (Jörgensen).  
 More easily sol. in  $\text{H}_2\text{O}$  than neutral sulphate, into which it is converted by recrystallization. Sol. in about 13 pts.  $\text{H}_2\text{O}$ . (Jörgensen.)

— **cerium sulphate,**  
 $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{SO}_4)_2$ ,  $\text{Ce}_2(\text{SO}_4)_6 + 2\frac{1}{2}\text{H}_2\text{O}$ .  
 Sl. sol. in cold, practically insol. in boiling  $\text{H}_2\text{O}$ . Sol. in acids. (Gibbs, Am. Ch. J. 15. 560.)  
 $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{SO}_4)_2$ ,  $\text{Ce}(\text{SO}_4)_3 + 2\frac{1}{2}\text{H}_2\text{O}$ . As above. (Gibbs.)

— **sulphate chloraurate.**  
 Three modifications:  
 $\alpha$ .  $\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{SO}_4)\text{Cl}$ ,  $\text{AuCl}_3$ . Ppt. (Jörgensen.)  
 $\beta$ .  $\text{Co}(\text{NH}_3)_5(\text{SO}_4)$ ,  $\text{AuCl}_3 + 2\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Gibbs.)  
 $\gamma$ . As above. Can be recrystallized from hot  $\text{H}_2\text{O}$ .

— **sulphate chloroplatinate.**  
 $2\text{Co}(\text{NH}_3)_5(\text{OH}_2)(\text{SO}_4)\text{Cl}_2$ ,  $\text{PtCl}_4$ .  
 Three modifications, all difficultly sol. in hot or cold  $\text{H}_2\text{O}$ . (Jörgensen.)

— **sulphite,**  $[\text{Co}(\text{NH}_3)_5(\text{OH}_2)]_2(\text{SO}_3)_2 + \text{H}_2\text{O}$ .  
 Sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Gibbs.)

— **cobaltic sulphite,**  
 $[\text{Co}(\text{NH}_3)_5]_2(\text{SO}_3)_2$ ,  $\text{Co}_2(\text{SO}_3)_3 + 9\text{H}_2\text{O}$ .  
 Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Künzel.)

**Roseocobaltic octamine compounds.**  
 See Roseotetramine cobaltic compounds.

**Roseoiridium compounds.**  
 See Iridoquopentamine compounds.

**Roseorhodium bromide,**  
 $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)\text{Br}$ .  
 Sol. in cold  $\text{H}_2\text{O}$ . (Jörgensen, J. pr. (2) 34. 394.)

**Roseorhodium cobalticyanide,**  
 $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)\text{Co}(\text{CN})_6$ .  
 Scarcely sol. in  $\text{H}_2\text{O}$ .

— **iodosulphate,**  $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)\text{I}(\text{SO}_4)$ .  
 Very sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Jörgensen.)

— **nitrate,**  $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_2$ .  
 Moderately sol. in cold  $\text{H}_2\text{O}$ . (Jörgensen.)  
 $\text{Rh}(\text{NH}_3)_5(\text{OH}_2)(\text{NO}_3)_2$ ,  $\text{HNO}_3$ . Decomp.

by  $\text{H}_2\text{O}$  or alcohol. (Jørgensen, J. pr. (2) 44. 63.)

**Roseorhodium nitrate chloroplatinate,**  
 $[\text{Rh}(\text{NH}_3)_4(\text{OH}_2)(\text{NO}_3)]_2\text{PtCl}_6 + 2\text{H}_2\text{O}$ .  
 Ppt. (Jørgensen.)

— **orthophosphate,**  
 $[\text{Rh}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{HPO}_4)_2 + 4\text{H}_2\text{O}$ .  
 Very sl. sol. in  $\text{H}_2\text{O}$ .

— **sodium pyrophosphate,**  
 $[\text{Rh}(\text{NH}_3)_4(\text{OH}_2)]_2\text{Na}_2\text{P}_2\text{O}_7 + 23\text{H}_2\text{O}$ .  
 Ppt. Very sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in very dil. acids.

— **sulphate,**  
 $[\text{Rh}(\text{NH}_3)_4(\text{OH}_2)]_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .  
 Very sl. sol. in cold, much more in hot  $\text{H}_2\text{O}$ .

— **sulphate chloroplatinate,**  
 $[\text{Rh}(\text{NH}_3)_4(\text{OH}_2)(\text{SO}_4)]_2\text{PtCl}_6$ .  
 Ppt. Nearly insol. in  $\text{H}_2\text{O}$  or alcohol.

**Roseotetramine cobaltic bromide,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2\text{Br}_2$ .  
 Sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HBr} + \text{Aq}$ . Nearly insol. in alcohol. (Jørgensen, Z. anorg. 2. 295.)

— **chloride,**  $\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2\text{Cl}_2$ .  
 Easily sol. in  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HCl} + \text{Aq}$ ; sol. in sat.  $\text{HgCl}_2 + \text{Aq}$ . (Jørgensen.)

— **cobalticyanide,**  
 $\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2\text{Co}(\text{CN})_6$ .  
 (Jørgensen.)

— **oxalate sulphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2]_2(\text{SO}_4)_2\text{C}_2\text{O}_4$ .  
 Ppt. (Jørgensen.)

— **pyrophosphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2]_2(\text{P}_2\text{O}_7)_2 + 6\text{H}_2\text{O}$ .  
 Nearly insol. in  $\text{H}_2\text{O}$ , but easily sol. in very dil. acids +  $\text{Aq}$ . (Jørgensen.)

— **sulphate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2]_2(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .  
 Sol. in about 35 pts.  $\text{H}_2\text{O}$ , and more easily by addition of dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Jørgensen.)

— **sulphate bromaurate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2]_2(\text{SO}_4)_2\text{AuBr}_4$ .  
 Sl. sol. in cold  $\text{H}_2\text{O}$ ; insol. in alcohol. (Jørgensen.)

— **sulphate chloroplatinate,**  
 $[\text{Co}(\text{NH}_3)_4(\text{OH}_2)_2]_2(\text{SO}_4)_2\text{PtCl}_6$ .  
 As the bromaurate. (Jørgensen.)

## Rubidium, $\text{Rb}_2$ .

Decomp.  $\text{H}_2\text{O}$  with violence. Insol. in hydrocarbons. Sol. in liquid  $\text{NH}_3$ . (Seely, C. N. 23. 169); (Franklin, Am. Ch. J. 1898, 20. 829).

## Rubidium acetylide acetylene $\text{RbC}_2$ , $\text{C}_2\text{H}_2$ .

Very hygroscopic.  
 Insol. in  $\text{CCl}_4$  and in ether. (Moissan, C. R. 1903, 136. 1220.)

## Rubidium amalgam, $\text{RbHg}_{12}$ .

Stable in contact with  $\text{Hg}$  below  $0^\circ$ . Above  $0^\circ$  the composition of the amalgam varies. Can be cryst. from  $\text{Hg}$  without decomp. below  $0^\circ$ . (Kerp, Z. anorg. 1900, 25. 68.)

## Rubidium amide, $\text{RbNH}_2$ .

Very deliquescent. Violently decomp. by  $\text{H}_2\text{O}$ ; less violently acted on by alcohol. (Titherley, Chem. Soc. 1897, 71. 470.)

## Rubidium ammonia, $\text{RbNH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .  
 Very sol. in liquid  $\text{NH}_3$ . (Moissan, C. R. 1903, 136. 1178.)

## Rubidium azoimide, $\text{RbN}_3$ .

Sl. hygroscopic.  
 Stable in aq. solution.  
 107.1 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ .  
 114.1 " " " " 100 "  $\text{H}_2\text{O}$  "  $17^\circ$ .  
 0.182 " " " " 100 " abs. alcohol at  $16^\circ$ .

Insol. in pure ether.  
 (Curtius, J. pr. 1898, (2) 58. 281.)

## Rubidium bromide, $\text{RbBr}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 98 pts. at  $5^\circ$ ; 104.8 pts. at  $16^\circ$ . (Reissig, A. 127. 33.)

Solubility in  $\text{H}_2\text{O}$ .

100 pts. of the solution contain at:

0.5°	5.0°	16.0°
47.26	49.50	51.17 pts. RbBr,
39.7°	57.5°	113.5°
56.87	60.39	67.24 pts. RbBr.

(Rimbach, B. 1905, 38. 1557.)

Sp. gr. of  $\text{RbBr}$  containing g. equiv.  $\text{RbBr}$  per l.

G. equiv. $\text{RbBr}$	Sp. gr. $6^\circ/6^\circ$	Sp. gr. $18^\circ/18^\circ$	Sp. gr. $30^\circ/30^\circ$
0.508	1.06448	1.06389	1.06326
1.020	1.12931	1.12799	1.12626
2.031	1.25622	1.25366	1.25187
4.072	1.50574	1.50107	1.49870

(Clausen, W. Ann. 1914, (4) 44. 1070.)



RbBr + Aq. containing 6.60% RbBr has sp. gr.  $20^{\circ}/20^{\circ} = 1.0525$ .

RbBr + Aq. containing 14.36% RbBr has sp. gr.  $20^{\circ}/20^{\circ} = 1.1226$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

#### Rubidium tribromide, RbBr<sub>3</sub>.

Very sol. in H<sub>2</sub>O; decomp. by alcohol and ether. (Wells and Wheeler, Sill. Am. J. 143. 475.)

#### Rubidium ruthenium bromide.

See Bromoruthenate and bromoruthenite, rubidium.

#### Rubidium selenium bromide.

See Bromoselenate, rubidium.

#### Rubidium tellurium bromide.

See Bromotellurate, rubidium.

#### Rubidium thallic bromide, RbBr, TlBr<sub>3</sub> + H<sub>2</sub>O.

Recryst. from H<sub>2</sub>O unchanged. (Pratt, Am. J. Sci. 1895, (3) 49. 403.)

3RbBr, TlBr<sub>3</sub> + H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Pratt.)

#### Rubidium stannic bromide.

See Bromostannate, rubidium.

#### Rubidium bromochloride, RbBrCl.

Easily decomp., even by H<sub>2</sub>O. (Wells and Wheeler.)

RbBrCl<sub>2</sub>. Sol. in H<sub>2</sub>O; decomp. by alcohol and ether. (Wells and Wheeler.)

#### Rubidium bromochloroiodide, RbBrClI.

Sol. in H<sub>2</sub>O and alcohol. Decomp. by ether. (Wells and Wheeler.)

#### Rubidium bromoiodide, RbBr<sub>2</sub>I.

Very sol. in H<sub>2</sub>O. Sat. solution contains about 44% RbBr<sub>2</sub>I, and sp. gr. = 3.84. (Wells and Wheeler.)

#### Rubidium carbide, Rb<sub>2</sub>C<sub>2</sub>.

Decomp. violently by H<sub>2</sub>O. (Moissan, C. R. 1903, 136. 1221.)

#### Rubidium chloride, RbCl.

100 pts. H<sub>2</sub>O dissolve 76.38 pts. at 1°; 82.89 pts. at 7°. (Bunsen.)

Solubility in H<sub>2</sub>O at t°.  
100 pts. of the solution contain pts. RbCl.

t°	Pts. RbCl
0.4	43.61
15.5	46.56
57.3	53.71
114.9	59.48

(Rimbach, B. 1902, 35. 1304.)

Solubility of RbCl in H<sub>2</sub>O at t°.

t°	G. RbCl per 100 g.		t°	G. RbCl per 100 g.	
	H <sub>2</sub> O	Solution		H <sub>2</sub> O	Solution
0	77.0	43.5	60	115.5	53.6
10	84.4	45.8	70	121.4	54.8
20	91.1	47.7	80	127.2	56.0
30	97.6	49.4	90	133.1	57.1
40	103.5	50.9	100	138.9	58.9
50	109.3	52.2	112.9	146.6	59.5

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203, A. 189.)

Sat. RbCl + Aq at 25° contains 48.57% RbCl. (Foote, Am. Ch. J. 1906, 35. 242.)

Sp. gr. of RbCl + Aq containing in 100 pts. H<sub>2</sub>O:

13.14    25.88    33.13 pts. RbCl.  
1.1066    1.2156    1.2675 sp. gr.

(Tammann, W. Ann. 24. 1885.)

A normal solution of RbCl has sp. gr. at 25° = 1.0610. (Wagner, Z. phys. Ch. 1890, 6. 39.)

RbCl + Aq containing 6.64% RbCl has sp. gr.  $20^{\circ}/20^{\circ} = 1.0502$ .

RbCl + Aq containing 10.59% RbCl has sp. gr.  $20^{\circ}/20^{\circ} = 1.0815$ . (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 278.)

Sp. gr.  $20^{\circ}/4^{\circ}$  of a normal solution of RbCl = 1.085405. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of RbCl + Aq sat. at t°.

t°	Sp. gr.	t°	Sp. gr.
0.55	1.4409	60.25	1.5558
18.7	1.4865	75.15	1.5746
31.5	1.5118	89.35	1.5905
44.7	1.5348	114*	1.6148

\* Boiling point.

(Berkeley.)

Sp. gr. of RbCl containing g. equiv. RbCl per l.

G. equiv. RbCl	Sp. gr. 6°/6°	Sp. gr. 15°/15°	Sp. gr. 30°/30°
0.5123	1.06410	1.04538	1.04503
1.001	1.08916	1.08810	1.08749
2.073	1.18200	1.17959	1.17828
3.984	1.34334	1.33967	1.33757

(Clausen, W. Ann. 1914, (4) 44. 1069.)

Very sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Solubility in alcohols at 25°.

100 g. methyl alcohol dissolve 1.41 g.

100 g. ethyl alcohol dissolve 0.078 g.

100 g. propyl alcohol dissolve 0.015 g.

100 g. isoamyl alcohol dissolve 0.0025 g.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Insol. in anhydrous pyridine and in 97% pyridine + Aq. Very sl. sol. in 95% pyridine + Aq; sl. sol. in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); acetone; (Naumann, B. 1904, 37. 4329); (Eidmann, C. C. 1899, II. 1014).

**Rubidium ruthenium trichloride.**

See Chlororuthenite, rubidium.

**Rubidium ruthenium tetrachloride.**

See Chlororuthenate, rubidium.

**Rubidium oxyruthenium chloride,**

$\text{Rb}_2\text{RuO}_4\text{Cl}_2$ .

Ppt.; decomp. by  $\text{H}_2\text{O}$ ; sol. in cold  $\text{HCl}$ . (Howe, J. Am. Chem. Soc. 1901, 23. 779.)

**Rubidium tellurium chloride.**

See Chlorotellurate, rubidium.

**Rubidium thallic chloride,  $2\text{RbCl}$ ,  $\text{TiCl}_3$  +  $\text{H}_2\text{O}$ .**

Can be recryst. from  $\text{H}_2\text{O}$  without change. (Pratt, Am. J. Sci. 1895, (3) 49. 399.)

$3\text{RbCl}$ ,  $\text{TiCl}_3$ . Crystallizes from  $\text{HCl}$  solution. (Neumann, A. 244. 348.)

+  $\text{H}_2\text{O}$ . Very sol. in cold  $\text{H}_2\text{O}$ . (Pratt, Am. J. Sci. 1895, (3) 49. 398.)

+  $2\text{H}_2\text{O}$ . Efflorescent in dry air. Sol. in 7.5 pts.  $\text{H}_2\text{O}$  at 18°, and 1.6 pts. at 100°. (Godefroy, Zeitschr. d. allgem. österr. Apothekerv. 1880. No. 9.)

**Rubidium stannic chloride.**

See Chlorostannate, rubidium.

**Rubidium titanium chloride,  $2\text{RbCl}$ ,  $\text{TiCl}_3$  +  $\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Stähler, B. 1904, 37. 4408.)

**Rubidium tungsten chloride,  $\text{Rb}_2\text{W}_2\text{Cl}_6$ .**

Sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ .

Sol. in very dil.  $\text{NaOH}$  + Aq.

Nearly insol. in most organic solvents. (Olsson, B. 1913, 46. 574.)

**Rubidium uranous chloride,  $\text{Rb}_2\text{UCl}_4$ .**

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

**Rubidium uranyl chloride,  $2\text{RbCl}$ ,  $(\text{UO}_2)_2\text{Cl}_2$  +  $2\text{H}_2\text{O}$ .**

Solubility in  $\text{H}_2\text{O}$ .

100 pts. of the solution contain at:

24.8° 80.3°

57.8 65.73 pts.  $\text{UO}_2\text{Cl}_2$ ,  $2\text{RbCl}$ .

(Rimbach, B. 1904, 37. 467.)

**Rubidium vanadium chloride,  $\text{Rb}_2\text{VCl}_4$  +  $\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. by  $\text{H}_2\text{O}$  on standing so that it dissolves. (Stähler, B. 1904, 37. 4411.)

**Rubidium zinc chloride,  $2\text{RbCl}$ ,  $\text{ZnCl}_2$ .**

Easily sol. in  $\text{H}_2\text{O}$  and  $\text{HCl}$  + Aq. (Godefroy, B. 8. 9.)

**Rubidium chloride selenium dioxide,  $\text{RbCl}$ ,  $2\text{SeO}_2$  +  $2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Muthmann, B. 1893, 26. 1013.)

**Rubidium chloriodide,  $\text{RbCl}_2\text{I}$ .**

Properties are similar to those of  $\text{RbBrClI}$ . (Wells.)

$\text{RbCl}_2\text{I}$ . Sol. in alcohol, not attacked by ether. (Wells and Wheeler, Sill. Am. J. 144. 42.)

Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)

Nearly insol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Very stable; sl. sol. in  $\text{H}_2\text{O}$  at 0°; only very sl. sol. in  $\text{HCl}$ . (Erdmann, Arch. Pharm. 1894, 232. 32.) (C. C. 1894, I. 670.)

**Rubidium fluoride,  $\text{RbF}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Eggeling, Z. anorg. 1905, 46. 174.)

100 g.  $\text{H}_2\text{O}$  dissolve 130.6 g.  $\text{RbF}$  at 18°. (de Forcrand, C. R. 1911, 152. 1210.)

Sol. in dil.  $\text{HF}$ . (Pennington, J. Am. Chem. Soc. 1898, 18. 57.)

Insol. in liquid  $\text{NH}_3$ . (Core, Am. Ch. J. 1898, 20. 829.)

**Rubidium hydrogen fluoride,  $\text{RbF}$ ,  $\text{HF}$ .**

Very deliquescent.

Insol. in alcohol and ether. (Chabrie, C. R. 1905, 140. 91.)

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$ . (Eggeling, Z. anorg. 1905, 46. 175.)

$\text{RbF}$ ,  $2\text{HF}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . (Eggeling, Z. anorg. 1905, 46. 176.)

**Rubidium silicon fluoride.**

See Fluosilicate, rubidium.

**Rubidium tantalum fluoride.**

See Fluotantalate, rubidium.

**Rubidium uranyl fluoride,  $4\text{RbF}$ ,  $\text{UO}_2\text{F}_2$  +  $6\text{H}_2\text{O}$ .**

(Ditte, C. R. 91. 115.)

**Rubidium hydride, RbH.**

Decomp. by  $H_2O$  with evolution of  $H_2$ . (Moissan, C. R. 1903, 136. 589.)

**Rubidium hydroxide, RbOH.**

Deliquescent, and very sol. in  $H_2O$ . Sol. in alcohol. (Bunsen.)

Sat. RbOH + Aq contains 64.17% RbOH at 15°. (de Forcrand, C. R. 1909, 149. 1344.)

**Rubidium iodide, RbI.**

100 pts.  $H_2O$  dissolve 137.5 pts. at 6.9°; 152 pts. at 17.4°. (Reissig, A. 127. 33.)

Sat. RbI + Aq. at 25° contains 61.93% RbI. (Foote and Chalker, Am. Ch. J. 1908, 39. 567.)

Sp. gr. of RbI + Aq containing:

5%	10%	cold sat.	hot sat.
Sp. gr. 1.0353	1.0755	1.726	1.9629.

(Erdmann, Aroh. Pharm. 1894, 232. 25.)

Sp. gr. of RbI + Aq containing g. equiv. RbI per l.

G. equiv. RbI	Sp. gr. 6°/6°	Sp. gr. 18°/18°	Sp. gr. 30°/30°
0.510	1.08347	1.08268	1.08226
1.025	1.16751	1.16569	1.16433
2.025	1.33012	1.32637	1.32531
4.015	1.64781	1.64144	1.63780

(Clausen, W. Ann. 1914, (4) 44. 1070.)

Nearly insol. in  $AsBr_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Sol. in  $AsCl_3$ . (Walden, Z. anorg. 1900, 25. 214); liquid  $SO_2$ . (Walden, Z. anorg. 1902, 30. 161);  $S_2Cl_2$ . (Walden, Z. anorg. 1900, 25. 217);  $SO_2Cl_2$ . (Walden);  $POCl_3$ . (Walden.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Solubility in organic solvents at t°.

C = pts. by wt. of RbI in 100 ccm. of the sat. solution.

L = no. of litres which at the saturation temp. hold in solution 1 mol. RbI.

Solvent	t°	C	L
Furfuroil	25°	4.93	4.31
Acetonitrile	25°	1.350	15.73
"	0°	1.478	14.36
Propionitrile	25°	0.305	69.61
"	0°	0.274	77.48
Nitromethane	25°	0.518	41.00
"	0°	0.567	37.44
Acetone	25°	0.674	31.5
"	0°	0.960	22.1

(Walden, Z. phys. Ch. 1906, 55. 718.)

**Rubidium triiodide, RbI<sub>3</sub>.**

Very sol. in  $H_2O$ . Sol. in about  $\frac{1}{2}$  pt.  $H_2O$  at 20°; sol. in alcohol. Decomp. by ether. (Wells and Wheller, Sill. Am. J. 143. 475.)

Solubility determinations show that RbI<sub>3</sub> is the only polyiodide of rubidium formed at 25°. RbI<sub>7</sub> and RbI<sub>8</sub>, mentioned by Abegg and Hamburger, (Z. anorg. 50, 403) could not be obtained. (Foote and Chalker, Am. Ch. J. 1908, 39. 567.)

**Rubidium silver iodide, 2RbI, AgI.**

Easily decomp. by  $H_2O$ . (Wells and Wheeler, Sill. Am. J. 144. 155.)

RbI, AgI +  $\frac{1}{2}H_2O$ . (Marsh, Chem. Soc. 1913, 103. 783.)

RbI, 2AgI. Not deliquescent.

Very sol. in acetone. (Marsh, Chem. Soc. 1913, 103. 783.)

**Rubidium tellurium iodide.**

See Iodotellurate, rubidium.

**Rubidium thallic iodide, RbI, TI<sub>3</sub> + 2H<sub>2</sub>O.**

Decomp. by  $H_2O$ . (Pratt, Am. J. Sci. 1895, (3) 49. 403.)

**Rubidium nitride,**

Decomp. by heat. (Franz Fischer, B. 1910, 43. 1468.)

See also Rubidium azoimide.

**Rubidium dioxide, RbO<sub>2</sub>.**

Decomp. by  $H_2O$ . (Erdmann, A. 1897, 294. 68.)

**Rubidium sulphide, Rb<sub>2</sub>S + 4H<sub>2</sub>O.**

Deliquescent; very sol. in  $H_2O$ . (Biltz, Z. anorg. 1906, 48. 299.)

**Rubidium disulphide, Rb<sub>2</sub>S<sub>2</sub>.**

Anhydrous.

Sol. in  $H_2O$ .

Very hygroscopic. (Biltz, Z. anorg. 1906, 50. 72.)

+  $H_2O$ . From Rb<sub>2</sub>S<sub>2</sub> + Aq.

Hygroscopic. (Biltz.)

**Rubidium trisulphide, Rb<sub>2</sub>S<sub>3</sub>.**

Anhydrous.

Sol. in  $H_2O$ .

Hydroscopic. (Biltz, Z. anorg. 1906, 50. 75.)

+  $H_2O$ . From Rb<sub>2</sub>S<sub>3</sub> + Aq. (Biltz.)

**Rubidium tetrasulphide Rb<sub>2</sub>S<sub>4</sub> + 2H<sub>2</sub>O.**

Sol. in  $H_2O$ . (Biltz, Z. anorg. 1906, 48. 304.)

**Rubidium pentasulphide, Rb<sub>2</sub>S<sub>5</sub>.**

Deliquescent. Decomp. by  $H_2O$ .

Very easily sol. in 70% alcohol.

Insol. in ether, ethyl sulphide or  $CHCl_3$ . (Biltz, B. 1905, 38. 127.)

**Rubidium hydrogen sulphide, RbHS.**

Deliquescent, very sol. in  $H_2O$ . (Biltz, Z. anorg. 1906, 43. 300.)

**Rubidium copper tetrasulphide, RbCuS<sub>4</sub>.**

Decomp. very slowly in the air.

Sl. sol. in  $H_2O$ .

Very slowly decomp. by cold conc., more rapidly by hot conc., and still more rapidly by dil. HCl,  $H_2SO_4$  and  $HNO_3$ . Sl. sol. in alcohol. (Biltz, B. 1907, 40. 978.)

**Ruthenic acid.****Barium ruthenate, BaRuO<sub>4</sub> + H<sub>2</sub>O.**

Ppt. (Debray and Joly, C. R. 106. 1494.)

**Calcium ruthenate, CaRuO<sub>4</sub>.**

Ppt.

**Magnesium ruthenate, MgRuO<sub>4</sub>.**

Ppt.

**Potassium ruthenate, K<sub>2</sub>RuO<sub>4</sub> + H<sub>2</sub>O.**

Very sol. in  $H_2O$ .

**Perruthenic acid.****Potassium perruthenate, KRuO<sub>4</sub>.**

Sl. sol. in  $H_2O$ . (Debray and Joly, C. R. 106. 1494.)

**Sodium perruthenate, NaRuO<sub>4</sub> + H<sub>2</sub>O.**

Sl. sol. in  $H_2O$ .

**Ruthenium, Ru.**

Not attacked by acids, except aqua regia, which dissolves it only very slightly. (Claus, Pogg. 65. 218.)

**Ruthenium ammonium comps.**

See Ruthenodiamine comps., etc.

**Ruthenium tribromide, RuBr<sub>3</sub>.**

Sol. in  $H_2O$ . Solution decomposes slowly on standing, but rapidly on heating. (Gutbier, Z. anorg. 1905, 45. 178.)

**Ruthenium tribromide, ammonia, 2RuBr<sub>3</sub>, 7NH<sub>3</sub>.**

Sol. in  $H_2O$  and ammonia with slight warming.

Insol. in alcohol. (Gutbier, Z. anorg. 1905, 45. 182.)

**Ruthenium dichloride, RuCl<sub>2</sub>.**

Insol. in acids, even in aqua regia. Sl. attacked by acids. Traces are dissolved by boiling with conc. KOH + Aq.

+ 2H<sub>2</sub>O. Known only in aqueous solution. (Claus, A. 59. 238.)

**Ruthenium trichloride, RuCl<sub>3</sub>.**

Deliquescent. Sol. in  $H_2O$  and alcohol, but solution is decomp. by heating into Ru<sub>2</sub>O<sub>3</sub> and HCl. (Claus.)

Pure RuCl<sub>3</sub> is insol. in cold  $H_2O$ , mineral, or organic acids. Slowly decomp. by boiling  $H_2O$ . Insol. in CCl<sub>4</sub>, CS<sub>2</sub>, CHCl<sub>3</sub>, PCl<sub>5</sub>, or ether. Slowly sol. in hot absolute alcohol, but decomp. into Ru(OH)Cl<sub>2</sub> by 95% alcohol. (Joly, C. R. 114. 292.)

Hydroscopic.

Sol. in  $H_2O$ ; decomp. at 50°.

Sol. in alcohol. (Gutbier, Z. anorg. 1905, 45. 174.)

See also Ruthenium nitrosochloride.

**Ruthenium tetrachloride, RuCl<sub>4</sub>.**

Sol. in  $H_2O$  and alcohol. (Claus.)

**Ruthenium trichloride with MCl.**

See Chlororuthenite, M.

**Ruthenium tetrachloride with MCl.**

See Chlororuthenate, M.

**Ruthenium sesquihydroxide, Ru<sub>2</sub>O<sub>3</sub>H<sub>3</sub>.**

Sol. in acids; insol. in alkalis. Less sol. in NH<sub>4</sub>OH + Aq than any other oxide of the Pt metals. (Claus.)

**Ruthenium dihydroxide, RuO<sub>4</sub>H<sub>2</sub> + 3H<sub>2</sub>O.**

Sol. in acids and alkalis. (Claus, A. 59. 237.)

Contains NO. Joly, C. R. 107. 994.)

**Ruthenium triiodide, RuI<sub>3</sub>.**

Ppt. (Claus.)

Insol. in  $H_2O$ , KI + Aq, and alcohol. (Gutbier, Z. anorg. 1905, 45. 181.)

**Ruthenium triiodide ammonia, 2RuI<sub>3</sub>, 7NH<sub>3</sub>.**

Sol. in  $H_2O$  and ammonia with slight warming.

Insol. in alcohol. (Gutbier, Z. anorg. 1905, 45. 182.)

**Ruthenium nitrosochloride, RuCl<sub>2</sub>(NO) + H<sub>2</sub>O, and 5H<sub>2</sub>O.**

Slowly sol. in cold, easily in hot  $H_2O$ . (Joly, C. R. 108. 855.)

**Ruthenium dihydronitrosochloride, NO.Ru<sub>2</sub>H<sub>2</sub>Cl<sub>2</sub>, 2HCl.**

Sol. in  $H_2O$ . (Brizard, A. ch. 1900, (7) 21. 353.)

**Ruthenium silver nitrosochloride, NO.Ru<sub>2</sub>H<sub>2</sub>Cl<sub>2</sub>, 2HCl, 3AgCl.**

Ppt. (Brizard, A. ch. 1900, (7) 21, 357.)

**Ruthenium nitrososesquioxide, Ru<sub>2</sub>O<sub>3</sub>(NO)<sub>2</sub> + 2H<sub>2</sub>O.**

Ppt. (Joly, C. R. 108. 854.)

**Ruthenium dihydronitrosohydroxide,**  
 $\text{NO} \cdot \text{Ru}_2\text{H}_2(\text{OH})_2 + 2\text{H}_2\text{O}.$

Sl. sol. in cold  $\text{H}_2\text{O}$  with decomp. (Brisard, A. ch. 1900, (7) 21. 349.)

**Ruthenium dihydronitrosooxychloride,**  
 $\text{NO} \cdot \text{Ru}_2\text{H}_2\text{Cl}_2\text{OH} + 2\text{H}_2\text{O}.$

Ppt. (Brisard, A. ch. 1900, (7) 21. 349.)

**Ruthenium monoxide,  $\text{RuO}$ .**

Insol. in acids. (Claus, A. 59. 236.)

**Ruthenium sesquioxide,  $\text{Ru}_2\text{O}_3$ .**

Insol. in acids. Mixture of  $\text{Ru}$  and  $\text{RuO}_2$ . (Debray and Joly, C. R. 106. 1494.)

See Ruthenium nitrososesequioxide.

**Ruthenium dioxide,  $\text{RuO}_2$ .**

Insol. in acids. (Debray and Joly.)

**Ruthenium trioxide,  $\text{RuO}_3$ .**

"Ruthenic acid." Known only in its salts.

**Ruthenium tetroxide,  $\text{RuO}_4$ .**

Rather difficultly and slowly sol. in  $\text{H}_2\text{O}$ . (Claus.)

Decomp. in aqueous solution into  $\text{Ru}_2\text{O}_3 + 2\text{H}_2\text{O}$ . (Debray and Joly.)

**Ruthenium pentoxide,  $\text{Ru}_2\text{O}_5$ .**

(Debray and Joly, C. R. 106. 1494.)

+  $2\text{H}_2\text{O}$ . Ppt. (Debray and Joly.)

**Ruthenium heptoxide,  $\text{Ru}_2\text{O}_7$ .**

"Perruthenic acid." Known only in its salts.

**Ruthenium oxide,  $\text{Ru}_4\text{O}_9$ .**

(Debray and Joly.)

**Ruthenium oxychloride,  $\text{Ru}(\text{OH})\text{Cl}_2$ .**

Very sol. in  $\text{H}_2\text{O}$ , but decomp. by an excess. (Joly, C. R. 114. 293.)

**Ruthenium silicide,  $\text{RuSi}$ .**

Insol. in boiling acids; slowly attacked by a mixture of fused  $\text{KHSO}_4$  and  $\text{KNO}_3$ . (Moissan, C. R. 1903, 137. 231.)

**Ruthenium trisulphide,  $\text{RuS}_3$ .**

Ppt. (Antony, Gazz. ch. it. 1900, 30. 539.)

**Ruthenomonamine hydroxide,**

$\text{Ru}(\text{OH})_2(\text{NH}_3)_2 + 4\text{H}_2\text{O}.$

See Ruthenosamine hydroxide.

**Ruthenodiamine carbonate,**

$\text{Ru}(\text{N}_2\text{H}_4)_2\text{CO}_3 + 5\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)

**Ruthenodiamine chloride,**

$\text{Ru}(\text{N}_2\text{H}_4\text{Cl})_2 + 3\text{H}_2\text{O}.$

Not very sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . Insol. in alcohol.

See Ruthenonitrosodiamine comps.

— mercuric chloride,  $\text{Ru}(\text{N}_2\text{H}_4\text{Cl})_2, \text{HgCl}_2$ .

Nearly insol. in cold, sol. in hot  $\text{H}_2\text{O}$ . (Gibbs, Sill. Am. J. (2) 34, 350.)

— chloroplatinate,  $\text{Ru}(\text{N}_2\text{H}_4\text{Cl})_2, \text{PtCl}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Claus.)

— hydroxide,  $\text{Ru}(\text{N}_2\text{H}_4\text{OH})_2$ .

Known only in aqueous solution.

— nitrate,  $\text{Ru}(\text{N}_2\text{H}_4\text{NO}_2)_2 + 2\text{H}_2\text{O}.$

Somewhat difficultly sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol.

— sulphate,  $\text{Ru}(\text{N}_2\text{H}_4)_2\text{SO}_4 + 4\text{H}_2\text{O}.$

Moderately sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)

**Ruthenocyanhydric acid,  $\text{H}_2\text{Ru}(\text{CN})_6$ .**

Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Less sol. in ether. (Claus, J. B. 1855. 444.)

**Potassium ruthenocyanide,  $\text{K}_2\text{Ru}(\text{CN})_6 + 3\text{H}_2\text{O}.$**

Sl. efflorescent. Very sol. in  $\text{H}_2\text{O}$ ; al. sol. in dil. alcohol. (Claus.)

**Ruthenonitrosodiamine bromide,**

$\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Br}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_2\text{Br}_2$ . Less sol. than corresponding chloride. (Joly, C. R. 106. 300.)

— chloride,  $\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Cl}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_2\text{Cl}_2$ . Sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 106. 1300.)

$\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Cl}_2 + 2\text{H}_2\text{O} = \text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2\text{Cl}_2, \text{HCl} + \text{H}_2\text{O}$  (?). Very sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.)

— chloroplatinate,

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_2\text{PtCl}_4$ .

Scarcely sol. in boiling  $\text{H}_2\text{O}$ . (Joly, C. R. 106. 1300.)

$\text{Ru}(\text{NO})(\text{NH}_3)_2\text{Cl}_2, \text{PtCl}_4$ . Ppt. (Joly, C. R. 111. 969.)

— iodide,  $\text{Ru}(\text{NO})(\text{NH}_3)_2\text{I}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.)

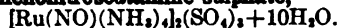
$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_2\text{I}_2$ . Less sol. than the corresponding bromide. (Joly, C. R. 106. 1300.)

— nitrate,  $\text{Ru}(\text{NO})(\text{NH}_3)_2(\text{NO}_2)_2$ .

More sol. in  $\text{H}_2\text{O}$  than  $\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_2(\text{NO}_2)_2$ . (Joly, C. R. 111. 969.)

$\text{Ru}(\text{NO})\text{OH}(\text{NH}_3)_4(\text{NO}_3)_2$ . Sl. sol. in cold  $\text{H}_2\text{O}$ ; insol. in conc.  $\text{HNO}_3$  + Aq. (Joly, C. R. 108. 1300.)

**Ruthenonitrosodiamine sulphate,**



Sl. sol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 111. 969.)

$[\text{Ru}(\text{NO})(\text{NH}_3)_4]_2(\text{SO}_4)_3 \cdot \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Joly.)

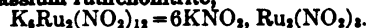
$\text{Ru}(\text{NO})(\text{OH})(\text{NH}_3)_4\text{SO}_4 + \text{H}_2\text{O}$ . Most sol. in  $\text{H}_2\text{O}$  of this class of salts. (Joly, C. R. 108. 1300.)

**Ruthenonitrous acid.**

**Ammonium ruthenonitrite,**  $\text{RuH}_2(\text{NO}_2)_4 \cdot 3\text{NH}_4\text{NO}_3 + 2\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ ; practically insol. in  $\text{KCl}$  + Aq. (Brizard, A. ch. 1900, (7) 21. 368.)

**Potassium ruthenonitrite,**



Easily sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Gibbs, Sill. Am. J. (2), 34. 344.)

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{KNO}_3$  + Aq. (Claus.)



Very sol. in  $\text{H}_2\text{O}$ . (Joly and Vèzes, C. R. 109. 667.)

$\text{K}_8\text{Ru}_2(\text{NO}_2)_{14} = \text{Ru}_2\text{O}_3(\text{N}_2\text{O}_5)_3, 8\text{KNO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in cold dil. acids. (Joly and Vèzes.)

$\text{Ru}_2\text{H}_2(\text{NO}_2)_4, 3\text{KNO}_3 + 4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. al. on long boiling. Almost insol. in conc.  $\text{KCl}$  + Aq. (Brizard, C. R. 1899, 129. 216.)

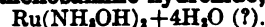
**Silver ruthenonitrite,**  $\text{NO} \cdot \text{Ru}_2\text{H}_2(\text{NO}_2)_4, 3\text{AgNO}_2 + 2\text{H}_2\text{O}$ .

Ppt. (Brizard, A. ch. 1900, (7) 21. 368.)

**Sodium ruthenonitrite,**  $\text{Ru}_2(\text{NO}_2)_4, 4\text{NaNO}_2 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  without decomp. (Joly, C. R. 1894, 118. 469.)

**Ruthenosamine hydroxide,**



Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Claus.)

**Samarium, Sm.**

The element has not been isolated.

**Samarium bromide,**  $\text{SmBr}_3 + 6\text{H}_2\text{O}$ .

Very deliquescent. (Cleve.)

**Samarium carbide,**  $\text{SmC}_2$ .

Decomp. by water and acids. (Moissan, C. R. 1900, 131. 925.)

**Samarium dichloride,**  $\text{SmCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$  with liberation of  $\text{H}_2$  and formation of samarium oxide and samarium oxychloride. Insol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , benzene, abs. alcohol, pyridine and toluene. (Matignon, C. R. 1906, 142. 85.)

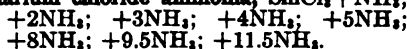
**Samarium trichloride,**  $\text{SmCl}_3$ .

The anhydrous salt is very hygroscopic and easily sol. in  $\text{H}_2\text{O}$ . (Matignon, C. R. 1902, 134. 1309.)

Very sol. in  $\text{H}_2\text{O}$ . Very sol. in abs. alcohol. 6.38 g. are sol. in 100 grams pyridine at ord. temp.; insol. in quinoline. (Matignon, A. ch. 1906, (8) 8. 406.)

+  $3\text{H}_2\text{O}$ . Deliquescent.

**Samarium chloride ammonia,**  $\text{SmCl}_3 + \text{NH}_3$ ;



(Matignon, C. R. 1905, 140. 143.)

**Samarium fluoride,**  $\text{SmF}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$  and dil. acids. (Cleve.)

**Samarium iodide,**  $\text{SmI}_3$ .

(Matignon, A. ch. 1906, (8) 8. 413.)

**Samarium hydroxide,**  $\text{Sm}_2(\text{OH})_6$ .

Insol. in alkalis; easily sol. in acids, and decomposes ammonium salts. (Cleve, C. N. 51. 145.)

**Samarium oxide,**  $\text{Sm}_2\text{O}_3$ .

Easily sol. in acids. (Cleve, C. N. 51. 145.)

**Samarium peroxide,**  $\text{Sm}_2\text{O}_5$ .

Precipitate. (Cleve.)

**Samarium oxychloride,**  $\text{SmOCl}$ .

(Matignon, A. ch. 1906, (8) 8. 412.)

**Samarium sulphide,**  $\text{Sm}_2\text{S}_3$ .

(Matignon, A. ch. 1906, (8) 8. 415.)

**Scandium, Sc.**

Element has not been isolated.

**Scandium bromide,**  $\text{Sc}_2\text{Br}_6 + 3\text{H}_2\text{O}$ , and +  $12\text{H}_2\text{O}$ .

(Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

**Scandium chloride,**  $\text{Sc}_2\text{Cl}_6 + 3\text{H}_2\text{O}$ , and +  $12\text{H}_2\text{O}$ .

(Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

**Scandium hydroxide.**

Easily sol. in conc.  $\text{HNO}_3$  or  $\text{HCl}$  + Aq. (Crookes, Roy. Soc. Proc. 1908, 80. A, 518.)

**Scandium oxide,  $\text{Sc}_2\text{O}_3$ .**

Easily sol. by boiling with conc.  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq.}$

**Scandium sulphide,  $\text{Sc}_2\text{S}_3$ .**

Decomp. by  $\text{H}_2\text{O}$  and by acids with evolution of  $\text{H}_2\text{S}$ . (Wirth, Z. anorg. 1914, 87. 5.)

**Selenantimonic acid.****Sodium selenantimonate,  $\text{Na}_3\text{SbSe}_4 + 9\text{H}_2\text{O}$ .**

Sol. in 2 pts. cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Hofacker, A. 107. 6.)

Sl. sol. in  $\text{H}_2\text{O}$ ; unstable. (Pouget, A. ch. 1899, (7) 18. 562.)

**Selenantimonous acid.****Potassium orthoselenantimonite,  $\text{K}_2\text{SbSe}_3$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 560.)

**Potassium paraselenantimonite,  $\text{K}_2\text{Sb}_2\text{Se}_7 + 3\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; unstable. (Pouget, A. ch. 1899, (7) 18. 560.)

**Sodium orthoselenantimonite,  $\text{Na}_3\text{SbSe}_3 + 9\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . Aqueous solution on standing deposits red crystals of sodium selenantimonate,  $\text{Na}_3\text{SbSe}_4 + 9\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 562.)

**Sodium paraselenantimonite,  $\text{Na}_2\text{Sb}_2\text{Se}_7$ .**

(Pouget, A. ch. 1899, (7) 18. 561.)

**Selenic acid,  $\text{H}_2\text{SeO}_4$ .**

Very sol. in  $\text{H}_2\text{O}$  with evolution of heat.

If aqueous solution is evaporated at temp. of  $165^\circ$ , acid has 2.524 sp. gr.; at temp. of  $267^\circ$ , acid has 2.60 sp. gr.; at temp. of  $285^\circ$ , acid has 2.625 sp. gr. Decomp. to  $\text{H}_2\text{SeO}_3$  at higher temp. (Mitscherlich, Pogg. 9. 623.)

By evaporation at  $265^\circ$ , acid of 2.609 sp. gr. containing 95%  $\text{H}_2\text{SeO}_4$  is obtained. If brought at same temp. in vacuo over  $\text{H}_2\text{SO}_4$ , acid of 2.627 sp. gr. with 97.5%  $\text{H}_2\text{SeO}_4$  is obtained. (Fabian, A. Suppl. 1. 243.)

**Sp. gr. of  $\text{H}_2\text{SeO}_4 + \text{Aq.}$** 

% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.
99.73	2.6083	90.0	2.3848
99.50	2.6051	89.0	2.3568
99.00	2.6975	88.0	2.3291
98.5	2.5863	87.0	2.3061
98.0	2.5767	86.0	2.2795
97.5	2.5695	85.0	2.5558
97.0	2.5601	84.0	2.2258
96.0	2.5388	83.0	2.1946
95.0	2.5163	82.0	2.1757
94.0	2.4925	81.0	2.1479
93.0	2.4596	80.0	2.1216
92.0	2.4322	79.0	2.0922
91.0	2.4081	73.50	1.9675

Sp. gr. of  $\text{H}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$ .

Wts. corrected to vacuum.

Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$
1.000	...	1.295	32.64	1.590	54.62
1.005	0.9	1.300	33.08	1.595	54.92
1.010	1.56	1.305	33.50	1.600	55.28
1.015	2.12	1.310	33.92	1.605	55.62
1.020	2.92	1.315	34.36	1.610	55.96
1.025	3.62	1.320	34.82	1.615	56.30
1.030	4.16	1.325	35.26	1.620	56.60
1.035	4.70	1.330	35.72	1.625	56.88
1.040	5.32	1.335	36.10	1.630	57.20
1.045	6.08	1.340	36.43	1.635	57.48
1.050	6.66	1.345	36.88	1.640	57.70
1.055	7.34	1.350	37.34	1.645	58.04
1.060	7.92	1.355	37.80	1.650	58.47
1.065	8.56	1.360	38.24	1.655	58.86
1.070	9.20	1.365	38.66	1.660	59.24
1.075	9.82	1.370	39.10	1.665	59.56
1.080	10.44	1.375	39.50	1.670	59.74
1.085	11.02	1.380	39.98	1.675	59.94
1.090	11.62	1.385	40.06	1.680	60.18
1.095	12.20	1.390	40.66	1.685	60.36
1.100	12.88	1.395	41.10	1.690	60.58
1.105	13.58	1.400	41.56	1.695	60.80
1.110	14.14	1.405	41.98	1.700	61.06
1.115	14.66	1.410	42.36	1.705	61.36
1.120	15.20	1.415	42.78	1.710	61.64
1.125	15.74	1.420	43.16	1.715	61.90
1.130	16.32	1.425	43.56	1.720	62.24
1.135	16.86	1.430	43.94	1.725	62.48
1.140	17.38	1.435	44.32	1.730	62.76
1.145	17.90	1.440	44.52	1.735	63.06
1.150	18.44	1.445	45.00	1.740	63.32
1.155	18.92	1.450	45.32	1.745	63.60
1.160	19.48	1.455	45.68	1.750	63.86
1.165	20.02	1.460	46.04	1.755	64.04
1.170	20.58	1.465	46.36	1.760	64.24
1.175	21.08	1.470	46.70	1.765	64.42
1.180	21.60	1.475	47.01	1.770	64.62
1.185	22.22	1.480	47.32	1.775	64.84
1.190	22.66	1.485	47.66	1.780	65.06
1.195	23.18	1.490	47.98	1.785	65.28
1.200	23.70	1.495	48.28	1.790	65.48
1.205	24.26	1.500	48.54	1.795	65.66
1.210	24.84	1.505	48.92	1.800	65.90
1.215	25.30	1.510	49.30	1.805	66.12
1.220	25.84	1.515	49.68	1.810	66.36
1.225	26.30	1.520	50.02	1.815	66.64
1.230	26.84	1.525	50.34	1.820	66.90
1.235	27.28	1.530	50.68	1.825	67.16
1.240	27.70	1.535	51.04	1.830	67.46
1.245	28.18	1.540	51.38	1.835	67.72
1.250	28.58	1.545	51.66	1.840	68.02
1.255	29.06	1.550	51.98	1.845	68.30
1.260	29.44	1.555	52.28	1.850	68.50
1.265	29.82	1.560	52.56	1.855	68.70
1.270	30.26	1.565	52.88	1.860	68.92
1.275	30.76	1.570	53.28	1.865	69.12
1.280	31.26	1.575	53.56	1.870	69.34
1.285	31.74	1.580	53.94	1.875	69.56
1.290	32.18	1.585	54.30	1.880	69.72

(Cameron and Macallan, Lond. R. Soc. Proc.

Sp. gr. of  $\text{H}_2\text{SeO}_4 + \text{Aq}$ —*Concluded.*

Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$	Sp. gr.	% $\text{H}_2\text{SeO}_4$
1.885	69.94	2.125	80.25	2.365	89.14
1.890	70.14	2.130	80.42	2.370	89.30
1.895	70.38	2.135	80.68	2.375	89.48
1.900	70.64	2.140	80.74	2.380	89.60
1.905	70.78	2.145	80.96	2.385	89.72
1.910	71.00	2.150	81.14	2.390	89.84
1.915	71.21	2.155	81.36	2.395	89.96
1.920	71.38	2.160	81.60	2.400	90.10
1.925	71.68	2.165	81.80	2.405	90.20
1.930	72.00	2.170	82.02	2.410	90.30
1.935	72.38	2.175	82.22	2.415	90.46
1.940	72.66	2.180	82.44	2.420	90.74
1.945	72.88	2.185	82.64	2.425	91.00
1.950	73.12	2.190	82.78	2.430	91.24
1.955	73.34	2.195	82.96	2.435	91.46
1.960	73.54	2.200	83.10	2.440	91.70
1.965	73.74	2.205	83.24	2.445	92.00
1.970	73.98	2.210	83.44	2.450	92.28
1.975	74.22	2.215	83.62	2.455	92.56
1.980	74.44	2.220	83.78	2.460	92.85
1.985	74.66	2.225	83.96	2.465	93.02
1.990	74.86	2.230	84.14	2.470	93.20
1.995	75.08	2.235	84.30	2.475	93.36
2.000	75.28	2.240	84.48	2.480	93.68
2.005	75.46	2.245	84.60	2.485	94.02
2.010	75.66	2.250	84.82	2.490	94.32
2.015	75.88	2.255	85.02	2.495	94.48
2.020	76.06	2.260	85.26	2.500	94.64
2.025	76.14	2.265	85.44	2.505	94.80
2.030	76.48	2.270	85.60	2.510	94.96
2.035	76.68	2.275	85.78	2.515	95.32
2.040	76.84	2.280	85.96	2.520	95.58
2.045	77.08	2.285	86.16	2.525	95.86
2.050	77.36	2.290	86.38	2.530	96.10
2.055	77.50	2.295	86.60	2.535	96.41
2.060	77.62	2.300	86.82	2.540	96.68
2.065	77.80	2.305	87.04	2.545	96.92
2.070	78.06	2.310	87.26	2.550	97.12
2.075	78.24	2.315	87.46	2.555	97.30
2.080	78.48	2.320	87.66	2.560	97.48
2.085	78.68	2.325	87.84	2.565	97.68
2.090	78.84	2.330	88.00	2.570	97.94
2.095	79.08	2.335	88.18	2.575	98.20
2.100	79.28	2.340	88.34	2.580	98.46
2.105	79.50	2.345	88.48	2.585	98.70
2.110	79.68	2.350	88.66	2.590	99.04
2.115	79.90	2.355	88.82	2.595	99.36
2.120	80.10	2.360	88.98	...	...

(Diemer and Lenher. J. phys. Chem. 1909, 13. 509.)

Sol. in conc. or fuming  $\text{H}_2\text{SO}_4$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Decomp. by alcohol.

+ $\text{H}_2\text{O}$ . (Cameron and Macallan, C. N. 59. 232.)

+ $2\text{H}_2\text{O}$ , and + $6\text{H}_2\text{O}$  (?). (C. and M.)

+ $4\text{H}_2\text{O}$ . (Kremann and Hofmeier, M. 1908, 29. 1117.)

## Selenates.

All the neutral and acid salts of  $\text{H}_2\text{SeO}_4$  are sol. in  $\text{H}_2\text{O}$ , except  $\text{BaSeO}_4$ ,  $\text{SrSeO}_4$ ,  $\text{CaSeO}_4$ , and  $\text{PbSeO}_4$ , which are nearly or quite insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ .

**Aluminum selenate,  $\text{Al}_2(\text{SeO}_4)_3$ .**

Resembles in every way aluminum sulphate. (Berzelius.)

**Aluminum ammonium selenate,**

$\text{Al}_2(\text{NH}_4)_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (Wohlwill, A. 114. 191.)

**Aluminum caesium selenate,  $\text{Al}_2\text{Cs}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .**

(Peterson, B. 9. 1563.)

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (Fabre, C. R. 105. 114.)

**Aluminum potassium selenate,  $\text{Al}_2\text{K}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .**

More sol. in  $\text{H}_2\text{O}$  than common alum. (Weber, Pogg. 108. 615.)

**Aluminum rubidium selenate,  $\text{Al}_2\text{Rb}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .**

(Peterson, B. 9. 1563.)

Much more sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (Fabre, C. R. 105. 114.)

**Aluminum sodium selenate,  $\text{Al}_2\text{Na}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .**

Sl. efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Wohlwill, A. 114. 191.)

**Aluminum thallium sulphate,  $\text{Al}_2\text{Tl}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Aluminum selenate potassium sulphate,  $\text{Al}_2(\text{SeO}_4)_3, \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (v. Gerichten, A. 168. 222.)

**Ammonium selenate,  $(\text{NH}_4)_2\text{SeO}_4$ .**

Easily sol. in  $\text{H}_2\text{O}$ .

100 g.  $\text{H}_2\text{O}$  dissolve 117 g.  $(\text{NH}_4)_2\text{SeO}_4$  at  $7^\circ$ ; 164 g. at  $59^\circ$ ; 197 g. at  $100^\circ$ . (Tutton, Proc. Roy. Soc. 1907, 79. A. 351.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

**Ammonium hydrogen selenate,  $\text{NH}_4\text{HSeO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium cadmium selenate,  $(\text{NH}_4)_2\text{SeO}_4, \text{CdSeO}_4 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë, W. A. B. 66, 2. 2.)

+ $6\text{H}_2\text{O}$ . Efflorescent. Very easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)



**Ammonium cerous selenate,**  
 $(\text{NH}_4)_2\text{Ce}_2(\text{SeO}_4)_4 + 9\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Jolin.)

**Ammonium chromium selenate,**  
 $(\text{NH}_4)_2\text{Cr}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Ammonium cobaltous selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{CoSeO}_4 + 6\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium cupric selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{CuSeO}_4 + 6\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium didymium selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{Dy}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

+  $10\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 363.)

**Ammonium erbium selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{Er}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium ferrous selenate,**  $(\text{NH}_4)_2\text{Fe}(\text{SeO}_4)_2$   
 $+ 6\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

+  $2\text{H}_2\text{O}$ .

**Ammonium lanthanum selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{La}_2(\text{SeO}_4)_3 + 9\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium magnesium selenate,**  
 $(\text{NH}_4)_2\text{Mg}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium manganous selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{MnSeO}_4 + 6\text{H}_2\text{O}.$

Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ .  
 (Topsoë.)

**Ammonium nickel selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{NiSeO}_4 + 6\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Ammonium samarium selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{Sm}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium thallium selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{Tl}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Fortini, C. C. 1903, II. 706.)

**Ammonium uranyl selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $(\text{UO}_2)_2\text{SeO}_4 + 2\text{H}_2\text{O}.$

Easily sol. in  $\text{H}_2\text{O}$ . (Sendtner.)

**Ammonium yttrium selenate,**  $(\text{NH}_4)_2\text{SeO}_4,$   
 $\text{Y}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium zinc selenate,**  
 $(\text{NH}_4)_2\text{SeO}_4, \text{ZnSeO}_4 + 6\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Antimony selenate.**

Insol. in  $\text{H}_2\text{O}$ . Not very sol. in acids. Sol.  
 in  $\text{H}_2\text{SeO}_4$ . (Cameron and Macallan.)

**Barium selenate,**  $\text{BaSeO}_4.$

Somewhat more sol. in  $\text{H}_2\text{O}$  and dil. acids  
 than  $\text{BaSO}_4$ . (Rose.) 100 ccm.  $\text{H}_2\text{O}$  dissolve  
 11.8 mg. in the cold, and 13.8 mg. at  $100^\circ$ .  
 (Petersson, Z. anal. 12. 287.)

Not decomp. by  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{HNO}_3$  +  
 Aq (Berselius), but decomp. by solution of  
 alkali carbonates at ordinary temp.

Very slowly decomp. by  $\text{HCl}$  + Aq. (Rose,  
 Pogg. 95. 426.)

**Bismuth selenate.**

Insol. in, and not decomp. by cold or hot  
 $\text{H}_2\text{O}$ . (Cameron and Macallan.)

**Cæsium selenate,**  $\text{Cs}_2\text{SeO}_4.$

Sol. in  $\text{H}_2\text{O}$ . (Petersson, B. 9. 1561.)

100 g.  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 244.8 g.  $\text{Cs}_2\text{SeO}_4$ .  
 (Tutton, Chem. Soc. 1897, 71. 850.)

Sp. gr. of  $\text{Cs}_2\text{SeO}_4$  + Aq at  $20^\circ$  compared  
 with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing:

% $\text{Cs}_2\text{SeO}_4$	45.94	53.43
Sp. gr.	1.5841	1.7432

(Tutton.)

**Cæsium hydrogen selenate,**  $\text{CsHSO}_4.$

Ppt. Very hygroscopic. (Norris, Am. Ch.  
 J. 1901, 26. 322.)

**Cæsium chromic selenate,**  $\text{Cs}_2\text{Cr}_2(\text{SeO}_4)_4 +$   
 $24\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Cæsium cobaltous selenate,**  $\text{Cs}_2\text{Co}(\text{SeO}_4)_2 +$   
 $6\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Cæsium indium selenate,**  $\text{CsIn}(\text{SeO}_4)_3 +$   
 $12\text{H}_2\text{O}.$

Efflorescent; sol. in  $\text{H}_2\text{O}$ . (Mathers, J.  
 Am. Chem. Soc. 1908, 30. 215.)

**Cæsium iron (ferric) selenate,**  $\text{Cs}_2\text{Fe}_2(\text{SeO}_4)_4$   
 $+ 24\text{H}_2\text{O}.$

Sl. sol. in  $\text{H}_2\text{O}$ . (Roncogliolo, Gazz. ch.  
 it. 1905, 35. (2) 553.)

**Cæsium magnesium selenate,**  $\text{Cs}_2\text{SeO}_4,$   
 $\text{MgSeO}_4 + 6\text{H}_2\text{O}.$

(Tutton, Chem. Soc. 1905, 87, 1163.)

**Cæsium zinc selenate,**  $\text{Cs}_2\text{Zn}(\text{SeO}_4)_2 + 6\text{H}_2\text{O}.$   
 (Tutton, Zeit. Kryst. 1900, 33. 14.)

**Cadmium selenate**,  $\text{CdSeO}_4 \cdot 2\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (v. Hauer, W. A. B. 39. 299.)

**Cadmium potassium selenate**,  $\text{CdSeO}_4, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; can be recrystallised without decomp. (v. Hauer, W. A. B. 54. 209.)

**Calcium selenate**,  $\text{CaSeO}_4 + 2\text{H}_2\text{O}$ .

Less sol. in hot than in cold  $\text{H}_2\text{O}$ . (v. Hauer, J. pr. 80. 214.)

Sat.  $\text{CaSeO}_4 + \text{Aq}$  contains at:

—1°    +5°    20°    37°    67°  
7.4    7.3    7.6    6.8    5.1%  $\text{CaSeO}_4$ .

(Étard, A. ch. 1894, (7) 2. 551.)

**Cerous selenate**,  $\text{Ce}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}, 9\text{H}_2\text{O}$ , or  $12\text{H}_2\text{O}$ .

More sol. in cold than hot  $\text{H}_2\text{O}$ . (Jolin.)  
+4 $\text{H}_2\text{O}$ . Very easily in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Cingolani, C. C. 1908, I. 1606.)

Stable above 100°.

+5 $\text{H}_2\text{O}$ . Stable at 92–100°.

+7 $\text{H}_2\text{O}$ . Stable at 80–92°.

+8 $\text{H}_2\text{O}$ . Stable at 50–78°.

+10 $\text{H}_2\text{O}$ . Stable at 34–40°.

+11 $\text{H}_2\text{O}$ . Stable at 12–28°.

+12 $\text{H}_2\text{O}$ . Stable at 0–12°. (Cingolani, C. A. 1908. 2658.)

Solubility of  $\text{Ce}_2(\text{SeO}_4)_3$  in  $\text{H}_2\text{O}$  at t°.

(G. salt calculated as anhydrous  $\text{Ce}_2(\text{SO}_4)_3$  dissolved in 100 cc.  $\text{H}_2\text{O}$ .)

t°	Using $\text{Ce}_2(\text{SeO}_4)_3 + 11\text{H}_2\text{O}$	Using $\text{Ce}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}$	t°	Using $\text{Ce}_2(\text{SeO}_4)_3 + 11\text{H}_2\text{O}$	Using $\text{Ce}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}$
0°	...	39.55	60°	13.68	...
11.6	37	...	60.8	...	13.12
12.6	...	36.9	78.2	5.52	...
26.6	33.84	...	80.5	...	4.56
28.8	...	33.2	91	2.02	...
34.2	33.15	...	95.4	1.53	...
45.6	32.16	...	98	...	1.785
45.9	...	31.89	100	...	2.513

(Cingolani, I. c.)

**Cerous potassium selenate**,  $\text{Ce}_2(\text{SeO}_4)_3, 5\text{K}_2\text{SeO}_4$ .

More sol. in  $\text{H}_2\text{O}$  than the corresponding sulphate. (Jolin.)

**Cerous sodium selenate**,  $\text{Ce}_2(\text{SeO}_4)_3, \text{Na}_2\text{SeO}_4 + 5\text{H}_2\text{O}$ .

Quite sol. in  $\text{H}_2\text{O}$ . (Jolin.)

**Chromic potassium selenate**,  $\text{Cr}_2\text{K}_3(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Resembles the sulphate in every particular.

**Chromic rubidium selenate**,  $\text{Cr}_2\text{Rb}_3(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

**Chromic sodium selenate**,  $\text{Cr}_2\text{Na}_3(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Chromic thalious selenate**,  $\text{Cr}_2\text{Ti}_3(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. 105. 114.)

**Chromic selenate potassium sulphate**,  $\text{Cr}_2(\text{SeO}_4)_3, \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (v. Gerichten.)

**Cobaltous selenate, basic**,  $4\text{CoO}, 3\text{SeO}_3 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Bogdan, Bull. Soc. (3) 9. 586.)

$\text{Co}_2(\text{OH})_2(\text{SeO}_4)_2$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Bogdan, C. C. 1895. 630.)

**Cobaltous selenate**,  $\text{CoSeO}_4 + 5\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

+6 $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

+7 $\text{H}_2\text{O}$ . Efflorescent. Extremely sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

+18 $\text{H}_2\text{O}$ . Very unstable. (Copaux, A. ch. 1905, (8) 6. 553.)

**Cobaltous potassium selenate**,  $\text{CoSeO}_4, \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .

More sol. in  $\text{H}_2\text{O}$  than corresponding sulphate. (v. Hauer, W. A. B. 39. 837.)

**Cobaltous rubidium selenate**,  $\text{CoRb}_3(\text{SeO}_4)_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Cobaltous thalious selenate**,  $\text{CoTi}_3(\text{SeO}_4)_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Cupric selenate, basic**,  $3\text{CuO}, 2\text{SeO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Bogdan, Bull. Soc. (3) 9. 588.)

+5 $\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Metzner, C. R. 1898, 127. 55.)

**Cupric selenate**,  $\text{CuSeO}_4 + 5\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ :—

257 g. salt in 1 l. sat. solution at 15°.

346 " " " 1 l. " " " 35°.

435 " " " 1 l. " " " 55°.

Aq. solution decomp. at 70°. (Metzner, C. R. 1898, 127. 55.)

+ $\text{H}_2\text{O}$ , and +2 $\text{H}_2\text{O}$ . (Metzner.)

**Cupric hydrazine selenate**,  $\text{N}_2\text{H}_4 \cdot \text{H}_2\text{SeO}_4, \text{CuSeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. in aq. solution. (Rimini, C. C. 1907, I. 86.)

- Cupric magnesium selenate**,  $\text{CuMg}_2(\text{SeO}_4)_4 + 28\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill.)
- Cupric nickel selenate**,  $\text{CuSeO}_4, \text{NiSeO}_4 + 14\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill.)
- Cupric potassium selenate**,  $\text{CuSeO}_4, \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Topsoë.)
- Cupric zinc selenate**,  $\text{CuZn}_2(\text{SeO}_4)_4 + 28\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill.)
- Cupric selenate ferrous sulphate**,  $2\text{CuSeO}_4, 3\text{FeSO}_4 + 35\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill.)
- Cupric selenate magnesium sulphate**,  $\text{CuSeO}_4, 3\text{MgSO}_4 + 28\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill.)
- Cupric selenate zinc sulphate**,  $\text{CuSeO}_4, 3\text{ZnSO}_4 + 28\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill.)
- Didymium selenate**,  $\text{Di}_2(\text{SeO}_4)_3 + 5\text{H}_2\text{O}$ , and  $6\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .  
+  $8\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)  
+  $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Didymium potassium selenate**,  $\text{Di}_2(\text{SeO}_4)_3, \text{K}_2\text{SeO}_4 + 9\text{H}_2\text{O}$ .  
Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Didymium sodium selenate**,  $\text{Di}_2(\text{SeO}_4)_3, \text{Na}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Dysprosium selenate**,  $\text{Dy}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Jantsch, B. 1911, 44. 1275.)
- Erbium selenate**,  $\text{Er}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ , and  $9\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)
- Erbium potassium selenate**,  $\text{Er}_2(\text{SeO}_4)_3, \text{K}_2\text{SeO}_4 + 8\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Gadolinium selenate**,  $\text{Gd}_2(\text{SeO}_4)_3 + 10\text{H}_2\text{O}$ .  
Decomp. in the air. (Benedicks, Z. anorg. 1900, 22. 410.)
- Gadolinium potassium selenate**,  $\text{Gd}_2(\text{SeO}_4)_3, 3\text{K}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Benedicks, Z. anorg. 1900, 22. 412.)
- Glucinum selenate**,  $\text{GlSeO}_4 + 4\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . (Atterberg.)
- Gold (auric) selenate**,  $\text{Au}_2(\text{SeO}_4)_3$ .  
Insol. in  $\text{H}_2\text{O}$ . Sol. in hot conc.  $\text{H}_2\text{SeO}_4 + \text{Aq}$ . Somewhat sol. in  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3 + \text{Aq}$ . Decomp. by  $\text{HCl} + \text{Aq}$ . (Lenher, J. Am. Chem. Soc. 1902, 24. 355.)
- Indium selenate**,  $\text{In}_2(\text{SeO}_4)_3 + 10\text{H}_2\text{O}$ .  
Hygroscopic; easily sol. in  $\text{H}_2\text{O}$ . (Mathers, J. Am. Chem. Soc. 1908, 30. 214.)
- Iron (ferrous) selenate**,  $\text{FeSeO}_4 + 5\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wohlwill, A. 114. 169.)  
+  $7\text{H}_2\text{O}$ . Efflorescent, and sol. in  $\text{H}_2\text{O}$ . (Topsoë.)
- Iron (ferrous) potassium selenate**,  $\text{FeSeO}_4, \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. somewhat on standing. (Topsoë.)
- Iron (ferric) rubidium selenate**,  $\text{Rb}_2\text{Fe}_2(\text{SeO}_4)_4 + 24\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Roncogliolo, Gazz. ch. it. 1905, 35. (2) 553.)
- Iron (ferric) selenate potassium sulphate**,  $\text{Fe}_2(\text{SeO}_4)_3, \text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (v. Gerichten.)
- Lanthanum selenate**,  $\text{La}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$ .  
Easily sol. in cold  $\text{H}_2\text{O}$ . (Cleve.)  
+  $12\text{H}_2\text{O}$ . (Frerichs and Smith, A. 191. 355.)
- Lanthanum potassium selenate**,  $\text{La}_2(\text{SeO}_4)_3, \text{K}_2\text{SeO}_4 + 9\text{H}_2\text{O}$ .  
Quite sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Lanthanum sodium selenate**,  $\text{La}_2(\text{SeO}_4)_3, \text{Na}_2\text{SeO}_4 + 4\text{H}_2\text{O}$ .  
Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)
- Lead selenate, basic**,  $2\text{PbO}, \text{SeO}_3$ .  
Decomp. by acids with separation of  $\text{PbSeO}_4$ .  
 $3\text{PbO}, \text{PbSeO}_4 + \text{H}_2\text{O}$ . Ppt. (Strömholm, Z. anorg. 1904, 38. 443.)
- Lead selenate**,  $\text{PbSeO}_4$ .  
Insol. in  $\text{H}_2\text{O}$  or  $\text{HNO}_3 + \text{Aq}$ . (Schafarik, W. A. B. 47. 256.)  
Min. *Kerstenite*.
- Lithium selenate**,  $\text{Li}_2\text{SeO}_4 + \text{H}_2\text{O}$ .  
Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Magnesium selenate,  $\text{MgSeO}_4 + 6\text{H}_2\text{O}$ .**

Solubility resembles closely that of  $\text{MgSO}_4$ . (Topsoë.)

**Magnesium potassium selenate,  $\text{MgK}_2(\text{SeO}_4)_2 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Magnesium rubidium selenate,  $\text{MgSeO}_4, \text{Rb}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .**

(Tutton, Chem. Soc. 1905, 87. 1163.)

**Manganous selenate,  $\text{MnSeO}_4 + 2\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)  
 $+5\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Solution decomp. on warming or standing. (Topsoë.)

**Manganous potassium selenate,  $\text{K}_2\text{SeO}_4, \text{MnSeO}_4$ .**

Not deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Mercurous selenate,  $6\text{Hg}_2\text{O}, 5\text{SeO}_4$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . Sl. attacked by boiling  $\text{HNO}_3$ . Insol. in  $\text{HCl} + \text{Aq}$ . (Köhler, Pogg. 89. 146.)

$\text{Hg}_2\text{SeO}_4$ . Very sl. sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{HCl} + \text{Aq}$ . (Cameron and Davy, C. N. 44. 63.)

**Mercuric selenate, basic,  $6\text{HgO}, 2\text{SeO}_4 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ , or cold  $\text{HNO}_3 + \text{Aq}$ . Sol. in hot  $\text{HNO}_3$  or  $\text{HCl} + \text{Aq}$ . (Köhler.)

$\text{HgSeO}_4, 2\text{HgO}$ . Sol. in 10,330 pts.  $\text{H}_2\text{O}$ . (Cameron and Davy.)

**Mercuric selenate,  $\text{HgSeO}_4 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  with formation of basic salt. (Köhler.)

Sol. in  $\text{H}_2\text{SeO}_4, \text{H}_2\text{SO}_4, \text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ , but decomp. by  $\text{H}_2\text{O}$  to  $2\text{HgO}, \text{HgSeO}_4$ . (Cameron and Davy, C. N. 44. 63.)

**Nickel selenate,  $\text{NiSeO}_4 + 6\text{H}_2\text{O}$ .**

Very easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer, W. A. B. 39. 305.)

**Nickel potassium selenate,  $\text{NiSeO}_4, \text{K}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Nickel thallium selenate,  $\text{NiSeO}_4, \text{Tl}_2\text{SeO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Peterson.)

**Platinum selenate.**

Sol. in boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Cameron and Macallan, Lond. R. Soc. Proc. 46. 13.)

**Potassium selenate,  $\text{K}_2\text{SeO}_4$ .**

Nearly equally sol. in cold and hot  $\text{H}_2\text{O}$ . (Mitscherlich, Pogg. 9. 623.)

100 g.  $\text{H}_2\text{O}$  dissolve 110.5 g.  $\text{K}_2\text{SeO}_4$  at  $0^\circ$ ; 112.8 g. at  $20^\circ$ ; 122.2 g. at  $100^\circ$ . (Étard, C. R. 1888, 106. 741.)

Sat.  $\text{K}_2\text{SeO}_4 + \text{Aq}$  contains at:

$-20^\circ$	$-5^\circ$	$+5^\circ$
51.5	51.7	52.0% $\text{K}_2\text{SeO}_4$ ,

$18^\circ$	$97^\circ$
52.6	54.9% $\text{K}_2\text{SeO}_4$ .

(Étard, A. ch. 1894, (7) 2. 550.)

100 g.  $\text{H}_2\text{O}$  at  $12^\circ$  dissolve 115.0 g.  $\text{K}_2\text{SeO}_4$ . (Tutton, Chem. Soc. 1897, 71. 850.)

Sp. gr. of  $\text{K}_2\text{SeO}_4 + \text{Aq}$  at  $20^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$ , containing:

% $\text{K}_2\text{SeO}_4$	35.76	41.79	50.00
Sp. gr.	1.3591	1.4385	1.5590

(Tutton, Chem. Soc. 1897, 71. 851.)

**Potassium hydrogen selenate,  $\text{KHSeO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Potassium praseodymium selenate,  $3\text{K}_2\text{SeO}_4, \text{Pr}_2(\text{SeO}_4)_3 + 4\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg. 1898, 18. 361.)

**Potassium samarium selenate,  $\text{K}_2\text{SeO}_4, \text{Sm}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 166.)

**Potassium sodium selenate,  $3\text{K}_2\text{SeO}_4, \text{Na}_2\text{SeO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Potassium thallium selenate,  $\text{K}_2\text{SeO}_4, \text{Tl}_2(\text{SeO}_4)_3 + 8\text{H}_2\text{O}$ .**

Very sol. in dil. acids. (Fortini, C. C. 1903, II. 706.)

**Potassium uranyl selenate,  $\text{K}_2\text{SeO}_4, (\text{UO}_2)_2\text{SeO}_4 + 2\text{H}_2\text{O}$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Sendtner.)

**Potassium yttrium selenate,  $\text{K}_2\text{SeO}_4, \text{Y}_2(\text{SeO}_4)_3 + 6\text{H}_2\text{O}$ .**

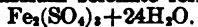
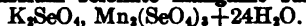
Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Potassium zinc selenate,  $\text{K}_2\text{SeO}_4, \text{ZnSeO}_4 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)  
 $+6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)

**Potassium selenate aluminum sulphate,  $\text{K}_2\text{SeO}_4, \text{Al}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (v. Gerichten.)

**Potassium selenate chromic sulphate,**Sol. in  $H_2O$ . (v. Gerichten.)**Potassium selenate ferric sulphate,  $K_2SeO_4,$** Sol. in  $H_2O$ . (v. Gerichten.)**Potassium selenate manganous sulphate,**Sol. in  $H_2O$ . (v. Gerichten, A. 168. 225.)**Potassium selenate manganic sulphate,**Sol. in  $H_2O$ . (v. Gerichten.)**Praseodymium selenate,  $Pr_2(SeO_4)_3.$** Sol. in  $H_2O$ . (von Schule, Z. anorg. 1898, 18. 360.)+  $8H_2O$ . Sl. sol. in  $H_2O$ ; sol. in  $H_2SO_4$ . (von Schule.)**Rubidium selenate,  $Rb_2SeO_4.$** Sol. in  $H_2O$ . (Petersson.)100 g.  $H_2O$  at  $12^\circ$  dissolve 158.9 g.  $Rb_2SeO_4$ . (Tutton, Chem. Soc. 1897, 71. 850.)Sp. gr. of  $Rb_2SeO_4 + Aq$  at  $20^\circ$  compared with  $H_2O$  at  $4^\circ$ , containing:%  $Rb_2SeO_4$  40.60 47.07

Sp. gr. 1.4688 1.5806

(Tutton.)

**Rubidium hydrogen selenate,  $RbHSeO_4.$** Sol. in equal pts.  $H_2O$ ; very hygroscopic. (Norris, Am. Ch. J. 1901, 26. 321.)**Rubidium zinc selenate,  $Rb_2Zn(SeO_4)_2 + 6H_2O.$** 

(Tutton, Zeit. Kryst. 1900, 33. 8.)

**Samarium selenate,  $Sm_2(SeO_4)_3 + 8H_2O.$** More sol. in  $H_2O$  than  $Sm_2(SO_4)_3.$ +  $12H_2O$ . Efflorescent. (Cleve.)**Scandium selenate,  $Sc_2(SeO_4)_3 + 2H_2O$ , and +  $8H_2O.$** 

(Crookes, Roy. Soc. Proc. 1908, 80, A. 518.)

**Silver selenate,  $Ag_2SeO_4.$** As  $Ag_2SO_4$ . (Mitscherlich, Pogg. 12. 138.)**Silver selenate ammonia,  $Ag_2SeO_4, 4NH_3.$** Easily sol. in  $H_2O$  or  $NH_4OH + Aq$  without decomp. (Mitscherlich, Pogg. 12. 141.)**Sodium selenate,  $Na_2SeO_4.$** Very sol. in  $H_2O$ , forming supersat. solutions. Cryst. also with  $10H_2O$ , which effloresce. Maximum point of solubility is at  $33^\circ$ . (Mitscherlich.)Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $Na_2SeO_4$	Mols. $H_2O$ to 1 mol. $Na_2SeO_4$	Mols. anhydrous salt to 100 mols. $H_2O$
35.2	45.47	12.59	7.94
39.5	45.26	12.70	7.87
50	44.49	13.10	7.63
75	42.83	14.00	7.14
100	42.14	14.42	6.93

(Funk, B. 1900, 33. 3697.)

+  $10H_2O$ . Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $Na_2SeO_4$	Mols. $H_2O$ to 1 mol. $Na_2SeO_4$	Mols. anhydrous salt to 100 mols. $H_2O$
0	11.74	79.08	1.26
15	25.01	31.48	3.18
25.2	36.91	17.95	5.57
27	39.18	16.30	6.13
30	44.05	13.33	7.50

(Funk.)

Sp. gr. of sat. solution at  $18^\circ = 1.315$ . (Funk.)**Sodium selenate vanadate.**

See Selenovanadate, sodium.

**Strontium selenate,  $SrSeO_4.$** Insol. in  $H_2O$  or  $HNO_3 + Aq$ ; decomp. by long boiling with  $HCl + Aq$ .**Tellurium selenate,  $2TeO_3, SeO_4.$** 

As sulphate. (Metzner, A. ch. 1898, (7) 15. 203.)

**Thallous selenate,  $Tl_2SeO_4.$** Sl. sol. in cold, much more in hot  $H_2O$ . Insol. in alcohol and ether. (Kuhlmann.)100 g.  $H_2O$  dissolve 2.13 g. at  $9.3^\circ$ ; 2.4 g. at  $12^\circ$ ; 10.86 g. at  $100^\circ$ . (Tutton, Proc. Roy. Soc. 1907, 79. A. 351.)2.8 g. are sol. in 100 g.  $H_2O$  at  $20^\circ$ ; 8.5 g. at  $80^\circ$ . (Glauser, Z. anorg. 1910, 66. 437.)**Thallous hydrogen selenate,  $HTlSeO_4 + 3H_2O.$** 

(Oettinger.)

**Thallous zinc selenate,  $Tl_2SeO_4, ZnSeO_4 + 6H_2O.$** Easily sol. in  $H_2O$ , but less than the corresponding sulphate. (Werther, Bull. Soc. 1865. 60.)**Thorium selenate,  $Th(SeO_4)_4 + 9H_2O.$** 100 pts.  $H_2O$  dissolve 0.498 pt.  $Th(SeO_4)_4$  at  $0^\circ$ , and 1.972 pts. at  $100^\circ$ . (Cleve.)

**Tin (stannic) selenate, basic,**  $\text{SnO}(\text{SeO}_4) + \text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 231.)

**Uranyl selenate,**  $(\text{UO}_2)_2\text{SeO}_4$ ,  $\text{H}_2\text{SeO}_4 + 18\text{H}_2\text{O}$ .

Very deliquescent.  
 $2(\text{UO}_2)_2\text{SeO}_4 \cdot \text{H}_2\text{SeO}_4 + 12\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Sendtner, A. 195. 325.)

**Ytterbium selenate,**  $\text{Yb}_2(\text{SeO}_4)_3$ .

*Anhydrous.*  
 $+15\text{H}_2\text{O} (?)$ ,  $+8\text{H}_2\text{O}$ . Ppt. (Cleve, Z. anorg. 1902, 32. 145.)

**Yttrium selenate,**  $\text{Y}_2(\text{SeO}_4)_3$ .

*Anhydrous.* Sol. in  $\text{H}_2\text{O}$  with hissing and evolution of heat. (Popp.)  
 $+8\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Cleve.)  
 $+9\text{H}_2\text{O}$ . Efflorescent.

**Zinc selenate,**  $\text{ZnSeO}_4 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)  
 $+6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Topsoë.)  
 $+7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

**Selenious acid,**  $\text{H}_2\text{SeO}_3$ .

Deliquescent in moist, efflorescent in dry air. Very sol. in cold, and in nearly every proportion in hot  $\text{H}_2\text{O}$ . Easily sol. in alcohol. (Berzelius.)

Sp. gr. of  $\text{H}_2\text{SeO}_3$  and of  $\text{H}_2\text{SeO}_3 + \text{Aq}$  at  $t^\circ$ .  
Two series of experiments.

	$t^\circ$	Sp. gr. at $t^\circ$
$\text{H}_2\text{SeO}_3 + \text{Aq}$ (A)	18.0	1.4386
1 vol. A + 0.5 vol. $\text{H}_2\text{O}$	18.0	1.3179
" + 1.0 "	17.7	1.2337
" + 1.5 "	16.6	1.2045
" + 2.0 "	14.0	1.1984
" + 2.5 "	17.0	1.1712
" + 3.0 "	19.2	1.1600
$\text{H}_2\text{SeO}_3 + \text{Aq}$ (B)	15.8	1.4698
1 vol. B + 0.5 vol. $\text{H}_2\text{O}$	16.5	1.3191
" + 1.0 "	13.0	1.2515
" + 1.5 "	14.2	1.2074
" + 2.0 "	17.0	1.1992
" + 2.5 "	16.5	1.1793
" + 3.0 "	14.2	1.1678

(de Coninck, C. C. 1905, I. 1693.)

See also **Selenium dioxide**.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

#### Selenites.

Alkali selenites are sol. in  $\text{H}_2\text{O}$ . The other neutral selenites are insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{HNO}_3 + \text{Aq}$ , Pb, and Ag salts slowly. The

neutral salts are insol. in  $\text{HCl} + \text{Aq}$ . The acid salts of the heavy metals are sol. in  $\text{H}_2\text{O}$ .

**Aluminum selenite, basic,**  $4\text{Al}_2\text{O}_3$ ,  $9\text{SeO}_2 + 36\text{H}_2\text{O}$ .

Precipitate. (Nilson, Upsala, 1875.)

**Aluminum selenite,**  $\text{Al}_2(\text{SeO}_3)_3$ .

Precipitate. (Berzelius.)  
 $+7\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson.) Sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ .  
 $+3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Boutzoureano, A. ch. (6) 17. 289.)

**Aluminum selenite, acid,**  $\text{Al}_2\text{O}_3$ ,  $4\text{SeO}_2 + 3\text{H}_2\text{O}$ .

(Boutzoureano.)  
 $2\text{Al}_2\text{O}_3$ ,  $9\text{SeO}_2 + 12\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nilson.)  
 $\text{Al}_2\text{O}_3$ ,  $6\text{SeO}_2$ . Very sol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
 $+5\text{H}_2\text{O}$ . (Nilson.)  
 $+2\text{H}_2\text{O}$ . (Boutzoureano.)

**Ammonium selenite,**  $(\text{NH}_4)_2\text{SeO}_3$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ .  
Precipitated from aqueous solution by alcohol. Insol. in ether. (Muspratt, A. 70. 275.)

**Ammonium hydrogen selenite,**  $\text{NH}_4\text{HSeO}_3$ .

Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ammonium trihydrogen selenite,**  $\text{NH}_4\text{H}_3(\text{SeO}_3)_3$ .

Deliquescent. (Berzelius.)

**Ammonium vanadium selenite.**

See **Vanadioselenite, ammonium**.

**Ammonium uranyl selenite,**  $(\text{NH}_4)_2\text{SeO}_3$ ,  $(\text{UO}_2)_2\text{SeO}_3$ .

Completely insol. in  $\text{H}_2\text{O}$ . (Sendtner.)

**Antimony selenite,**  $\text{Sb}_2(\text{SeO}_3)_3$ ,  $\text{SeO}_2$ .

(Nilson, Bull. Soc. (2) 23. 494.)

**Barium selenite,**  $\text{BaSeO}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . So in acids. (Nilson.)  
 $+ \text{H}_2\text{O}$ . (Nilson.)

**Barium pyroselenite,**  $\text{BaSe}_2\text{O}_6$ .

Very sl. sol. in cold, more in warm  $\text{H}_2\text{O}$ . (Berzelius.)

**Bismuth selenite,**  $\text{Bi}_2(\text{SeO}_3)_3$ ,  $\text{H}_2\text{SeO}_3$ .

(Nilson.)  
 $\text{Bi}_2(\text{SeO}_3)_3$ . (Nilson.)

**Cadmium selenite,**  $\text{CdSeO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Muspratt, Chem. Soc. 2. 65.)

**2CdO, 3SeO<sub>2</sub>+H<sub>2</sub>O.** Insol. in H<sub>2</sub>O; sol. in acids. (Boutsoureano.)  
 + $\frac{1}{2}$ H<sub>2</sub>O. Insol. in H<sub>2</sub>O; sol. in dil. acids. (Boutsoureano.)

**Cadmium selenite ammonia, CdSeO<sub>3</sub>, NH<sub>3</sub>.**  
 Insol. in cold or hot H<sub>2</sub>O. (Boutsoureano, A. ch. (6) 17. 289.)

**Calcium selenite, CaSeO<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.**  
 Very sl. sol. in H<sub>2</sub>O. (Berzelius.) More sol. in H<sub>2</sub>SeO<sub>3</sub>+Aq.  
 +2H<sub>2</sub>O. (Nilson.)

**Calcium hydrogen selenite, CaH<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>+H<sub>2</sub>O.**  
 Quite sol. in H<sub>2</sub>O. (Nilson.)  
 Ca<sub>2</sub>H<sub>2</sub>Se<sub>2</sub>O<sub>11</sub>. Easily sol. in H<sub>2</sub>O. (Nilson.)

**Cerous selenite, basic, 2Ce<sub>2</sub>O<sub>3</sub>, 5SeO<sub>2</sub>+30H<sub>2</sub>O.**  
 Precipitate. (Nilson.)

**Cerous selenite, Ce<sub>2</sub>(SeO<sub>3</sub>)<sub>3</sub>+3H<sub>2</sub>O.**  
 Insol. in H<sub>2</sub>O. Sol. in much selenious acid. (Jolin.)  
 +12H<sub>2</sub>O. (Nilson.)

**Cerous selenite, acid, Ce<sub>2</sub>O<sub>3</sub>, 4SeO<sub>2</sub>+5, or 6 H<sub>2</sub>O.**  
 Insol. in H<sub>2</sub>O, but sol. in selenious, and other acids. (Jolin.)  
 Ce<sub>2</sub>O<sub>3</sub>, 6SeO<sub>2</sub>+5H<sub>2</sub>O. Not decomp. by H<sub>2</sub>O. (Nilson.)

**Ceric selenite, Ce(SeO<sub>3</sub>)<sub>2</sub>.**  
 Insol. in H<sub>2</sub>O.  
 Sl. sol. in conc. HNO<sub>3</sub>. Sol. in dil. acids. Sol. in H<sub>2</sub>O<sub>2</sub>+Aq. (Barbieri, B. 1910, 43. 2215.)

**Chromium selenite, basic, 4Cr<sub>2</sub>O<sub>3</sub>, 9SeO<sub>2</sub>+64H<sub>2</sub>O.**  
 Precipitate. (Nilson.)

**Chromic selenite, Cr<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>+3H<sub>2</sub>O.**  
 (Boutsoureano.)  
 +15H<sub>2</sub>O. (Nilson.)  
 Very sl. sol. or insol. in H<sub>2</sub>O; sl. sol. in H<sub>2</sub>SeO<sub>3</sub>+Aq; sol. in hot conc. HCl+Aq. (Taquet, C. R. 96. 107.)

**Chromic selenite, acid, Cr<sub>2</sub>O<sub>3</sub>, 4SeO<sub>2</sub>+13H<sub>2</sub>O.**  
 Slowly sol. in HCl+Aq. Insol. in H<sub>2</sub>O. (Nilson.)  
 Cr<sub>2</sub>O<sub>3</sub>, 5SeO<sub>2</sub>+9H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Nilson.)

**Chromic diselenite.**  
 Insol. in H<sub>2</sub>O; sol. in acids. (Taquet, C. R. 97. 1435.)

**Cobaltous selenite, CoSeO<sub>3</sub>.**  
 Insol. in H<sub>2</sub>O. (Berzelius.)  
 + $\frac{1}{2}$ H<sub>2</sub>O. Insol. in H<sub>2</sub>O; sol. in acids. (Boutsoureano, A. ch. (6) 17. 289.)

**Cobaltous hydrogen selenite, CoH<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>.**  
 Sol. in H<sub>2</sub>O. (Berzelius.)  
 +2H<sub>2</sub>O. Sol. in H<sub>2</sub>O with decomp. (Boutsoureano.)

**Cuprous selenite.**  
 Insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+Aq. (Berzelius.)

**Cupric selenite, basic, 2CuO, SeO<sub>2</sub>.**  
 Insol. in H<sub>2</sub>O; sol. in NH<sub>4</sub>OH+Aq. (Boutsoureano.)  
 Sol. in acids.

**Cupric selenite, CuSeO<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.**  
 Insol. in H<sub>2</sub>O or H<sub>2</sub>SeO<sub>3</sub>+Aq. (Berzelius.)  
 +H<sub>2</sub>O, and 2H<sub>2</sub>O. (Boutsoureano.)  
 +2H<sub>2</sub>O. Min. *Chalcomenite*. Insol. in H<sub>2</sub>O or H<sub>2</sub>SeO<sub>3</sub>+Aq. (Friedel and Sarasin, Zeit. Kryst. 1881, 6. 300.)

**Cupric selenite, acid, CuO, 2SeO<sub>2</sub>+H<sub>2</sub>O=CuH<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>.**  
 Insol. in H<sub>2</sub>O. Sol. in acids. (Nilson.)  
 +2H<sub>2</sub>O. As above. (Boutsoureano.)  
 +4H<sub>2</sub>O. As above. (B.)

**Cupric selenite ammonia, CuSeO<sub>3</sub>, NH<sub>3</sub>+H<sub>2</sub>O.**  
 Decomp. by H<sub>2</sub>O. (Boutsoureano, A. ch. (6) 17. 289.)

**Didymium selenite, basic, 3Di<sub>2</sub>O<sub>3</sub>, 8SeO<sub>2</sub>+28H<sub>2</sub>O.**  
 Precipitate. (Nilson.)  
 +21H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Cleve, Bull. Soc. (2) 43. 363.)

**Didymium selenite, Di<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O.**  
 Precipitate. (Smith.)

**Didymium selenite, acid, Di<sub>2</sub>O<sub>3</sub>, 4SeO<sub>2</sub>+5H<sub>2</sub>O.**  
 Precipitate. (Cleve.)  
 Composition is Di<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>+6H<sub>2</sub>O. (Smith.)  
 +9H<sub>2</sub>O. (Nilson.)  
 2Di<sub>2</sub>O<sub>3</sub>, 9SeO<sub>2</sub>+18H<sub>2</sub>O. (Nilson.)

**Erbium selenite, Er<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>+5H<sub>2</sub>O, and 9H<sub>2</sub>O.**  
 Precipitate. (Nilson.)

**Erbium hydrogen selenite, Er<sub>2</sub>H<sub>2</sub>(SeO<sub>3</sub>)<sub>4</sub>+4H<sub>2</sub>O.**  
 Decomp. by hot H<sub>2</sub>O.

**Gadolinium hydrogen selenite,**

Ppt. (Benedicks, Z. anorg. 1900, 22. 413.)

**Glucinum selenite, basic,  $5\text{GfO}, 2\text{SeO}_2 + 10\text{H}_2\text{O}.$** 

Precipitate. (Nilson.) According to Atterberg, is  $7\text{GfO}, 3\text{SeO}_2 + 14\text{H}_2\text{O}.$

$2\text{GfO}, \text{SeO}_2 + 4\text{H}_2\text{O}.$  (Atterberg, Bull. Soc. (2) 19. 497.)

$3\text{GfO}, 2\text{SeO}_2 + 6\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}.$  (Atterberg.)

**Glucinum selenite,  $\text{GfSeO}_4 + 2\text{H}_2\text{O}.$** 

Sol. in little  $\text{H}_2\text{O},$  decomp. by excess. (Nilson.)

**Glucinum selenite, acid.**

(a)  $3\text{GfO}, 5\text{SeO}_2 + 3\text{H}_2\text{O};$  (b)  $\text{GfO}, 2\text{SeO}_2 + \text{H}_2\text{O};$  (c)  $3\text{GfO}, 7\text{SeO}_2 + 5\text{H}_2\text{O};$  (d)  $\text{GfO}, 3\text{SeO}_2 + 2\text{H}_2\text{O}.$  All are very sl. sol. in cold or warm  $\text{H}_2\text{O}.$  a, b, and c are sol. in warm  $\text{H}_2\text{O}$  containing  $\text{HCl};$  d is sol. only in boiling dil.  $\text{HCl} + \text{Aq}.$  (Nilson.)

**Indium selenite, basic,  $\text{In}_2\text{Se}_2\text{O}_{10} + 64\text{H}_2\text{O}.$** 

(Nilson.)

**Indium selenite,  $\text{In}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}.$** 

Sl. sol. in  $\text{H}_2\text{O}.$  (Nilson.)

**Indium hydrogen selenite,  $\text{In}_2(\text{SeO}_3)_3, 3\text{H}_2\text{SeO}_3 + 4\text{H}_2\text{O}.$** 

Sol. in  $\text{H}_2\text{O}.$  (Nilson.)

$2\text{In}_2(\text{SeO}_3)_3, 3\text{H}_2\text{SeO}_3 + 12\text{H}_2\text{O}.$  Sol. in  $\text{H}_2\text{O}.$  (Nilson.)

**Iron (ferrous) selenite.**

Ppt. Sol. in  $\text{HCl} + \text{Aq}$  with partial separation of Se. (Berzelius.)

**Iron (ferrous) hydrogen selenite.**

Sl. sol. in  $\text{H}_2\text{O}.$  (Berzelius.)

**Iron (ferric) selenite, basic,  $2\text{Fe}_2\text{O}_3, 3\text{SeO}_2 + x\text{H}_2\text{O}.$** 

Insol. in  $\text{H}_2\text{O}.$  (Berzelius.)

$\text{Fe}_2\text{O}_3, 2\text{SeO}_2.$  Insol. in  $\text{H}_2\text{O},$  easily sol. in acids. (Boutzoureano, A. ch. (6) 17. 289.)  $3\text{Fe}_2\text{O}_3, 8\text{SeO}_2 + 28\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}.$  (Nilson.)

**Iron (ferric) selenite,  $\text{Fe}_2(\text{SeO}_3)_3 + 4\text{H}_2\text{O}.$** 

Insol. in  $\text{H}_2\text{O}.$  (Muspratt, Chem. Soc. 2. 52.)

$+ \text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}.$  (Boutzoureano, A. ch. (6) 17. 289.)

$+ 3\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}.$  (B.)

$+ 10\text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O}.$  (B.)

**Iron (ferric) selenite, acid,  $\text{Fe}_2\text{O}_3, 6\text{SeO}_2 + x\text{H}_2\text{O}.$** 

Insol. in  $\text{H}_2\text{O}.$  Sol. in  $\text{HCl} + \text{Aq}.$  (Berzelius.)

$+ 2\text{H}_2\text{O}.$  (Boutzoureano, A. ch. (6) 17. 289.)

$\text{Fe}_2\text{O}_3, 4\text{SeO}_2 + \text{H}_2\text{O}.$  Insol. in  $\text{H}_2\text{O};$  sol. in acids. (Boutzoureano.)

**Lanthanum selenite, basic,  $3\text{La}_2\text{O}_3, 8\text{SeO}_2 + 28\text{H}_2\text{O}.$** 

Precipitate. (Nilson.)

**Lanthanum selenite,  $\text{La}_2(\text{SeO}_3)_3 + 9\text{H}_2\text{O},$  or  $12\text{H}_2\text{O}.$** 

Insol. in  $\text{H}_2\text{O}.$  (Nilson.)

**Lanthanum selenite, acid,  $\text{La}_2\text{H}_4(\text{SeO}_3)_3 + 4\text{H}_2\text{O}.$** 

(Nilson.)

$\text{La}_2\text{H}_4(\text{SeO}_3)_3 + 2\text{H}_2\text{O}.$  (Cleve.)

**Lead selenite,  $\text{PbSeO}_3.$** 

Scarcely sol. in  $\text{H}_2\text{O},$  even when it contains  $\text{H}_2\text{SeO}_3.$  Sl. sol. in  $\text{HNO}_3 + \text{Aq}.$  (Berzelius.)

**Lithium selenite,  $\text{Li}_2\text{SeO}_3 + \text{H}_2\text{O}.$** 

Difficultly sol. in  $\text{H}_2\text{O}.$  (Nilson, Bull. Soc. (2) 21. 253.)

**Lithium hydrogen selenite,  $\text{LiHSO}_3.$** 

Very sol. in  $\text{H}_2\text{O}.$  (Nilson.)

**Lithium trihydrogen selenite,  $\text{LiH}_3(\text{SeO}_3)_3.$** 

Not deliquescent. Sol. in  $\text{H}_2\text{O}.$  (Nilson.)

**Lithium vanadium selenite.**

See Vanadioselenite, lithium.

**Magnesium selenite,  $\text{MgSeO}_3 + 2\text{H}_2\text{O}.$** 

Insol. in  $\text{H}_2\text{O};$  sol. in dil. acids, especially if warm, also in  $\text{H}_2\text{SeO}_3 + \text{Aq}.$  (Boutzoureano, A. ch. (6) 18. 302.)

$+ 3\text{H}_2\text{O}.$  Very sl. sol. in hot  $\text{H}_2\text{O}.$  (Berzelius.)

$+ 6\text{H}_2\text{O}.$  As the  $2\text{H}_2\text{O}$  salt. (Boutzoureano.)

$+ 7\text{H}_2\text{O}.$  Sl. sol. in  $\text{H}_2\text{O}.$  Easily sol. in acetic, and mineral acids. (Hilger, Z. anal. 13. 132.)

**Magnesium hydrogen selenite,  $\text{MgH}_2(\text{SeO}_3)_2 + 3\text{H}_2\text{O}.$** 

Very deliquescent. Easily sol. in  $\text{H}_2\text{O}.$  (Nilson.)

Insol. in alcohol. (Muspratt.)

$\text{MgO}, 2\text{SeO}_2.$  Insol. in  $\text{H}_2\text{O};$  sol. in acids. (Boutzoureano.)

**Magnesium tetrahydrogen selenite,**

$\text{MgH}_4(\text{SeO}_3)_3,$  and  $+ 3\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}.$  (Nilson.)



**Manganous selenite,  $\text{MnSeO}_3 + \text{H}_2\text{O}$ .**

Precipitate. (Nilson.)

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)Sol. in cold  $\text{HCl} + \text{Aq}$ . (Muspratt.)+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Boutzoureano.)**Manganous selenite, acid,  $\text{MnSe}_2\text{O}_3$ .**Sol. in  $\text{H}_2\text{O}$ . (Berzelius; Nilson.) $\text{MnO}$ ,  $2\text{SeO}_2 + \text{H}_2\text{O} = \text{MnH}_2(\text{SeO}_3)_2$ . (Boutzoureano, A. ch. (6) 17. 289.)+  $5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  to  $\text{MnSeO}_3$ . (Boutzoureano.)**Manganic selenite, basic,  $\text{Mn}_2\text{O}_3, 2\text{SeO}_3$ .**Insol. in  $\text{H}_2\text{O}$ , cold  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3 + \text{Aq}$ ; insol. in hot dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . (Laugier, C. R. 104. 1508.)Sol. in warm  $\text{HCl} + \text{Aq}$  with decomp.**Manganic selenite,  $\text{Mn}_2(\text{SeO}_3)_3 + 5\text{H}_2\text{O}$ . (Laugier.)****Manganic selenite, acid,  $\text{Mn}_2\text{O}_3, 4\text{SeO}_3$ .**Insol. in  $\text{H}_2\text{O}$ , cold  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3 + \text{Aq}$ . Insol. in dil. hot  $\text{H}_2\text{SO}_4$ , and  $\text{HNO}_3 + \text{Aq}$ . Sol. in cold  $\text{HCl} + \text{Aq}$ ; and in  $\text{H}_2\text{SO}_4 + \text{Aq}$  with separation of Se. (Laugier, C. R. 104. 1508.)**Mercurous selenite, basic,  $3\text{Hg}_2\text{O}, 2\text{SeO}_3 + 5\text{H}_2\text{O}$ .**

(Boutzoureano.)

**Mercurous selenite,  $\text{Hg}_2\text{SeO}_3$ .**Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . Sol. in hot  $\text{HNO}_3 + \text{Aq}$ . (Köhler, Pogg. 89. 146.)Sl. sol. in  $\text{HCl} + \text{Aq}$ , and  $\text{KOH} + \text{Aq}$ . (Berzelius.)**Mercurous selenite, acid,  $3\text{Hg}_2\text{O}, 4\text{SeO}_3$ .**Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . Sl. sol. in boiling  $\text{HNO}_3 + \text{Aq}$ . (Köhler.)**Mercuric selenite, basic,  $7\text{HgO}, 4\text{SeO}_3$ .**Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HNO}_3 + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Köhler, Pogg. 89. 146.)**Mercuric selenite,  $\text{HgSeO}_3$ .**Insol. in  $\text{H}_2\text{O}$ . (Berzelius.) Nearly insol. in  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{K}_2\text{SeO}_3 + \text{Aq}$ . (Divers, Chem. Soc. 43. 585.)Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ ; sol. in  $\text{HCl} + \text{Aq}$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 278.)Solubility in  $\text{Na}_2\text{SeO}_3 + \text{Aq}$  at  $25^\circ$ .

$\text{Na}_2\text{SeO}_3 + \text{Aq}$ Normality	% $\text{HgSeO}_3$
2.0	2.73
1.0	1.39
0.5	0.70
0.25	0.53
0.125	0.32
0.0625	0.18

(Rosenheim and Pritze, Z. anorg. 1909, 63. 281.)

 $\text{HgSeO}_3, \text{H}_2\text{SeO}_3$ . Easily sol. in  $\text{H}_2\text{O}$ ; very sl. sol. in alcohol. (Berzelius.)

See also selenium dioxide.

**Mercuric sodium selenite,  $\text{HgSeO}_3, \text{Na}_2\text{SeO}_3$ .**Decomp. by  $\text{H}_2\text{O}$  and alkalis with pptn. of  $\text{HgSeO}_3$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 279.)**Mercuric selenite sodium chloride,  $\text{HgSeO}_3, \text{NaCl} + 2\text{H}_2\text{O}$ .**Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 280.)**Nickel selenite,  $\text{NiSeO}_3 + \text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Muspratt, Chem. Soc. 2. 52.)+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 28.)**Nickel selenite, acid.**Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Potassium selenite,  $\text{K}_2\text{SeO}_3 + \text{H}_2\text{O}$ .**Very deliquescent. Sol. in nearly all proportions in  $\text{H}_2\text{O}$ . Insol. in alcohol, which separates it as oil from aqueous solution. (Muspratt, Chem. Soc. 2. 52.)**Potassium hydrogen selenite,  $\text{KHSeO}_3$ .**

Very deliquescent. Very sl. sol. in alcohol. (Muspratt, Chem. Soc. 2. 52.)

**Potassium trihydrogen selenite,  $\text{KH}_2(\text{SeO}_3)_2$ .**Very deliquescent. Pptd. from  $\text{H}_2\text{O}$  by alcohol. (Muspratt.)

Not deliquescent. (Nilson.)

**Potassium hydrogen pyroselenite,  $\text{KHSe}_2\text{O}_3 + \text{H}_2\text{O}$ .**

(Muthmann, B. 1893, 26. 1015.)

**Potassium uranyl selenite,  $\text{K}_2\text{SeO}_3, (\text{UO}_2)_2\text{SeO}_3$ .**Absolutely insol. in  $\text{H}_2\text{O}$ . (Sendtner.)**Praseodymium hydrogen selenite,  $\text{Pr}_2(\text{SeO}_3)_3, \text{H}_2\text{SeO}_3 + 3\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg. 1898, 18. 362.)**Samarium selenite, basic,  $3\text{Sm}_2\text{O}_3, 8\text{SeO}_3 + 7\text{H}_2\text{O}$ .**

Precipitate. (Cleve.)

**Samarium selenite, acid,  $\text{Sm}_2\text{O}_3, 4\text{SeO}_3 + 5\text{H}_2\text{O}$ .**

Precipitate. (Cleve.)

**Scandium selenite,  $\text{Sc}_2(\text{SeO}_3)_3 + \text{H}_2\text{O}$ .**

Insol. precipitate. Digitized by Google

**Scandium hydrogen selenite**,  $\text{Sc}_2(\text{SeO}_3)_3 \cdot 3\text{H}_2\text{SeO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Not attacked by cold dil. acids, but easily if warmed.

**Silver selenite**,  $\text{Ag}_2\text{SeO}_3$ .

Very sl. sol. in cold, somewhat more sol. in hot  $\text{H}_2\text{O}$ . Easily sol. in hot  $\text{HNO}_3 + \text{Aq}$ , from which it is precipitated by  $\text{H}_2\text{O}$ . (Berzelius.)

Insol. in  $\text{K}_2\text{SeO}_3 + \text{Aq}$ ; sl. sol. in dil  $\text{HNO}_3 + \text{Aq}$ . (Divers, Chem. Soc. 49. 585.)

**Silver selenite ammonia**,  $\text{Ag}_2\text{SeO}_3 \cdot \text{NH}_3$ .

Insol. in boiling  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

**Sodium selenite**,  $\text{Na}_2\text{SeO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius.)  
 $+5\text{H}_2\text{O}$ .

**Sodium selenite, acid**,  $\text{NaHSeO}_3$ .

Permanent. Sol. in  $\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{Se}_2\text{O}_8$ . Sol. in  $\text{H}_2\text{O}$ . (Sacc, A. ch. (3) 21. 119.)  
 $\text{NaH}_2(\text{SeO}_3)_2$ . Not deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Sodium vanadium selenite**.

See Vanadioselenite, sodium.

**Strontium selenite**,  $\text{SrSeO}_3 \cdot 7\text{H}_2\text{O}$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3 + \text{Aq}$ . (Muspratt.)

**Strontium hydrogen selenite**,  $\text{SrH}_2(\text{SeO}_3)_2$ .

Easily sol. in hot or cold  $\text{H}_2\text{O}$ . (Nilson.)  
 Nearly insol. in hot or cold  $\text{H}_2\text{O}$ . (Berzelius.)

**Thallous selenite**,  $\text{Tl}_2\text{SeO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Kuhlmann, Bull. Soc. (2) 1. 330.)

**Thallous hydrogen selenite**,  $\text{TlHSeO}_3$ .

More sol. in  $\text{H}_2\text{O}$  than the above comp. (Kuhlmann.)

**Thallic selenite**,  $\text{Tl}_2(\text{SeO}_3)_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3$ .  
 Easily decomp. by  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . (Marino, Z. anorg. 1909, 62. 177.)

**Thorium selenite**,  $\text{Th}(\text{SeO}_3)_2 \cdot \text{H}_2\text{O}$ , or  $8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ . (Nilson.)

**Thorium selenite, acid**,  $2\text{ThO}_3 \cdot 7\text{SeO}_3 + 16\text{H}_2\text{O}$ .

$\text{ThO}_3 \cdot 5\text{SeO}_3 + 8\text{H}_2\text{O}$ . (Nilson.)

**Tin (stannic) selenite**.

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ , from which it is pptd. by  $\text{H}_2\text{O}$ . (Berzelius.)

**Uranic selenite**,  $\text{U}_2\text{O}_3 \cdot \text{SeO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Boutzoureano.)  
 $+2\text{H}_2\text{O}$ . (B.)

**Uranic selenite, acid**,  $2\text{U}_2\text{O}_3 \cdot 3\text{SeO}_3 + 7\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

**Uranyl selenite**,  $(\text{UO}_2)\text{SeO}_3 + 2\text{H}_2\text{O}$ .

Precipitate. (Nilson.)

**Uranyl selenite, acid**,  $3\text{UO}_3 \cdot 5\text{SeO}_3 + 7\text{H}_2\text{O}$ , or  $9\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .  
 $\text{UO}_3 \cdot 2\text{SeO}_3 + \text{H}_2\text{O} = (\text{UO}_2)_2\text{H}_2(\text{SeO}_3)_3$ .  
 Absolutely insol. in  $\text{H}_2\text{O}$  and  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Sendtner, A. 195. 325.)

**Vanadium selenite**.

See Vanadioselenious acid.

**Ytterbium selenite**,  $\text{Yb}_2(\text{SeO}_3)_3$ .

Insol. precipitate.

**Ytterbium hydrogen selenite**,  $\text{Yb}_2\text{H}_2(\text{SeO}_3)_4 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ .

**Yttrium selenite**,  $\text{Y}_2(\text{SeO}_3)_3 + 12\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Berzelius.)  
 Sol. in hot  $\text{H}_2\text{SeO}_3 + \text{Aq}$ . (Nilson.)

**Yttrium hydrogen selenite**,  $\text{Y}_2\text{H}_2(\text{SeO}_3)_4 + 3\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Cleve.)

**Zinc selenite**,  $\text{ZnSeO}_3$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Boutzoureano, A. ch. (6) 18. 289.)  
 $+2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SeO}_3$ , or  $\text{HNO}_3 + \text{Aq}$ . (Muspratt, Chem. Soc. 2. 52.)

**Zinc hydrogen selenite**,  $\text{ZnH}_2(\text{SeO}_3)_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius.)  
 $+2\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ . (Boutzoureano.)  
 $\text{ZnO} \cdot 4\text{SeO}_3 + 3\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Wöhler, A. 63. 279.)

**Zinc selenite ammonia**,  $\text{ZnSeO}_3 \cdot \text{NH}_3$ .

Insol. in cold or hot  $\text{H}_2\text{O}$ . (Boutzoureano, A. ch. (6) 17. 289.)

**Zirconium selenite, basic**,  $4\text{ZrO}_3 \cdot 3\text{SeO}_3 + 18\text{H}_2\text{O}$ .

Precipitate. Sl. sol. in  $\text{HCl} + \text{Aq}$ . (Nilson.)

**Zirconium selenite,  $Zr(SeO_3)_2$ .**

Absolutely insol. in  $H_2O$ ; difficultly sol. in boiling  $HCl + Aq.$  (Nilson.)  
 $+ H_2O.$  (Nilson.)

**Selenium, Se.**

Insol. in  $H_2O.$  Schultz (J. pr. (2) **32**, 390) has obtained a soluble colloidal modification which can be isolated by dialysis.

Insol. in  $HCl + Aq.$  Decomp. by  $HNO_3 + Aq.$  Sol. in fuming  $H_2SO_4.$  (Schultz-Sellack, B. **4**, 113.)

1000 pts.  $CS_2$  dissolve 1 pt. cryst. Se at boiling-point ( $46.6^\circ$ ), and 0.16 pt. at  $0^\circ$  (Mitscherlich, J. B. **1855**, 314.) Solubility of Se in  $CS_2$  is variable—1 pt. Se is sol. in 1376–2464–3746 pts.  $CS_2$  at  $20^\circ$  (Rammelsberg, B. **7**, 669). Cryst. Se, which is sol. in  $CS_2$ , becomes insol. in  $CS_2$  after heating to  $110^\circ$ , but after fusion is again sol. (Otto).

*Four modifications.*—(1) Amorphous red; (2) crystalline red; (3) granular gray; (4) laminated. 1 and 2 are sol. in  $CS_2$ , 3 and 4 are insol. in  $CS_2$ . All forms are sol. in  $SeCl_4$ , from which crystallizes a black modification, insol. in  $CS_2$ .  $CCl_4$  with trace of  $CS_2$  dissolves red Se slightly, black Se not at all.  $Se(C_2H_5)_2$  dissolves all modifications in small but apparently equal quantities. (Rathke, A. **152**, 181.)

According to Saunders (J. phys. Chem. **1900**, **4**, 428) selenium exists in three modifications.

1. Liquid, including vitreous, amorphous, and colloidal selenium.

*a. Vitreous.*

Sol. in liquid  $NH_3$  at  $25^\circ$ . (Franklin, Am. Ch. J. **1898**, **20**, 820.)

Insol. in liquid  $NH_3$  between  $-30^\circ$  and  $+10^\circ$ . Franklin's results are due to impure selenium and not completely dry  $NH_3$ . (Hugot, A. Ch. **1900**, (7) **21**, 5.)

Almost insol. in  $CS_2$ . (Schützenberger Chimie générale **1**, 438.)

Action of light increases solubility in  $CS_2$ . (Saunders, J. phys. Chem. **1900**, **4**, 456.)

Solubility in methylene iodide at  $12^\circ$  is 1.3 pts in 100. (Retgers, Z. anorg. **1893**, **3**, 343.)

Sol. in  $CSe_2$ , ethyl selenide, and in ethyl sulphide.

Very sol. in  $Se_2Cl_2$ . (Rathke, A. **1869**, **152**, 181.)

*b. Amorphous.*

Completely sol. in  $CS_2$  at ord. temp. if Se has not been heated. If heated or extracted with warm  $CS_2$  it becomes partly insol. (Peterson, Z. phys. Chem. **1891**, **81**, 612.)

Passes into red crystalline form in solution in  $CS_2$ ,  $C_2H_5$ , isobutyric acid, acetophenone, acetone,  $CHCl_3$ , thiophene, toluene, benzonitrile, ethyl acetate, and alcohol. (Saunders, J. phys. Chem. **1900**, **4**, 463.)

Solution in quinoline, aniline, pyridine,

etc., cause conversion into gray metallic form.

*c. Colloidal.*

Forms colloidal solution with  $H_2O$ .

A colloidal solution of Se in  $H_2O$  can be obtained. It is not decomp. by boiling, but is decomp. by electrolytes with separation of red selenium. (Gutbier, Z. anorg. **1902**, **32**, 106.)

*2. Red crystalline.*

Sol. in  $CS_2$ .

*3. Gray, crystalline or metallic.*

Sol. in selenium chloride and other solvents as vitreous Se. (Rathke, A. **1869**, **152**, 181.)

Sl. sol. in  $CS_2$ , toluene, nitrobenzene, quinoline, aniline, and  $KOH$ . Pptd. from conc.  $KOH + Aq.$  in long needles with mpt.  $219^\circ$ . (Coste, C. R. **1909**, **149**, 674.)

Sol. in many organic substances at high temp. as quinoline, ethyl benzoate, aniline and naphthalene. (Saunders, J. phys. Chem. **1900**, **4**, 469.)

Completely insol. in  $CS_2$ . (Saunders, J. phys. Chem. **1900**, **4**, 474.)

### Solubility of the two modifications of gray crystalline Se in $CS_2$ .

100 cc. boiling  $CS_2$  dissolve mg. Se.

I	II	III
Mg. Se	Mg. Se	Mg. Se
3.2	4.1	2.7
2.8	4.0	2.2
3.6	2.9	1.9
3.3	2.8	1.0
2.2	2.9	2.0
...	4.0	...

I. Se heated 1 hr. at  $140^\circ$ . Modification A.

II. Modification A.

III. Se heated 48 hrs. at  $190^\circ$ – $200^\circ$ . Modification B.

(Marc, Z. anorg. **1907**, **53**, 302.)

$Se_2Br_2$  dissolves 22% Se. (Schneider, Pogg. **128**, 327.)

Red Se is sol. in  $(NH_4)_2SO_4 + Aq.$  (Uelsmann, A. **116**, 122.)

Sol. in alkalies and Mg sulphites +  $Aq.$

365 pts.  $K_2SO_4 + Aq$  dissolve 102 pts. Se.  
 360 pts.  $MgSO_4 \cdot 3H_2O + Aq$  dissolve 116 pts. Se.

Insol. in  $BaSO_4 + Aq.$  (Rathke and Zschiesche, J. pr. **92**, 145.)

Sol. in  $KCN + Aq$  with formation of  $KSeCN$ . (Franklin, Am. Ch. J. **1898**, **20**, 830.)

100 pts. methylene iodide dissolve 1.3 pts. Se at  $12^\circ$ . (Retgers, Z. anorg. **3**, 343.)

Sol. in quinoline, but reacts with the solvent with evolution of  $H$ . (Beckmann and Gabel, Z. anorg. **1906**, **51**, 236.)

**Selenium monobromide,  $\text{Se}_2\text{Br}_2$ .**

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. Decomp. by absolute alcohol and benzene. Sol. in  $\text{C}_2\text{H}_5\text{I}$ , but soon decomposed. Miscible with  $\text{CS}_2$ ; less sol. in  $\text{CHCl}_3$  and  $\text{C}_2\text{H}_5\text{Br}$ . (Schneider, Pogg. 128. 327.)

**Selenium tetrabromide,  $\text{SeBr}_4$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. Decomp. by alcohol. Sol. in  $\text{HCl}+\text{Aq}$ ; sl. sol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ , and  $\text{C}_2\text{H}_5\text{Br}$ . (Schneider, Pogg. 129. 460.)

Decomp. by  $\text{C}_2\text{H}_5\text{I}$ .

**Selenium bromotrichloride,  $\text{SeCl}_3\text{Br}$ .**

Insol. in  $\text{CS}_2$ . (Fvans and Ramsay, Chem. Soc. 45. 62.)

**Selenium tetrabromide sulphur trioxide,  $\text{SeBr}_4 \cdot 2\text{SO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Prandtl, Z. anorg. 1909, 62. 242.)

**Selenium tribromochloride,  $\text{SeClBr}_3$ .**

See Selenium chlorotribromide.

**Selenium monochloride,  $\text{Se}_2\text{Cl}_2$ .**

Gradually decomp. by  $\text{H}_2\text{O}$ . Dissolves all modifications of selenium on heating (Rathke, A. 152. 181). Insol. in conc.  $\text{H}_2\text{SO}_4$ ; easily sol. in fuming  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{CHCl}_3$ ,  $\text{C}_2\text{H}_5$ ,  $\text{CCl}_4$ . Gradually decomp. by  $\text{H}_2\text{O}$ , alcohol, and ether. (Divers and Shimose, B. 17. 862.) Sol. in  $\text{CS}_2$ . (Evans and Ramsay, Chem. Soc. 45. 62.)

**Selenium tetrachloride,  $\text{SeCl}_4$ .**

Deliquescent on moist air. Decomp. with  $\text{H}_2\text{O}$ . (Berzelius, A. ch. 9. 225.) Insol. in  $\text{CS}_2$ . Easily sol. in hot  $\text{POCl}_3$ , from which it crystallizes on cooling. (Michaelis, Zeit. Chem. (2) 6. 460.) Very sl. sol. in  $\text{CS}_2$ . (Evans and Ramsay, Chem. Soc. 45. 62.)

**Selenium dichlorobromide,  $\text{SeCl}_2\text{Br}_2$ .**

(Evans and Ramsay, Chem. Soc. 45. 62.)

**Selenium chlorotribromide,  $\text{SeClBr}_3$ .**

Very sl. sol. in  $\text{CS}_2$ . (Evans and Ramsay.)

**Selenium trichlorobromide,  $\text{SeCl}_3\text{Br}$ .**

See Selenium bromotrichloride.

**Selenium fluoride.**

Sol. in conc.  $\text{HF}+\text{Aq}$ . Decomp. immediately by  $\text{H}_2\text{O}$ . (Knox.)

**Selenium monoiodide,  $\text{Se}_2\text{I}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . All solvents of iodine dissolve out that element. (Schneider, Pogg. 129. 627.)

**Selenium tetraiodide,  $\text{SeI}_4$ .**

Slowly decomp. by much  $\text{H}_2\text{O}$ . Iodine is dissolved out by all solvents of that element. (Schneider, Pogg. 129. 627.)

**Selenium nitride.**

See Nitrogen selenide.

**Selenium monoxide,  $\text{SeO}$  (?).**

Sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Does not exist. (Sacc.)

**Selenium dioxide,  $\text{SeO}_2$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in glacial  $\text{HC}_2\text{H}_3\text{O}_2$ . (Hinsberg, A. 260. 40)

Solubility in  $\text{H}_2\text{O}$  between  $-3^\circ$  and  $+36^\circ$  =  $45.0 + 0.7692t$ . (Étard, C. R. 1888, 106. 742.)

1 pt. is sol. in 2.67 pts.  $\text{H}_2\text{O}$  at  $11.3^\circ$

1 pt. " " " 2.60 " " "  $14^\circ$

1 pt. " " " 2.54 " " "  $15.6^\circ$

(de Coninck, C. R. 1906, 142. 571.)

Sp. gr. of  $\text{SeO}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{SeO}_2$	Sp. gr.
15.1	1	0.9923
15.3	2	1.0068
13.0	3	1.0200
13.0	4	1.0302
14.5	5	1.0346
14.8	6	1.0402
14.1	7	1.0535
15.0	8	1.0571
15.6	9	1.0719
15.2	10	1.0743

(de Coninck, C. R. 1906, 142. 571.)

See also Selenious acid.

1 pt.  $\text{SeO}_2$  is sol. in 9.84 pts. alcohol ( $93^\circ$ ) at  $14^\circ$

1 pt.  $\text{SeO}_2$  is sol. in 15.0 pts. methyl alcohol at  $11.8^\circ$

1 pt.  $\text{SeO}_2$  is sol. in 23.0 pts. acetone at  $15.3^\circ$

1 pt.  $\text{SeO}_2$  is sol. in 90.0 pts. acetic acid at  $12.9^\circ$ . (de Coninck, C. R. 1906, 142. 572.)

Traces dissolve in acetic anhydride. Sol. in phenyl mercaptan, (Hinsberg, A. 1890, 260. 40.)

Insol. in pure  $\text{C}_2\text{H}_5$ . (Clausnizer, A. 1879, 196. 271.)

See Selenious acid.

**Selenium trioxide,  $\text{SeO}_3$ .**

Not obtained in a pure state. (Cameron and Macallan.)

See Selenic acid.

**Selenium dioxide hydrobromic acid,  $\text{SeO}_2$ , 4HBr.**Decomp. at  $55^\circ$  (Ditte, A. ch. (5) 10. 82.) $\text{SeO}_2$ , 5HBr. Decomp. at  $65^\circ$  (Ditte, A. ch. (5) 10. 82.)**Selenium dioxide hydrochloric acid,  $\text{SeO}_2$ , 2HCl.**Decomp. at  $26^\circ$ . $\text{SeO}_2$ , 4HCl. Decomp. at  $0^\circ$ . Sol. in  $\text{H}_2\text{O}$  without evolution of gas. (Ditte, A. ch. (5) 10. 82.)**Selenium dioxide sulphur trioxide,  $\text{SeO}_2$ ,  $\text{SO}_3$ .**Decomp. violently by  $\text{H}_2\text{O}$ . (Weber, B. 19. 3185.)Composition may be  $(\text{SeO})\text{SO}_4$  (?).**Selenium oxy-compounds.**

See Selenyl compounds.

**Selenium diphosphide,  $\text{P}_2\text{Se}$ .**

See Phosphorus monoselenide.

**Selenium tetraphosphide,  $\text{P}_4\text{Se}$ .**

See Phosphorus semiselenide.

**Selenium monosulphide,  $\text{SeS}$ .**Insol. in  $\text{H}_2\text{O}$  and ether. Sol. in  $\text{CS}_2$ . Decomp. by alcohol. (Ditte, C. R. 73. 625, 660.)

Other compounds of Se and S are probably mixtures of the two elements.

**Selenium disulphide,  $\text{SeS}_2$ .**

Compound of this formula is a mixture of SeS and S. (Ditte, C. R. 73. 625, 660.)

**Selenium sulphoxide,  $\text{SeSO}_3$ .**Decomp. by  $\text{H}_2\text{O}$ . Sol. in fuming  $\text{H}_2\text{SO}_4$ , conc.  $\text{H}_2\text{SO}_4$ . Sol. in  $\text{H}_2\text{SO}_4$  of 1.806 sp. gr. without decomp. (Weber, Pogg. 156. 531.)Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SO}_4$ . (Divers and Shimose, B. 17. 858.)**Seleniuretted hydrogen,  $\text{H}_2\text{Se}$ .**

See Hydrogen selenide.

**Selenoarsenic acid.****Potassium selenoarsenate,  $\text{KAsSe}_3 + 2\text{H}_2\text{O}$ .**Only sl. sol. in cold  $\text{H}_2\text{O}$ ; sol. in warm  $\text{H}_2\text{O}$  with decomp.; more stable in  $\text{KOH} + \text{Aq}$ . (Clever, Z. anorg. 1895, 10. 132.)**Sodium selenoarsenate,  $\text{Na}_3\text{AsSe}_4 + 9\text{H}_2\text{O}$ .**Very sol. in  $\text{H}_2\text{O}$ ; very unstable. (Szary, B. 1895, 28. 2658.)**Selenoarsenious acid.****Sodium selenoarsenite,  $\text{Na}_3\text{AsSe}_3 + 9\text{H}_2\text{O}$ .**Moderately sol. in  $\text{H}_2\text{O}$ . (Clever and Muthmann, Z. anorg. 1895, 10. 139.)**Selenobismuthous acid.****Potassium metaselenobismuthite,  $\text{Bi}_2\text{Se}_3$ ,  $\text{K}_2\text{Se}$  or  $\text{KBiSe}_2$ .**Insol. in cold dil.  $\text{HCl} + \text{Aq}$ . Sol. on warming, with evolution of  $\text{H}_2\text{Se}$ . (Hilger and van Scherpenberg, Mitt. Pharm. II. 4.)**Selenocyanhydric acid,  $\text{HSeCN}$ .**

Known only in aqueous solution.

**Ammonium selenocyanide,  $\text{NH}_4\text{SeCN}$ .**Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .**Barium —,  $\text{Ba}(\text{SeSCN})_2$ .**Very sol. in  $\text{H}_2\text{O}$ .**Lead —,  $\text{Pb}(\text{SeCN})_2$ .**Sl. sol. in cold, sol. with sl. decomp. in boiling  $\text{H}_2\text{O}$ . Insol. in alcohol.**Mercurous —,  $\text{Hg}_2(\text{SeCN})_2$ .**

Ppt.

**Mercuric —,  $\text{Hg}(\text{SeCN})_2$ .**Sl. sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{MCN}$ ,  $\text{MSCN}$ , or  $\text{MSeCN} + \text{Aq}$ ; also sol. in hot  $\text{HgCl}_2 + \text{Aq}$ . (Cameron and Davy, C. N. 44. 63.)Decomp. by hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1909, 63. 276.)**Mercuric potassium —,  $\text{Hg}(\text{SeCN})_2$ ,  $\text{KSeCN}$ .**Easily sol. in  $\text{H}_2\text{O}$ . Sl. sol. in cold alcohol. (Cameron and Davy, C. N. 44. 63.)**Mercuric selenocyanide chloride,  $\text{Hg}(\text{SeCN})_2$ ,  $\text{HgCl}_2$ .**Sol. in boiling  $\text{H}_2\text{O}$  and in abs. alcohol. Decomp. by long boiling with  $\text{H}_2\text{O}$ . (Rosenheim and Pritze, Z. anorg. 1909, 63. 276.)**Platinum potassium — (Potassium platinum-selenocyanide),  $\text{K}_2\text{Pt}(\text{SeCN})_4$ .**Sol. in  $\text{H}_2\text{O}$  and alcohol. (Clarke, B. 11. 1325.)**Potassium —,  $\text{KSeCN}$ .**Very deliquescent, and sol. in  $\text{H}_2\text{O}$  with absorption of heat. More sol. in  $\text{H}_2\text{O}$  than  $\text{KSCN}$ . Sol. in alcohol.**Potassium — mercuric bromide,  $\text{KSeCN}$ ,  $\text{HgBr}_2$ .**Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$  or alcohol. (Cameron and Davy, C. N. 44. 63.)

**Potassium selenocyanide mercuric chloride,**  
 $\text{KSeCN}, \text{HgCl}_2$ .

As the bromide.

**Potassium — mercuric iodide,**  $\text{KSeCN}, \text{HgI}_2$ .

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$  or alcohol (Cameron and Davy.)

**Potassium — mercuric sulphocyanide,**  
 $\text{KSeCN}, \text{Hg}(\text{SCN})_2$ .

Sl. sol. in cold, much more in hot  $\text{H}_2\text{O}$  or alcohol. Somewhat sol. in ether. (Cameron and Davy.)

**Silver —,**  $\text{AgSeCN}$ .

Insol. in  $\text{H}_2\text{O}$ . Almost insol. in  $\text{NH}_4\text{OH}$  + Aq or cold dil. acids. Quickly decomp. by hot conc. acids.

**Sodium —,**  $\text{NaSeCN}$ .

Very sol. in  $\text{H}_2\text{O}$ .

**Selenomolybdic acid.**

**Potassium selenomolybdate,**  $5\text{K}_2\text{O}, 6\text{SeO}_3, 17\text{MoO}_3$ .

Readily sol. in  $\text{H}_2\text{O}$  without decomp. (Gibbs, Am. Ch. J. 1895, 17. 177.)

**Selenopentathionic acid.**

**Sodium selenopentathionate,**  $\text{Na}_2\text{S}_5\text{SeO}_6$ .

A dil. solution may be boiled for some time without change. (Norris and Fay, Am. Ch. J. 1900, 23. 121.)

**Selenophosphoric acid.**

**Ammonium selenophosphate,**  
 $2(\text{NH}_4)_2\text{O}, \text{P}_2\text{O}_5, 2\text{SeO}_3 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, B. 1903, 36. 1402.)

**Potassium selenophosphate,**  
 $2\text{K}_2\text{O}, \text{P}_2\text{O}_5, 2\text{SeO}_3 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.  
 $3.5\text{K}_2\text{O}, \text{P}_2\text{O}_5, 5\text{SeO}_3 + 5.5\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Weinland.)

**Rubidium selenophosphate,**  
 $2\text{Rb}_2\text{O}, \text{P}_2\text{O}_5, 2\text{SeO}_3 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland.)

**Triselenophosphorous acid.**

**Potassium triselenophosphite,**  
 $\text{K}_3\text{HPSe}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by moist air and dil. acids; sol. in conc.  $\text{KOH}$  + Aq.; sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Muthmann, Z. anorg. 1897, 13. 198.)

**Selenosamic acid,**  $\text{HSeO}_2\text{NH}_2$ .

Known only in its salts.

**Ammonium selenosamate,**  $(\text{NH}_4)_2\text{SeO}_3\text{NH}_2$ .

Deliquescent. Decomp. slowly by  $\text{H}_2\text{O}$  into  $(\text{NH}_4)_2\text{SeO}_3$ .

1 pt. is sol. in 116 pts. cold alcoholic ammonia at  $12^\circ$ . More sol. in hot alcoholic ammonia. Sl. attacked by cold  $\text{HCl}$  or  $\text{HNO}_3$ . (Cameron and Macallan, C. N. 1888, 57. 163.)

**Ammonium hydrogen selenosamate,**  
 $\text{NH}_4\text{H}(\text{SeO}_3\text{NH}_2)_2$ .

Deliquescent. Sol. in 14 pts. alcohol at  $14^\circ$ . (Cameron and Macallan, Proc. Roy. Soc. 44. 112.)

**Selenostannic acid.**

**Ammonium selenostannate,**  $3\text{SnSe}_2, (\text{NH}_4)_2\text{Se} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

**Platinum potassium —,**  $\text{K}_2\text{Se}, 3\text{PtSe}, \text{SnSe}_2$ .

Insol. in hot or cold  $\text{H}_2\text{O}$ ,  $\text{NH}_4\text{OH}$ , or  $\text{KOH}$  + Aq. Not attacked by hot  $\text{HCl}$  + Aq. (Schneider, J. pr. (2) 44. 507.)

**Platinum sodium —,**  $\text{Na}_2\text{Se}, 3\text{PtSe}, \text{SnSe}_2$ .

Properties as the corresponding K salt. (Schneider.)

**Potassium —,**  $\text{K}_2\text{SnSe}_2 + 3\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 441.)

**Selenosulphantimonic acid.**

**Sodium selenosulphantimonate,**  $\text{Na}_2\text{SbSeS}_3 + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Hofacker, A. 107. 6.)  
 $\text{Na}_2\text{SbS}_{1.5}\text{Se}_{2.5} + 9\text{H}_2\text{O}$ . Somewhat sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 564.)

**Selenosulphantimonous acid.**

**Potassium selenosulphantimonite,**  
 $\text{Sb}_2\text{S}_3\text{Se}_4\text{K}_{10} + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 563.)

**Sodium selenosulphantimonite,**  $\text{Na}_2\text{SbS}_{1.5}\text{Se}_{1.5} + 9\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 564.)

**Selenosulpharsenic acid.**

**Potassium selenosulpharsenate,**  $3\text{K}_2\text{S}, \text{As}_2\text{Se}_3 + 12\text{H}_2\text{O}$ .

Very unstable in the air. Very sol. in  $\text{H}_2\text{O}$ . Fairly stable in aqueous solution. Decomp. by acids. (Clever, Z. anorg. 1895, 10. 134.)

**Sodium selenosulpharsenate**,  $\text{Na}_2\text{AsS}_2\text{Se} + 8\text{H}_2\text{O}$ .

Decomp. by acids; stable in dry air. (Messinger, B. 1897, 30. 801.)

$3\text{Na}_2\text{S}, \text{As}_2\text{Se}_3 + 18\text{H}_2\text{O}$ . Quite sol. in  $\text{H}_2\text{O}$ ; quite stable in air. (Clever, Z. anorg. 1895, 10. 140.)

$\text{Na}_4\text{As}_2\text{S}_3\text{Se}_3 + 16\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Messinger, B. 1897, 30. 803.)

$\text{Na}_4\text{As}_2\text{S}_2\text{Se}_3 + 16\text{H}_2\text{O}$ . Stable in dry air; easily sol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Messinger, B. 1897, 30. 800.)

$\text{Na}_4\text{AsS}_2\text{Se}_3 + 9\text{H}_2\text{O}$ . Decomp. in aq. solution by dil. acids. (Messinger, B. 1897, 30. 802.)

$\text{Na}_2\text{AsSSe}_3 + 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; decomp. by aq. acids; hygroscopic. (Messinger.)

### Selenosulphophosphorous acid.

**Potassium selenosulphophosphite**,  $2\text{K}_2\text{S}, \text{P}_2\text{Se}_3 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; decomp. by acids. (Muthmann, Z. anorg. 1897, 13. 198.)

### Selenosulphostannic acid.

**Ammonium selenosulphostannate**,  $(\text{NH}_4)_2\text{S}, 3\text{SnSe}_2 + 3\text{H}_2\text{O}$ .

Easily decomp. (Ditte, C. R. 1882, 95. 643.)

**Potassium** —,  $\text{K}_2\text{SnSe}_2\text{S} + 3\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

**Sodium** —,  $\text{Na}_2\text{SnSe}_2\text{S} + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

### Selenosulphoxyarsenic acid.

**Sodium selenosulphoxyarsenate**,  $\text{Na}_2\text{AsO}_2\text{SSe} + 10\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$  but solution rapidly decomp. (Messinger, B. 1897, 30. 798.)

$\text{Na}_4\text{As}_2\text{S}_2\text{SeO}_3 + 24\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Messinger.)

$\text{Na}_4\text{As}_2\text{SeS}_2\text{O}_4 + 20\text{H}_2\text{O}$ . Stable in dry air. Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. by dil. acids. (Messinger.)

$\text{Na}_4\text{As}_2\text{S}_2\text{Se}_2\text{O}_3 + 20\text{H}_2\text{O}$ . Ppt. (Messinger.)

$\text{Na}_4\text{As}_2\text{S}_2\text{Se}_2\text{O}_3 + 36\text{H}_2\text{O}$ . Decomp. by aq. acids; sol. in  $\text{H}_2\text{O}$ ; quite stable. (Messinger.)

### Selenosulphur trioxide, $\text{SeSO}_3$ .

See Selenium sulphoxide.

### Selenosulphuric acid, $\text{H}_2\text{SeSO}_4$ .

Known only in its salts.

**Potassium selenosulphate**,  $\text{K}_2\text{SeSO}_4 + x\text{H}_2\text{O}$ .

Deliquescent in moist air; decomp. by  $\text{H}_2\text{O}$ . (Rathke, J. pr. 95. 1.)

**Selenotritithionic acid**,  $\text{H}_2\text{S}_2\text{SeO}_4$ .

Known only in solution, which is stable in dark. (Schulze, J. pr. (2) 32. 390.)

**Barium selenotritithionate.**

Sol. in  $\text{H}_2\text{O}$ . (Rathke.)

**Potassium** —,  $\text{K}_2\text{SeS}_2\text{O}_4$ .

Sol. in  $\text{H}_2\text{O}$  with gradual decomp. (Rathke J. pr. 95. 8; 97. 56.)

**Diselenotritithionic acid**,  $\text{H}_2\text{SSe}_2\text{O}_4$ .

Exceedingly unstable. (Schulze.)

### Selenovanadic acid.

**Lithium selenovanadate**,  $4\text{Li}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 30\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Prandtl and Lustig, Z. anorg. 1907, 53. 401.)

**Potassium selenovanadate**,  $2\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{SeO}_2 + 12\text{H}_2\text{O}$ .

(Prandtl and Lustig.)  
 $3\text{K}_2\text{O}, 5\text{V}_2\text{O}_5, 16\text{SeO}_2 + 40\text{H}_2\text{O}$ . (Prandtl and Lustig.)

$4\text{K}_2\text{O}, 6\text{V}_2\text{O}_5, 21\text{SeO}_2 + 37\text{H}_2\text{O}$ . (Prandtl and Lustig.)

$5\text{K}_2\text{O}, 10\text{V}_2\text{O}_5, 26\text{SeO}_2 + 43\text{H}_2\text{O}$ . (Prandtl and Lustig.)

**Sodium selenovanadate**,  $4\text{Na}_2\text{O}, 6\text{V}_2\text{O}_5, 5\text{SeO}_2 + 20\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Solution decomp. gradually. (Prandtl and Lustig.)

$2\text{Na}_2\text{O}, 7\text{V}_2\text{O}_5, 10\text{SeO}_2 + 13\text{H}_2\text{O}$ . (Prandtl and Lustig.)

$2\text{Na}_2\text{O}, 7\text{V}_2\text{O}_5, 12\text{SeO}_2 + 45\text{H}_2\text{O}$ , and  $+90\text{H}_2\text{O}$ . (Prandtl and Lustig.)

### Selenoxyarsenic acid.

**Ammonium selenoxyarsenate**,  $2(\text{NH}_4)_2\text{O}, 2\text{SeO}_3, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, B. 1903, 36. 1403.)

**Barium sodium selenoxyarsenate**,  $\text{BaNaAsO}_2\text{Se} + 9\text{H}_2\text{O}$ .

Ppt. (Weinland, Z. anorg. 1897, 14. 56.)

**Potassium selenoxyarsenate**,  $2\text{K}_2\text{O}, 2\text{SeO}_3, \text{As}_2\text{O}_5 + 3\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland and Bartlingck, B. 1903, 36. 1403.)

$7\text{K}_2\text{O}, 10\text{SeO}_3, 2\text{As}_2\text{O}_5 + 11\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Weinland and Bartlingck.)

$3\text{K}_2\text{O}, \text{As}_2\text{Se}_3 + 10\text{H}_2\text{O}$ . Easily decomp. by

moisture. Very sol. in  $H_2O$ . (Clever, Z. anorg. 1895, 10. 126.)

**Rubidium selenoxyarsenate**,  $2Rb_2O, 2SeO_3, As_2O_3 + 3H_2O$ .

Sol. in  $H_2O$  with decomp. (Weinland and Bartlingck.)

**Sodium selenoxyarsenate**,  $Na_2AsSeO_3$ .

Fairly stable in air and in aq. solution. (Weinland, B. 1896, 29. 1010.)

$Na_2AsSeO_3 + 12H_2O$ . Stable in the air when pure; sol. in  $H_2O$  with decomp. (Weinland, Z. anorg. 1897, 14. 50.)

$Na_2AsSeO_3 + 12H_2O$ . Very sol. in  $H_2O$ ; very unstable. (Szarvasy, B. 1895, 23. 2657.)  
 $3Na_2O, 3Na_2Se, As_2O_3 + 50H_2O$ . Easily sol. in  $H_2O$ . Solution may be boiled for a long time without decomp. (Clever, Z. anorg. 1895, 10. 136.)

**Selenoxyphosphoric acid.**

**Ammonium triselenmonoxyphosphate**,  $(NH_4)_3PSe_3O + 10H_2O$ .

Ppt. (Ephraim, B. 1910, 43. 280.)

**Ammonium hydrogen triselenmonoxyphosphate**,  $(NH_4)_2H(PSe_3O) + 18H_2O$ .

Ppt. (Ephraim.)

**Barium hydrogen diselendioxyphosphate**,  $BaHPPSe_2O_2 + 14H_2O$ .

Decomp. in moist air. (Ephraim.)

**Potassium selenoxyphosphate**,  $K_2PSe_2O_{11} + H_2O$ .

Decomp. by  $HNO_3$ . Insol. in alcohol and ether. (Ephraim.)

**Sodium monoselenotrioxophosphate**,  $Na_2PSeO_3 + 20H_2O$ .

Decomp. by  $H_2O$ . (Ephraim.)

**Sodium triselenmonoxyphosphate**,  $Na_2PSe_3O + 10H_2O$ .

Sol. in  $H_2O$ . Decomp. in aq. solution. Easily sol. in conc.  $NaOH + Aq$ . (Muthmann, Z. anorg. 1897, 13. 199.)

**Selenyl bromide**,  $SeOBr_2$  (?).

(Schneider, Pogg. 129. 450.)

**Selenyl bromide sulphur trioxide**,  $SeOBr_2, SO_3$ .

(Prandtl, Z. anorg. 1909, 62. 242.)

**Selenyl chloride**,  $SeO_2Cl_2$ .

Easily decomp. by  $H_2O$ . (Weber, Pogg. 118. 615.)

**Selenyl sulphur chloride.**

See Sulphoselenyl chloride.

**Selenyl stannic chloride**,  $2SeOCl_2, SnCl_4$ .

Extremely deliquescent. Completely sol. in  $H_2O$ . (Weber, B. A. B. 1865. 154.)

**Selenyl titanium chloride**,  $2SeOCl_2, TiCl_4$ .

Decomp. by  $H_2O$  with separation of an insol. residue. Decomp. by  $NH_4OH + Aq$ . (Weber, B. A. B. 1865. 154.)

**Sesquauramine.**

See Sesquauramine.

**Sesquihydraurylamine**,  $(HOAu)_3N, NH_3$ .

See Sesquihydraurylamine.

**Silicic acid**,  $SiO_2, xH_2O$ .

See also Silicon dioxide.

Silicic acid is sol. in 1000 pts. pure  $H_2O$ . (Kirwan.)

When pptd. from alkali silicates +  $Aq$  by  $CO_2$ , 0.021 pt.  $SiO_2$  remains dissolved in 100 pts.  $H_2O$ . (Struckmann, A. 94. 341.)

When pptd. as above, 100 pts.  $H_2O$  dissolve 0.09 pt.  $SiO_2$  in 3 days; 100 pts.  $H_2CO_3 + Aq$  dissolve 0.078 pt.  $SiO_2$  in 3 days. But if heated much more dissolves, the jelly itself becoming liquid, such jelly containing 2.49 pts.  $SiO_2$  to 100 pts.  $H_2O$ . This solution is not pptd. by considerable quantities of alcohol, but conc.  $(NH_4)_2CO_3$ ,  $NaCl$ , or  $CaCl_2 + Aq$ , etc., cause gelatinization. (Maschke, J. pr. 68. 234.)

Solubility in  $H_2O$  depends on the amt. of  $H_2O$ , in presence of which the silicic acid is set free by dil. acids,  $CO_2$ , or alkali salts +  $Aq$ . If  $H_2O$  is present in sufficient quantity to retain the silicic acid, much more will remain in solution than can be dissolved by digesting the gelatinous acid with  $H_2O$  afterwards. 1 pt.  $SiO_2$  can thus be held in solution by 500 pts.  $H_2O$ . Presence of  $NH_4OH$ ,  $(NH_4)_2CO_3$ , or  $NH_4Cl$  (in solutions of which  $SiO_2$  is remarkably insol.) diminishes the power of  $H_2O$  to retain  $SiO_2$  in solution.  $SiO_2$  is always more sol. in dil. than conc.  $NH_4OH + Aq$ . (Liebig, A. 94. 373.)

Silicic acid from the coagulation of the colloidal form (see p. 802) is sol. in about 5000 pts.  $H_2O$  when formed from a 1% solution, and 10,000 pts. when formed from a 5% solution, but is insol. after being dried. (Graham, A. 121. 36.)

Silicic acid is more sol. in dil. acids than in  $H_2O$ , because, when acid is added in excess to moderately dil.  $K_2SiO_3 + Aq$ , the solution remains clear, but if only enough acid is added to neutralize the base present, silicic acid will gradually separate out. If acid is added to conc.  $K_2SiO_3 + Aq$ , silicic acid separates out insol. in excess of acid, but if 20-30 pts.  $H_2O$  are present to 1 pt.  $K_2SiO_3$ , and an excess of acid added at once, the silicic acid will remain in solution. This result is obtained with  $HCl$ ,  $HNO_3$ ,  $H_2SO_4$ , or



$\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  These solutions may dissolve a neutral salt until saturated and no silicic acid will separate out. Therefore it is the acid that holds the  $\text{SiO}_2$  in solution, and not the  $\text{H}_2\text{O}$ . (C. J. B. Karsten, (1836) Pogg. 6. 353.)

Even  $\text{CO}_2$  has the power of holding  $\text{SiO}_2$  in solution. (Karsten, l. c.)

Solubility in acids of silicic acid of Struckmann (see above): 100 pts. dil.  $\text{HCl} + \text{Aq}$  of 1.088 sp. gr. dissolve 0.0172 g.  $\text{SiO}_2$  in 11 days; 100 pts.  $\text{H}_2\text{O}$  sat. with  $\text{CO}_2$  dissolve 0.0136 g.  $\text{SiO}_2$  in 7 days.

Silicic acid obtained by passing  $\text{SiF}_4$  into  $\text{H}_2\text{O}$  is sol. while still moist in 11,000 pts. cold, and 5500 pts. boiling  $\text{HCl} + \text{Aq}$  of 1.115 sp. gr. (Fuchs, A. 82. 119.)

Silicic acid at the moment of separation (as in dissolving cast-iron, steel, etc.) is abundantly sol. in aqua regia (3 pts.  $\text{HCl} + \text{Aq}$  of sp. gr. 1.13 and 1 pt.  $\text{HNO}_3 + \text{Aq}$  of sp. gr. 1.33). (Wittstein, Z. anal. 7. 433.)

The aq. solution obtained by the hydrolysis of ethyl silicate is more stable in acids +  $\text{Aq}$  or alkali than in pure  $\text{H}_2\text{O}$ . (Jordis, Z. anorg. 1903, 35. 16.)

$\text{NH}_4\text{OH} + \text{Aq}$  dissolves considerable freshly precipitated silicic acid,  $(\text{NH}_4)_2\text{CO}_3$  only a very little. (Karsten, Pogg. 6. 357.)

Dry or ignited  $\text{SiO}_2$  is sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . 100 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  containing 10%  $\text{NH}_3$  dissolve: 0.714 pt.  $\text{SiO}_2$  from gelatinous silicic acid; 0.303 pt. from artificially dried silicic acid; 0.377 pt. from amorphous  $\text{SiO}_2$ ; 0.017 pt. from quartz. (Pribram, Z. anal. 6. 119.)

$\text{NH}_4\text{OH} + \text{Aq}$  dissolves 0.382 pt.  $\text{SiO}_2$  from dry silicic acid; 0.357 pt. from ignited  $\text{SiO}_2$ ; 0.00827 pt. from quartz. (Souchay, Z. anal. 11. 182.)

Silicic acid precipitated from alkali silicates +  $\text{Aq}$  with  $\text{CO}_2$  is sol. as follows: 100 pts. pure  $\text{H}_2\text{O}$  dissolve 0.021 pt.  $\text{SiO}_2$ ; 100 pts.  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$  containing 5%  $(\text{NH}_4)_2\text{CO}_3$ , 0.020 pt.; 100 pts. containing 1%  $(\text{NH}_4)_2\text{CO}_3$ , 0.062 pt.; 100 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  containing 19.2%  $\text{NH}_3$ , 0.071 pt.; 100 pts. containing 1.6%, 0.0986 pt. (Struckmann, A. 94. 341.)

100 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (10%  $\text{NH}_3$ ) dissolve of: crystallized  $\text{SiO}_2$ , 0.017 pt.; amorphous  $\text{SiO}_2$ , ignited, 0.38 pt.; amorphous  $3\text{SiO}_2 \cdot 4\text{H}_2\text{O}$ , 0.21 pt.; amorphous silicic acid in form of jelly, 0.71 pt. Upon evaporation no ppt. is formed, even when 80 mols.  $\text{SiO}_2$  are present to 1 mol.  $\text{NH}_3$ . (Wittstein, J. B. 1866. 192.)

Sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$ , especially if warm. (Dumas.)

Sol. in  $\text{K}_2\text{SiO}_3$  or  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ . (Fuchs.)

Easily sol. in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , separating as a jelly on cooling. (Pfaff.)

$\text{NH}_4\text{Cl}$  or other  $\text{NH}_4$  salts ppt.  $\text{SiO}_2$  from solution in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ .

100 pts.  $\text{Ti}_2\text{O}_3$  in  $\text{H}_2\text{O}$  dissolve 4.17 pts. amorphous  $\text{SiO}_2$  in 24 hours' boiling. (Flemming, Jena. Zeit. 4. 36.)

Sol. in butyl amine. (Wurts, A. ch. (3) 42. 166.)

Not more sol. in  $\text{H}_2\text{O}$  containing sugar than in pure  $\text{H}_2\text{O}$ . (Petsholdt, J. pr. 60. 368.)

#### Soluble silicic acid.

*Colloidal form by dialysis.* Solutions containing 4.9%  $\text{SiO}_2$  may be evaporated until they contain 14%  $\text{SiO}_2$ . The  $\text{SiO}_2$  is separated from its solution thus made in many ways—

(1) By standing. This happens the more easily the more conc. the solution is, and is hastened by heat. A 10–12% solution gelatinizes at ordinary temp. in a few hours, and immediately upon heating. A 5–6% solution may be kept 5–6 days, a 2% solution, 2–3 months, and a 1% solution may be kept 2 or more years without gelatinizing.

(2) When the solution is evaporated to dryness in vacuo at  $15^\circ$  a transparent glass is left which is insol. in  $\text{H}_2\text{O}$ .

(3) The coagulation of colloidal silicic acid is accelerated by powdered graphite and other indifferent bodies, and it is brought about in a few minutes by a solution of the alkali carbonates, even when only  $\frac{1}{10,000}$  pt. of the carbonate is present. (Graham, A. 121. 36.)

(4) Coagulation is also brought about by passing  $\text{CO}_2$  through the solution. (Liebig.)

$\text{CO}_2$  does not cause coagulation. (Maschke.)

Coagulation is not caused by  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_2\text{C}_4\text{H}_4\text{O}_6$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ , or by neutral or acid salts +  $\text{Aq}$ . (Graham.)

$\text{NaCl}$  and  $\text{Na}_2\text{SO}_4 + \text{Aq}$  coagulate the solution. (Maschke.)

Alcohol, sugar, glycerine, or caramel do not coagulate.

Soluble  $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ ,  $\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , albumen, and casein precipitate soluble  $\text{SiO}_2$ . (Graham, A. 121. 36.)

The jelly from colloidal  $\text{SiO}_2$  is very sol. in slightly alkaline  $\text{H}_2\text{O}$ . 1 pt.  $\text{NaOH}$  in 10,000 pts.  $\text{H}_2\text{O}$  dissolves in an hour at  $100^\circ$  an amt. of the jelly corresponding to 200 pts.  $\text{SiO}_2$ . (Graham.)

#### Other colloidal forms.

Various solutions of silicic acid may be obtained as follows:

The jelly formed when  $\text{SiF}_4$  is passed through  $\text{H}_2\text{O}$  dissolves in a large amt. of  $\text{H}_2\text{O}$ , and  $\text{SiO}_2$  separates out on evaporation. This is still sol. in  $\text{H}_2\text{O}$ , but is made insol. by evaporation with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . (Berzelius.)

When  $\text{SiF}_4$  is absorbed by crystallized  $\text{H}_3\text{BO}_3$ , and the  $\text{HF}$  and  $\text{H}_3\text{BO}_3$  removed by a large excess of  $\text{NH}_4\text{OH} + \text{Aq}$ , a silicic acid is obtained which is very sol. in  $\text{H}_2\text{O}$ . The solution is not decomp. by boiling, but on evaporation an insol. powder remains. (Berzelius, A. ch. 14. 366.)

When  $\text{K}_2\text{SiO}_3 + \text{Aq}$  is precipitated by  $\text{CuCl}_2$ , the precipitate washed and dissolved in  $\text{HCl} + \text{Aq}$ , the solution treated with  $\text{H}_2\text{S}$  filtered and boiled, a solution of silicic acid is obtained

which gelatinizes with KOH or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Doveri, A. ch. (3) 21. 40.)

When  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  containing at most 3%  $\text{SiO}_2$  is saturated with  $\text{HCl} + \text{Aq}$  of 1.10 sp. gr., and  $\text{Na}_2\text{SiO}_3$  added until the solution is slightly opalescent and carefully warmed to  $30^\circ$ , a gelatinous mass is obtained which will dissolve in  $\text{H}_2\text{O}$  by 12-16 hours' boiling if treated before being exposed to the air. The solution is slightly opalescent. The solution can be evaporated by heat until it contains 6%  $\text{SiO}_2$ . In a vacuum or over  $\text{H}_2\text{SO}_4$ , solutions containing 10% may be obtained. The electric current, freezing, alcohol, or  $\text{H}_2\text{SO}_4$  precipitate or coagulate the solution. (Kühn, J. pr. 59. 1.)

$\text{SiS}_2$  with  $\text{H}_2\text{O}$  gives off  $\text{H}_2\text{S}$ , and forms a solution of  $\text{SiO}_2$  which, after dilution, can be kept for months. But when boiled or evaporated, or when a sol. silicate is added, it becomes gelatinous. It leaves an insol. residue when evaporated to dryness. (Fremy, A. ch. (3) 38. 314.)

Various forms of silicic acid have been described as definite compounds of  $\text{SiO}_2$  with varying amounts of  $\text{H}_2\text{O}$ , but it is doubtful if any true definite compounds exist, as the percentage of  $\text{H}_2\text{O}$  varies with the moisture of the air to which it is exposed. (See Ebelmen, A. ch. (3) 16. 129; Doveri, A. ch. (3) 21. 40; Fuchs, A. 82. 19; Merz, J. pr. 99. 177; van Bemmelen, B. 11. 2232, etc.)

### Silicates.

The silicates are insol. in  $\text{H}_2\text{O}$  with the exception of the alkali salts, and these are sol. only when the ratio of the base to the acid is above a certain limit.

### Aluminum silicate, $2\text{Al}_2\text{O}_3, \text{SiO}_2 + 10\text{H}_2\text{O}$ .

Min. *Collyrite*. Sol. in acids, with formation of  $\text{SiO}_2, x\text{H}_2\text{O}$ . Becomes transparent in  $\text{H}_2\text{O}$  and is decomp.

$4\text{Al}_2\text{O}_3, 3\text{SiO}_2$ . Min. *Dillnite*.

$\text{Al}_2\text{O}_3, \text{SiO}_2$ . Min. *Andalusite*, *Chastolite*, *Sillimanite*, *Disthene* or *Cyanite*. Insol. in acids.

+5-7  $\text{H}_2\text{O}$ . Min. *Allophane*. Completely sol. in dil. acids; decomp. by conc. acids with separation of  $\text{SiO}_2, x\text{H}_2\text{O}$ .

$2\text{Al}_2\text{O}_3, 3\text{SiO}_2 + 4\text{H}_2\text{O}$ . Min. *Pholerite*. Insol. in  $\text{HNO}_3 + \text{Aq.}$

+6 $\text{H}_2\text{O}$ . Min. *Glaserite*.

$\text{Al}_2\text{O}_3, 2\text{SiO}_2 + 2\text{H}_2\text{O}$ . Min. *Kaolin*, *Clay*. Insol. in dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$ ; moderately dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  when heated to evaporation, extracts  $\text{Al}_2\text{O}_3$  and some  $\text{SiO}_2$ , and leaves the rest of the  $\text{SiO}_2$  sol. in boiling  $\text{Na}_2\text{CO}_3 + \text{Aq.}$  All the  $\text{Al}_2\text{O}_3$  is dissolved by heating with 5-6 pts.  $\text{H}_2\text{SO}_4 + 1\text{pt. H}_2\text{O}$  until  $\text{H}_2\text{SO}_4$  evaporates, and then treating with  $\text{H}_2\text{O}$ .

Quickly attacked by  $\text{H}_2\text{SiF}_6 + \text{Aq.}$

Decomp. by boiling  $\text{KOH} + \text{Aq.}$  with residue of  $\text{SiO}_2$ . (Rammelsberg.)

$\text{KOH} + \text{Aq}$  extracts  $\frac{1}{4}$  of the  $\text{SiO}_2$  (Mala-

guti); is converted thereby into double silicates of K and Al, which are sol. in  $\text{HCl} + \text{Aq.}$  (Lemberg.)

Solubility in  $\text{KOH}$  and  $\text{HCl}$  increased if first heated to a low glow. (Glinka, C. C. 1899, II. 1063.)

*Colloidal clay*. (Schlössing, C. R. 79. 473.) +4 $\text{H}_2\text{O}$ . *Halloysite*. Decomp. by acids.

$4\text{Al}_2\text{O}_3, 9\text{SiO}_2 + 12\text{H}_2\text{O}$ . Min. *Porcelain clay* from Passau.

$\text{Al}_2\text{O}_3, 3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Razoumoffskine*.

$\text{Al}_2\text{O}_3, 4\text{SiO}_2 + 7\text{H}_2\text{O}$ . Min. *Montmorillonite*. Not decomp. by  $\text{HCl} + \text{Aq.}$  but by hot  $\text{H}_2\text{SO}_4$ .

+ $\text{H}_2\text{O}$ . Min. *Pyrophyllite*. Not decomp. by  $\text{H}_2\text{SO}_4$ .

+3 $\text{H}_2\text{O}$ . Min. *Anauzite*.

$2\text{Al}_2\text{O}_3, 9\text{SiO}_2 + 6\text{H}_2\text{O}$ . Min. *Cimolite*.

"Aluminum silicate" is insol. in acetone. (Naumann, B. 1904, 37. 4328); ethyl acetate. (Naumann, B. 1910, 43. 314.)

### Aluminum barium silicate, $\text{Al}_2\text{O}_3, \text{BaO}, 2\text{SiO}_2 + \text{H}_2\text{O}$ (?)

Min. *Edingtonite*. Decomp. by  $\text{HCl} + \text{Aq}$  with separation of  $\text{SiO}_2, x\text{H}_2\text{O}$ .

$5\text{Al}_2\text{O}_3, 4\text{BaO}, 10\text{SiO}_2$ . (Fremy and Feil, C. R. 86. 1033.)

$2\text{Al}_2\text{O}_3, 4\text{BaO}, 7\text{SiO}_2$ . Min. *Barylite*. Very sl. decomp. by alkali carbonates +  $\text{Aq.}$  (Blomstrand.)

### Aluminum barium potassium silicate,

$\text{Al}_2\text{O}_3, (\text{Ba}, \text{K})_2\text{O}, 5\text{SiO}_2 + 2\text{H}_2\text{O}$ .

Min. *Harmotome*. When finely powdered, difficultly decomp. by  $\text{HCl} + \text{Aq}$  with separation of pulverulent  $\text{SiO}_2, x\text{H}_2\text{O}$ .

$\text{Al}_2\text{O}_3, (\text{Ba}, \text{K})_2\text{O}, 4\text{SiO}_2$ . Min. *Haglophane*. Scarcely attacked by acids.

### Aluminum caesium silicate, $\text{H}_2\text{Cs}_2\text{Al}_2\text{Si}_2\text{O}_{11}$ (?)

Min. *Pollucite*. Very sl. decomp. by  $\text{HCl} + \text{Aq.}$

### Aluminum calcium silicate, $\text{Al}_2\text{O}_3, \text{CaO}, 2\text{SiO}_2$ .

Min. *Anorthite*. Completely decomp. by  $\text{HCl} + \text{Aq}$  with separation of pulverulent  $\text{SiO}_2, x\text{H}_2\text{O}$ .

Min. *Barsowite*. Instantaneously decomp. by  $\text{HCl} + \text{Aq.}$  with separation of gelatinous  $\text{SiO}_2, x\text{H}_2\text{O}$ .

+4 $\text{H}_2\text{O}$ . Min. *Gismonite*. Gelatinizes with  $\text{HCl} + \text{Aq.}$

$\text{Al}_2\text{O}_3, \text{CaO}, 3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Scolezite*. Easily sol. in  $\text{HCl} + \text{Aq.}$  without formation of gelatinous  $\text{SiO}_2$ . Sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$  with pptn. of  $\text{CaC}_2\text{O}_4$ .

Decomp. by, and sol. to a certain extent in  $\text{H}_2\text{CO}_3 + \text{Aq.}$  and decomp. also even by pure  $\text{H}_2\text{O}$ . (Rogers, Am. J. Sci. (2) 5. 408.)

+5 $\text{H}_2\text{O}$ . Min. *Lervyn*. Decomp. by acids without gelatinizing.

$\text{Al}_2\text{O}_3, \text{CaO}, 4\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Caporcanite*. *Leonhardtite*. Efflorescent. Easily

sol. in acids, with pptn. of gelatinous  $\text{SiO}_2$ ,  $\text{zH}_2\text{O}$ .

$\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $4\text{SiO}_2 + 4\text{H}_2\text{O}$ . Min. *Laumontite*. Easily gelatinizes with  $\text{HCl}$  or  $\text{HNO}_3$  + Aq. but is not affected by  $\text{H}_2\text{SO}_4$  unless hot.

$\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $6\text{SiO}_2 + 5\text{H}_2\text{O}$ . Min. *Epistilbite*. Gelatinizes with conc.  $\text{HCl}$  + Aq. (Goldschmidt, Z. anal. 17. 267.)

Scarcely decomp. by boiling conc.  $\text{HCl}$  + Aq. (Jannasch and Tenne, Miner. Jahrb. 1880, 1. 43.)

+  $6\text{H}_2\text{O}$ . *Stilbite*. *Heulandite*. Slowly but completely gelatinized by  $\text{HCl}$  + Aq.

$\text{Al}_2\text{O}_3$ ,  $2\text{CaO}$ ,  $3\text{SiO}_2 + \text{H}_2\text{O}$ . Min. *Prehnite*. Imperfectly decomp. by acids before ignition, but easily afterwards.

$\text{Al}_2\text{O}_3$ ,  $3\text{CaO}$ ,  $3\text{SiO}_2$ . *Lime alumina garnet*. *Grossularite*. Partially decomp. by acids before ignition, but easily afterwards.

$2\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$ . *Margarite*. Not attacked by acids.

$3\text{Al}_2\text{O}_3$ ,  $4\text{CaO}$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$ . *Zoisite*. Partially decomp. by  $\text{HCl}$  + Aq.

$4\text{Al}_2\text{O}_3$ ,  $6\text{CaO}$ ,  $9\text{SiO}_2$ . Min. *Meionite*. Completely sol. in  $\text{HCl}$  + Aq.

**Aluminum calcium ferric silicate**,  $2\text{Al}_2\text{O}_3$ ,  $4\text{CaO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$ .

Min. *Epidote*. Only sl. attacked by  $\text{HCl}$  + Aq before ignition.

**Aluminum calcium ferric magnesium silicate**,  $\text{H}_2(\text{Ca}, \text{Mg})_{10}(\text{Al}, \text{Fe})_{10}\text{Si}_{15}\text{O}_{147}$ .

Min. *Vesuvianite*, *Idocrase*. Only partially decomp. by  $\text{HCl}$  + Aq before ignition.

**Aluminum calcium iron, etc., silicate borate**,  $\text{H}_2\text{R}^+(\text{Al}_2, \text{B}_2)\text{Si}_5\text{O}_{33}$ .

Min. *Azinite*. Not attacked by  $\text{HCl}$  + Aq before ignition.

**Aluminum calcium magnesium silicate**,  $4\text{H}_2\text{Ca}_2\text{Mg}_5\text{Si}_6\text{O}_{24}$ ,  $5\text{H}_2\text{CaMgAl}_6\text{O}_{12} = 15\text{Al}_2\text{O}_3$ ,  $13\text{CaO}$ ,  $37\text{MgO}$ ,  $24\text{SiO}_2 + 13\text{H}_2\text{O}$ .

Min. *Clintonite*. Completely decomp. by  $\text{HCl}$  + Aq without gelatinization.

$3\text{H}_2\text{Ca}_2\text{Mg}_5\text{Si}_6\text{O}_{24}$ ,  $4\text{H}_2\text{CaMgAl}_6\text{O}_{12}$ . Min. *Brandisite*. Not attacked by  $\text{HCl}$  + Aq.

Slowly decomp. by boiling conc.  $\text{H}_2\text{SO}_4$ .

$5\text{H}_2\text{Ca}_2\text{Mg}_5\text{Si}_6\text{O}_{24}$ ,  $8\text{H}_2\text{CaMgAl}_6\text{O}_{12}$ . Min. *Xanthophyllite*. Very sl. decomp. by hot  $\text{HCl}$  + Aq.

$3(\text{Ca}, \text{Mg})\text{O}$ ,  $\text{Al}_2\text{O}_3$ ,  $2\text{SiO}_2$ . Min. *Gehlenite*. Easily decomp. by acids.

**Aluminum calcium potassium silicate**,  $(\text{H}, \text{K})_2\text{CaAl}_2\text{Si}_6\text{O}_{15} + 6\text{H}_2\text{O}$ .

Min. *Chabasite*. Decomp. by  $\text{HCl}$  + Aq.  $(\text{K}, \text{Ca})\text{Al}_2\text{Si}_6\text{O}_{10} + 4\text{H}_2\text{O}$ . Min. *Zeagonite*. Completely sol. in  $\text{HCl}$  + Aq.

**Aluminum calcium sodium silicate**,  $3\text{Al}_2\text{O}_3$ ,  $8\text{CaO}$ ,  $\text{Na}_2\text{O}$ ,  $9\text{SiO}_2$ .

Min. *Sarcosite*. Decomp. by acids.

$2\text{Al}_2\text{O}_3$ ,  $12(\text{Ca}, \text{Na}_2)\text{O}$ ,  $9\text{SiO}_2$  (?). Min. *Mellitite*. Gelatinized by acids.

$\text{Na}_2\text{CaAl}_2\text{Si}_6\text{O}_{15}$  (?). Min. *Margarite*.  $\text{Na}_2\text{CaAl}_2\text{Si}_{10}\text{O}_{21}$ . Min. *Faujasite*. Decomp. by  $\text{HCl}$  + Aq.

$(\text{Na}, \text{Ca})\text{Al}_2\text{Si}_6\text{O}_{12}$ . Min. *Gmelinite*. Decomp. by  $\text{HCl}$  + Aq.

$(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_6\text{O}_{13} + 6\text{H}_2\text{O}$ . Min. *Foresite*. Difficultly decomp. by  $\text{HCl}$  + Aq.

$(\text{Ca}, \text{Na}_2)\text{Al}_2\text{Si}_6\text{O}_{12} + 2\frac{1}{2}\text{H}_2\text{O}$ . Min. *Thomsonite*. Gelatinizes with  $\text{HCl}$  + Aq.

$\text{zNa}_2\text{Al}_2\text{Si}_6\text{O}_{16}$ ,  $\gamma\text{CaAl}_2\text{Si}_6\text{O}_{16}$ . Min. *Oligoclase*, *Labradorite*. Sl. decomp. by acids, more easily the larger the amt. of Ca present.

**Aluminum calcium sodium silicate sulphate**,  $2(\text{Na}_2, \text{Ca})\text{Al}_2(\text{SiO}_4)_2$ ,  $(\text{Na}_2, \text{Ca})\text{SO}_4$ .

Min. *Hauyn*. Gelatinizes with  $\text{HCl}$  + Aq.

**Aluminum glucinum silicate**,  $\text{Al}_2\text{O}_3$ ,  $3\text{GIO}$ ,  $6\text{SiO}_2$ .

Min. *Beryl*. Emerald. Not decomp. by acids, excepting partially by  $\text{H}_2\text{SO}_4$  after being ignited.

$\text{Al}_2\text{O}_3$ ,  $2\text{GIO}$ ,  $2\text{SiO}_2 + \text{H}_2\text{O}$ . Min. *Euclase*. Not attacked by acids.

**Aluminum ferrous silicate**,  $\text{Al}_2\text{Fe}(\text{SO}_4)_2$ .

Min. *Garnet*. Sl. decomp. by  $\text{HCl}$  + Aq.  $\text{H}_2\text{FeAl}_2\text{SiO}_7$ . Min. *Chloritoid*. Not attacked by  $\text{HCl}$  + Aq. Completely decomp. by  $\text{H}_2\text{SO}_4$ .

$\text{Al}_2\text{O}_3$ ,  $3\text{FeO}$ ,  $3\text{SiO}_2 + 3\text{H}_2\text{O}$ . Min. *Voigtite*.

**Aluminum iron lithium potassium silicate**,  $\text{K}_2\text{Li}_2\text{Fe}_2\text{Al}_2\text{Si}_2\text{O}_{33}$ .

Min. *Zinnwaldite*. Sl. decomp. by acids.

**Aluminum ferrous magnesium silicate**,  $6\text{Al}_2\text{O}_3$ ,  $3(\text{Mg}, \text{Fe})\text{O}$ ,  $6\text{SiO}_2 + \text{H}_2\text{O}$ .

Min. *Stauradite*. Not attacked by acids.

**Aluminum ferric magnesium silicate**,  $2(\text{Al}, \text{Fe})\text{O}_3$ ,  $2\text{MgO}$ ,  $6\text{SiO}_2$ .

Min. *Cordierite*. Sl. attacked by acids. +  $\text{zH}_2\text{O}$ . Min. *Esmarkite*, *Chlorophyllite*.

**Aluminum ferrous manganous silicate**,  $\text{Al}_2\text{O}_3$ ,  $\text{FeO}$ ,  $2\text{MnO}$ ,  $3\text{SiO}_2$ .

Min. *Partschinite*.

**Aluminum ferrous sodium, etc., silicate borate**,  $\text{R}^+(\text{Al}_2)(\text{B}_2)\text{Si}_4\text{O}_{20} + \text{R}^+(\text{Al}_2)_2(\text{B}_2)\text{Si}_4\text{O}_{20}$ , etc.

Min. *Tourmaline*. Not decomp. by  $\text{HCl}$  + Aq; very sl. decomp. by  $\text{H}_2\text{SO}_4$ .

**Aluminum lithium silicate**,  $\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $5\text{SiO}_2$ . Not attacked by acids. (Hautefeuille, C. R. 90. 541.)

$\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $6\text{SiO}_2$ .  $\text{Al}_2\text{O}_3$ ,  $\text{Li}_2\text{O}$ ,  $4\text{SiO}_2$ . [Min. *Spodumene*. Not attacked by acids.]

$4\text{Al}_2\text{O}_3, 3\text{Li}_2\text{O}, 30\text{SiO}_2$ . Min. *Petalite*. Not attacked by acids.

**Aluminum lithium potassium silicate**,  
(Li, K) $_{10}\text{Al}_{10}\text{Si}_{10}\text{O}_{52}$ .

Min. *Lepidokite*. Sl. decomp. by acids.

**Aluminum magnesium silicate**,  $5\text{Al}_2\text{O}_3, 4\text{MgO}, 28\text{SiO}_2$ .

Min. *Sapphirine*.

**Aluminum magnesium potassium silicate**,  
 $z\text{H}_2\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{24}, y\text{Mg}_{12}\text{Si}_6\text{O}_{31}$ .

Min. *Lepidomelane*. Easily decomp. by HCl or  $\text{HNO}_3$ +Aq, with residue of a skeleton of  $\text{SiO}_2$ .

$3\text{Al}_2\text{O}_3, 12\text{MgO}, 2\text{K}_2\text{O}, 12\text{SiO}_2+\text{H}_2\text{O}$ . Min. *Anomite*.

$7\text{Al}_2\text{O}_3, 35\text{MgO}, 7\text{K}_2\text{O}, 36\text{SiO}_2$ . Min. *Phlogopite*.

**Aluminum manganous silicate**,  $2\text{Al}_2\text{O}_3, 6\text{MnO}, 6\text{SiO}_2$ .

Not decomp. by very dil. HCl+Aq. (Gorgeu, C. R. 97. 1303.)

**Aluminum potassium silicate**,  $\text{Al}_2\text{O}_3, \text{K}_2\text{O}, \text{SiO}_2$ .

Very slowly decomp. by cold  $\text{H}_2\text{O}$ ; 12% is dissolved by hot  $\text{H}_2\text{O}$ . Sol. in alkali hydroxides+Aq, but insol. in carbonates+Aq.

$\text{K}_2\text{O}, \text{Al}_2\text{O}_3, 2\text{SiO}_2$ . Insol. in cold  $\text{H}_2\text{O}$ , but 6% dissolves on boiling. Sol. in dil. acids. Insol. in alkali hydroxides or carbonates+Aq. (Gorgeu, A. ch. (6) 10. 45.)

$\text{K}_2\text{O}, \text{Al}_2\text{O}_3, 3\text{SiO}_2+3\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3$ +Aq. (Deville, A. ch. (3) 61. 313.)

$\text{K}_2\text{O}, \text{Al}_2\text{O}_3, 4\text{SiO}_2$ . Min. *Leucite*. Decomp. by HCl+Aq with separation of pulverulent  $\text{SiO}_2$ .

$+4\text{H}_2\text{O}$ . Ppt. (Deville, C. R. 54. 324.)  
 $\text{H}_2\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{24}$ . Min. *Muscovite*, "Mica."

Not attacked by HCl or  $\text{H}_2\text{SO}_4$ +Aq.

$\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{17}+3\text{H}_2\text{O}$ . Min. *Pinite*. Partly decomp. by HCl+Aq.

$\text{K}_2\text{Al}_2\text{Si}_2\text{O}_{18}$ . Min. *Orthoclase*. *Feldspar*. Scarcely attacked by acids. Slowly sol. in  $\text{H}_2\text{SO}_4$  or HCl+Aq when finely powdered. (Rogers.)

**Aluminum potassium sodium silicate**,  
 $\text{K}_2\text{Al}_2(\text{SiO}_3)_4, 5\text{Na}_2\text{Al}_2(\text{SiO}_3)_2(?)$ .

Min. *Nepheline*. Decomp. by HCl+Aq.

**Aluminum silver silicate**,  $\text{Al}_2\text{Ag}_2\text{Si}_2\text{O}_8$ .

Insol. in  $\text{NH}_4\text{OH}$ +Aq. (Silber, B. 14. 941.)  
 $\text{Al}_2\text{Ag}_2\text{Na}_2\text{Si}_2\text{O}_8$ . As above. (Silber.)

**Aluminum sodium silicate**,  $\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, \text{SiO}_2$ .

Insol. in cold  $\text{H}_2\text{O}$ , but 38-40% dissolves in hot  $\text{H}_2\text{O}$ . (Gorgeu.)

$\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, 2\text{SiO}_2$ . Insol. in cold  $\text{H}_2\text{O}$ ; boiling  $\text{H}_2\text{O}$  dissolves 1-2%. Sol. in HCl or  $\text{HNO}_3$  diluted with 10-20 vols.  $\text{H}_2\text{O}$ . Insol.

in alkali hydroxides or carbonates+Aq. (Gorgeu, A. ch. (6) 10. 145.)

Not attacked by  $\text{H}_2\text{O}$ . (Silber, B. 14. 941.)  
 $+3\text{H}_2\text{O}$ . Easily sol. in HCl+Aq. (v. Ammon.)

$\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, 3\text{SiO}_2+3\text{H}_2\text{O}$ . Decomp. by acids. (Deville, A. ch. (3) 61. 326.)

$\text{Al}_2\text{O}_3, \text{Na}_2\text{O}, 4\text{SiO}_2+3\text{H}_2\text{O}$ . Easily sol. in HCl+Aq. (v. Ammon.)

$2\text{Al}_2\text{O}_3, 3\text{Na}_2\text{O}, 3\text{SiO}_2$ . Insol. in cold  $\text{H}_2\text{O}$ , but 27-30% dissolves on boiling. (Gorgeu.)

$\text{H}_2\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{24}$ . Min. *Paragonite*. Decomp. by conc.  $\text{H}_2\text{SO}_4$ .

$\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{12}+2\text{H}_2\text{O}$ . Min. *Analcite*. Readily decomp. by HCl+Aq.

$\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{10}+2\text{H}_2\text{O}$ . Min. *Natroilite*. Sol. in  $\text{H}_2\text{O}$  with separation of  $\text{SiO}_2$ . Also sol. in  $\text{H}_2\text{C}_2\text{O}_4$ +Aq.

$\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{18}$ . Min. *Albite*. Not attacked by acids.

**Aluminum sodium silicate chloride**,  
 $3\text{Na}_2\text{Al}_2(\text{SiO}_3)_3, 2\text{NaCl}$ .

Min. *Sodalite*. Easily decomp. by HCl, and  $\text{HNO}_3$ +Aq.

**Aluminum sodium silicate sulphate**,  
 $3\text{Na}_2\text{Al}_2(\text{SiO}_3)_3, \text{Na}_2\text{SO}_4$ .

Min. *Nosean*. Easily decomp. by HCl+Aq.

**Aluminum sodium silicate sulphide**.  
See Ultramarine.

**Barium silicate**,  $\text{BaSiO}_3$ .

Somewhat sol. in boiling  $\text{H}_2\text{O}$ . Completely sol. in dil. HCl+Aq. (v. Ammon.)

$+6\text{H}_2\text{O}$ , or  $7\text{H}_2\text{O}$ . Boiling  $\text{H}_2\text{O}$  decomposes, and dissolves about  $\frac{1}{2}$  the weight of this substance. (le Chatelier, C. R. 92. 931.)

$2\text{BaO}, \text{SiO}_2$ . Decomp. by  $\text{H}_2\text{O}$  into  $\text{BaSiO}_3+6\text{H}_2\text{O}$ . (Laudrin.)

**Bismuth silicate**,  $2\text{Bi}_2\text{O}_3, 3\text{SiO}_2$ .

Min. *Eulytite*. Decomp. by HCl+Aq.

**Bismuth ferric silicate**,  $\text{Bi}_2\text{Fe}_2\text{Si}_2\text{O}_{17}$ .

Min. *Bismuthoferrite*.

**Boron calcium silicate**.

See Borate silicate, calcium, and Silicate borate, calcium.

**Cadmium silicate**,  $\text{CdSiO}_3+1\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in HCl+Aq with deposition of pulverulent  $\text{SiO}_2, z\text{H}_2\text{O}$ . (Rousseau and Tite, C. R. 114. 1262.)

**Cæsium silicate**,  $\text{Cs}_2\text{SiO}_3$ .

(Kahlenberg, J. phys. Chem. 1898, 2. 82.)

**Calcium silicate,  $\text{CaSiO}_3$ .**

Slowly sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ .

Sol. in about 100,000 pts.  $\text{H}_2\text{O}$ . (Gorgeu, A. ch. 1885, (6) 4. 550.)

100 cc. sat. aq. solution of air dried calcium silicate contains 0.0046 g.  $\text{CaO} = 0.0095$  g.  $\text{CaSiO}_3$  at  $17^\circ$ . (Weisberg, Bull. Soc. 1896, (3) 15. 1097.)

100 cc. sat. solution of air dried calcium silicate in 10% sugar solution at  $17^\circ$  contains 0.0065 g.  $\text{CaO} = 0.0135$  g.  $\text{CaSiO}_3$ ; 20% sugar solution, 0.0076 g.  $\text{CaO} = 0.0175$  g.  $\text{CaSiO}_3$ .

After boiling and filtering hot, 10% sugar solution contains 0.0094 g.  $\text{CaO} = 0.0195$  g.  $\text{CaSiO}_3$ ; 20% sugar solution, 0.0120 g.  $\text{CaO} = 0.0249$  g.  $\text{CaSiO}_3$ . (Weisberg.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate: (Naumann, B. 1910, 43. 314.)

$4\text{CaO}, 3\text{SiO}_2$ . (Laudrin.)

$5\text{CaO}, 3\text{SiO}_2 + 5\text{H}_2\text{O}$ . When freshly precipitated is somewhat sol. in  $\text{H}_2\text{O}$  and easily decomp. by  $\text{HCl} + \text{Aq}$ . (v. Ammon.)

$\text{CaO}, 3\text{SiO}_2 + 2\text{H}_2\text{O}$ . (Hjeldt, J. pr. 94. 129.)

$2\text{CaO}, 9\text{SiO}_2 + 3\text{H}_2\text{O}$ . Ppt.

$\text{CaSiO}_3$ . Min. *Wollastonite*. Gelatinizes with  $\text{HCl} + \text{Aq}$ .

$\text{CaSi}_2\text{O}_6 + 2\text{H}_2\text{O}$ . Min. *Okenite*. Easily decomp. by cold  $\text{HCl} + \text{Aq}$  when powdered.

**Calcium glucinum silicate sodium fluoride,**  
( $\text{Ca}, \text{Gl}$ ) $_{10}\text{Si}_{11}\text{O}_{48}, 6\text{NaF}$ .

Min. *Leucophane*.

$7(\text{Ca}, \text{Gl})_2\text{Si}_7\text{O}_{70}, 6\text{NaF}$ . Min. *Melinophane*.

**Calcium ferrous silicate,  $\text{CaSiO}_3, \text{FeSiO}_3$ .**

Min. *Hedenbergite*, *Pyroxene*. Sl. decomp. by acids.

**Calcium ferric silicate,  $\text{Ca}_2\text{Fe}_2(\text{SiO}_3)_4$ .**

Min. *Garnet*. Sl. decomp. by  $\text{HCl} + \text{Aq}$ .

$2\text{CaSiO}_3, 11 \text{Fe}_2(\text{SiO}_3)_2$ . Min. *Szaboite*. Sl. attacked by  $\text{HCl} + \text{Aq}$ , and still less by  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Calcium ferroferric silicate,  $2\text{CaO}, 4\text{FeO}, \text{Fe}_2\text{O}_3, 4\text{SiO}_2 + \text{H}_2\text{O} = \text{H}_2\text{Ca}_2\text{Fe}_2\text{Fe}_2\text{Si}_4\text{O}_{12}$ .**

Min. *Lievrille*, *Iwaite*. Easily gelatinizes with  $\text{HCl} + \text{Aq}$ .

**Calcium ferrous magnesium silicate,**  
( $\text{Ca}, \text{Fe}, \text{Mg}$ ) $\text{SiO}_3$ .

Min. *Amphibole*, *Hornblende*, *Asbestos*, *Actinolite*, *Tremolite*. Only sl. attacked by acids.

**Calcium ferroferric sodium silicate,  $\text{CaSiO}_3, \text{FeSiO}_3, \text{Fe}_2(\text{SiO}_3)_2, \text{Na}_2\text{SiO}_3$ .**

Min. *Aegirite*.

**Calcium magnesium silicate,  $\text{CaO}, \text{MgO}, 4\text{SiO}_2$ .**

(Mutachler, A. 176. 86.)

$\text{Ca}_2\text{SiO}_4, \text{Mg}_2\text{SiO}_4$ . Min. *Monticellite*. Completely sol. in dil.  $\text{HCl} + \text{Aq}$ .

( $\text{Ca}, \text{Mg}$ ) $\text{SiO}_3$ . Min. *Diopside*, *Pyroxene*. Very sl. attacked by acids.

**Calcium manganous silicate,  $\text{CaSiO}_3, 2\text{MnSiO}_3$ .**

Min. *Bustamite*.

**Calcium potassium silicate.**

See under Glass.

**Calcium sodium silicate,  $(\text{Ca}, \text{Na}_2, \text{H}_2)\text{SiO}_2$ .**

Min. *Pectolite*. Decomp. by  $\text{HCl} + \text{Aq}$ . See under glass.

**Calcium sodium silicate zirconate,**  
 $\text{Na}_2\text{Ca}(\text{Si}, \text{Zr})_2\text{O}_{21} + 9\text{H}_2\text{O}$ .

Min. *Wöhlerite*. Decomp. by  $\text{HCl} + \text{Aq}$ .

**Calcium uranyl silicate,  $3\text{CaO}, 5\text{UO}_2, 6\text{SiO}_2 + 18\text{H}_2\text{O}$ .**

Min. *Uranophane*. Gelatinizes with acids.  $\text{CaO}, 3\text{UO}_2, 3\text{SiO}_2 + 9\text{H}_2\text{O}$ . Min. *Uranotile*.

**Calcium silicate chloride,  $2\text{CaO}, \text{SiO}_2, \text{CaCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HCl} + \text{Aq}$ . (le Chatelier, C. R. 97. 1510.)

**Calcium silicate fluoride,  $2\text{CaO}, 3\text{SiO}_2, 6\text{CaF}_2$ .**  
(Deville, C. R. 52. 110.)

**Calcium silicate potassium fluoride,**  
 $4\text{H}_2\text{CaSi}_2\text{O}_6, \text{KF} + 4\text{H}_2\text{O}$ .

Min. *Apophyllite*. Decomp. by  $\text{HCl} + \text{Aq}$ .

**Calcium silicate stannate.**

See Silicostannate, calcium.

**Calcium silicate titanate,  $\text{CaO}, \text{SiO}_2, \text{TiO}_2$ .**

(Hautefeuille, A. ch. (4) 4. 154.)

Min. *Titanite*. Incompletely decomp. by  $\text{HCl} + \text{Aq}$ , wholly by  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Cerous silicate,  $\text{Ce}_2(\text{SiO}_3)_2$ .**

More or less attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , according to the concentration. (Didier, C. R. 101. 882.)

**Cerium didymium lanthanum silicate,**  
 $2(\text{Ce}, \text{La}, \text{Di})_2\text{O}_3, 3\text{SiO}_2$ .

Min. *Cerite*. Gelatinizes with  $\text{HCl} + \text{Aq}$ .

**Cerium glucinum yttrium silicate,**  
( $\text{Y}, \text{Ce}, \text{Gl}$ ) $\text{SiO}_3$ .

Min. *Gadolinite*. Easily gelatinized by  $\text{HCl} + \text{Aq}$ .

**Cerous silicate chloride,  $2\text{Ce}_2\text{O}_3, 3\text{SiO}_2, 4\text{CeCl}_2 = \text{Ce}_4(\text{SiO}_3)_3, 4\text{CeCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ , but slowly decomp. thereby. (Didier, C. R. 101. 882.)

**Cobaltous silicate,  $\text{Co}_2\text{SiO}_4$ .**

Gelatinizes with  $\text{HCl} + \text{Aq.}$  (Bourgeois, C. R. 108. 1077.)

**Cupric silicate,  $\text{CuH}_2\text{SiO}_4$ .**

Min. *Diopside*. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  with separation of  $\text{SiO}_2$ . Not attacked by  $\text{KOH} + \text{Aq.}$

$\text{CuSiO}_3 + 2\text{H}_2\text{O}$ . Min. *Chrysocolla*. Decomp. by  $\text{HCl} + \text{Aq.}$

$+ 3\text{H}_2\text{O}$ . Min. *Asperokite*. Easily decomp. by  $\text{HCl} + \text{Aq.}$

"Cupric silicate" is insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Cupric silicate ammonia,  $\text{CuSi}_2\text{O}_5, 2\text{NH}_3$ .**

Ppt. (Schiff, A. 123. 38.)

**Glucinum silicate,  $\text{Gl}_2\text{SiO}_4$ .**

Min. *Phenacite*. Not attacked by acids.

**Glucinum ferrous manganous silicate ferrous manganous sulphide,  $3(\text{Gl}, \text{Fe}, \text{Mn})_2\text{SiO}_4, (\text{Mn}, \text{Fe})\text{S}$ .**

Min. *Helvine*. Decomp. by  $\text{HCl} + \text{Aq.}$

**Iron (ferrous) silicate,  $\text{Fe}_2\text{SiO}_4$ .**

Min. *Fayalite*. Gelatinizes with  $\text{HCl} + \text{Aq.}$

$\text{FeSiO}_3$ . Min. *Grunerite*.

$+ 6\text{H}_2\text{O}$ . Min. *Chlorophite*.

$4\text{FeO}, \text{SiO}_2$ . (Zobel, Dingl. 154. 111.)

**Iron (ferric) silicate,  $\text{Fe}_2\text{Si}_2\text{O}_7 + 5\text{H}_2\text{O}$ .**

Min. *Nontronite*. Gelatinizes with hot acids.

$4\text{Fe}_2\text{O}_3, 9\text{SiO}_2 + 18\text{H}_2\text{O}$ . Min. *Hisingerite*.

$2\text{Fe}_2\text{O}_3, 9\text{SiO}_2 + 2\text{H}_2\text{O}$ . Min. *Anthosiderite*.

**Iron (ferroferic) magnesium silicate,**

$(\text{Fe}, \text{Mg})_2\text{Fe}_2\text{Si}_2\text{O}_{10} + 4\text{H}_2\text{O}$ .

Min. *Cronstedtite*. Gelatinizes with acids.

**Iron (ferroferic) sodium silicate,  $5\text{Na}_2\text{SiO}_3,$** 

$2\text{Fe}_2\text{SiO}_3, 4\text{Fe}_2(\text{SiO}_3)_3$ .

Min. *Akavite*. Sl. decomp. by acids.

**Iron (ferrous) magnesium silicate,  $\text{Fe}_2\text{SiO}_4,$** 

$\text{Mg}_2\text{SiO}_4$ .

Min. *Olivenite, Chrysotile, Peridot*. Gelatinizes with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

$(\text{Fe}, \text{Mg})\text{SiO}_3 + \frac{1}{2}\text{H}_2\text{O}$ . Min. *Picrophyllite*.

$+ \frac{1}{2}\text{H}_2\text{O}$ . Min. *Monradite*.

$(\text{Fe}, \text{Mg})\text{SiO}_3$ . Min. *Bronzite, Hypersthene*. Not attacked by acids.

$2\text{MgSiO}_3, 2\text{FeSiO}_3$ . Min. *Anthrophyllite*. Not attacked by acids.

**Iron (ferrous) manganous silicate,  $\text{Fe}_2\text{SiO}_4,$** 

$\text{Mn}_2\text{SiO}_4$ .

Min. *Knobekite*. Gelatinizes with  $\text{HCl} + \text{Aq.}$

**Iron (ferrous) manganous silicate chloride,**

$7(\text{Fe}, \text{Mn})\text{SiO}_3, (\text{Fe}, \text{Mn})\text{Cl}_2 + 5\text{H}_2\text{O}$ .

Min. *Pyrosmalite*. Completely decomp. by conc.  $\text{HNO}_3 + \text{Aq.}$

**Iron (ferric) potassium silicate,  $\text{Fe}(\text{SiO}_3)_2,$** 

$\text{K}_2\text{SiO}_3$ .

(Hautefeuille and Perrey, C. R. 107. 1150.)

**Iron (ferric) sodium silicate,  $\text{Na}_2\text{Fe}_2\text{Si}_2\text{O}_{12}$ .**

Min. *Crokydokit*. Not attacked by acids.

**Lead silicate.**

Insol. in acetone. (Naumann, B. 1904, 37. 4329); methyl acetate. (Naumann, B. 1909, 42. 3790.)

See under Glass.

**Lithium silicate,  $\text{Li}_2\text{Si}_2\text{O}_7$ .**

$\text{Li}_2\text{SiO}_4$ .

$\text{Li}_2\text{SiO}_3$ . More stable towards  $\text{H}_2\text{O}$  than the other alkali metasilicates. (Rieke and Endell, C. C. 1911, I. 7.)

Decomp. by boiling  $\text{H}_2\text{O}$  and acids. (Friedel, C. C. 1901, II. 89.)

Scarcely attacked by cold  $\text{H}_2\text{O}$ . (Friedel, Bull. Soc. Min. 1901, 24. 141.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3601); methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Magnesium silicate,  $\text{Mg}_2\text{Si}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**

Min. *Serpentine*. Decomp. by  $\text{HCl} + \text{Aq.}$ , more easily by  $\text{H}_2\text{SO}_4$ .

Min. *Chrysotile*.

$\text{Mg}_2\text{Si}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Min. *Gymnita, Soapstone*. Decomp. by  $\text{H}_2\text{SO}_4$ .

$\text{MgSiO}_3$ . Not completely decomp. by  $\text{HCl} + \text{Aq.}$

$+ \frac{1}{2}\text{H}_2\text{O}$ . Min. *Aphrodite*. Decomp. by hot acids.

$+ \frac{1}{2}\text{H}_2\text{O}$ . Min. *Picrosmine*.

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in dil. acids. (v. Ammon.)

Min. *Forsterite*.

$3\text{MgO}, 4\text{SiO}_2 + \text{H}_2\text{O}$  or  $4\text{MgO}, 5\text{SiO}_2 + \frac{1}{2}\text{H}_2\text{O}$ . Min. *Talc* or *Steatite*. Not attacked by  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

$\text{Mg}_2\text{Si}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Min. *Spadaite*. Decomp. by conc.  $\text{HCl} + \text{Aq.}$

$\text{Mg}_2\text{Si}_2\text{O}_7 + 4\text{H}_2\text{O}$ . Min. *Meerschauum*. Decomp. by  $\text{HCl} + \text{Aq.}$

"Magnesium silicate" is insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Magnesium potassium silicate,**

$\text{MgO}, \text{K}_2\text{O}, 3\text{SiO}_2$ .

Easily sol. in acids with decomp. (Duboin, C. R. 1895, 120. 681.)

**Magnesium silicate fluosilicate,  $\text{Mg}_2\text{Si}_2\text{O}_7,$** 

$\text{Mg}_2\text{Si}_2\text{F}_{11}$ .

Min. *Humite, Chondrodite*. Gelatinizes with  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq.}$

**Manganous silicate,  $Mn_2SiO_4$ .**

Min. *Tephroite*. Decomp. by  $HCl + Aq$  with formation of a stiff jelly.

$MnSiO_3$ . Min. *Rhodnite*, *Hermannite*. Not attacked by  $HCl + Aq$ .

$Mn_2Si_2O_7 + 2H_2O$ . Min. *Friedelite*.

Easily gelatinized by  $HCl + Aq$ .

"Manganous silicate" is insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Manganous zinc silicate,  $(Mn,Zn)_2SiO_4$ .**

Min. *Troostite*.

**Manganous silicate chloride,  $MnSiO_3, MnO, MnCl_2$ .**

Decomp. by  $H_2O$ . (Gorgeu.)

**Nickel silicate,  $Ni_2SiO_4$ .**

Easily decomp. by acids. (Bourgeois, C. R. 108. 1077.)

**Potassium silicate,  $K_2SiO_3$ .**

Completely sol. in  $H_2O$ . (Ordway, Sill. Am. J. (2) 33. 34.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

$K_2Si_2O_5$ . Sol. in  $H_2O$ . Conc.  $K_2Si_2O_5 + Aq$  contains 28% of the salt, and has sp. gr. 1.25. (Fuchs.)

Hydroscopic. Decomp. at once by  $H_2O$ . (Morey, J. Am. Chem. Soc. 1914, 36. 222.)

$K_2Si_2O_7$ . Partially sol. in  $H_2O$  as  $K_2SiO_3$ .  $K_2Si_2O_7 + 16H_2O$ . Insol. in  $H_2O$ . (Forchhammer.)

The K silicates are pptd. from their aqueous solution by alcohol with partial decomp., but less readily than Na silicates.

More sol. in  $H_2O$  than the corresponding Na salts. (Ordway, Sill. Am. J. (2) 32. 155.)

Solution can be obtained which is perfectly clear when  $4\frac{1}{2}SiO_2$  are present to  $1K_2O$ , if there are no impurities present. (Ordway.)

The K silicates resemble the Na salts, which see for further data.

**Potassium hydrogen silicate,  $KHSiO_3$ .**

Not readily affected by  $H_2O$ , even by treatment at  $100^\circ$  for several hours.

Decomp. by heating with dil.  $HCl$ . (Morey, J. Am. Chem. Soc. 1914, 36. 222.)

**Potassium zinc silicate.**

Sol. in  $KOH + Aq$ . (Schindler.)

$K_2O, 6ZnO, 4SiO_2$ . Sol. in  $HCl + Aq$ . (Duboin, C. R. 1905, 141. 255.)

$8K_2O, 9ZnO, 17SiO_2$ . Sol. in  $HCl + Aq$ . (Duboin.)

**Potassium zirconium silicate,  $K_2O, ZrO_2, 2SiO_2$ .**

Decomp. by  $HCl + Aq$ . (Melliss.)

**Rubidium silicate,  $Rb_2SiO_3$ .**

(Kahlenberg, J. phys. Chem. 1898, 2. 82.)

**Silver silicate,  $Ag_2SiO_3$ .**

Decomp. by all acids; sol. in  $NH_4OH + Aq$ . (Hawkins, Sill. Am. J. 139. 311.)

**Sodium silicate,  $Na_2SiO_3$ .**

Rapidly decomp. by  $H_2O$ . (Morey, J. Am. Chem. Soc. 1914, 36. 224.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+5, 6, and  $8H_2O$ . Easily sol. in  $H_2O$ . + $9H_2O$ . Solubility in  $\frac{1}{2}$ -N  $NaOH + Aq$ .

100 ccm. of the solution contain 25.56 g.  $Na_2SiO_3 + 9H_2O$  at  $17.5^\circ$ .

Sp. gr. of the solution = 1.129. (Vesterberg, C. C. 1913. 777.)

100 ccm. of a sat. solution of sodium silicate in  $\frac{1}{2}$ -N.  $NaCl + Aq$ . contain 3.83 g.  $Na_2SiO_3 + 9H_2O$  at  $17.5^\circ$ . Sp. gr. of solution = 1.15.

100 ccm. of a sat. solution of sodium silicate in sat.  $NaCl + Aq$  contain 20.64 g.  $Na_2SiO_3 + 9H_2O$  at  $17.5^\circ$ . (Vesterberg.)

$Na_2Si_2O_5$ . Sol. in  $H_2O$ .

Slowly decomp. by cold  $H_2O$ . (Morey, J. Am. Chem. Soc. 1914, 36. 223.)

$Na_4Si_2O_7$ .

$Na_2Si_2O_5$ . Slowly sol. in  $H_2O$ .

+ $12H_2O$ .

Above compounds are all more or less indefinite.

*Water glass.*  $xNa_2O, ySiO_2 + zH_2O$ . Sol. in  $H_2O$ , but solution is decomposed by all weak acids, even  $CO_2$ .

Fused water glass is but little acted on by cold  $H_2O$ , but when pure, easily dissolves in  $H_2O$  by long boiling. (Ordway, Am. J. Sci. (2) 32. 337.)

When the  $SiO_2$  is present in greater proportion than in  $Na_2O, 3SiO_2$ , it is very difficult to dissolve in  $H_2O$ .

Na silicate is less easily sol. in  $H_2O$  than the corresponding K compound.

Solubility of water glass in  $H_2O$  is much impaired by earthy impurities, so that traces have great effect in preventing the solubility.

$NH_4$  salts decomp. water glass solutions. A solution containing  $\frac{1}{2}\% Na_2SiO_3$  is scarcely precipitated by  $NH_4Cl$ , but easily by  $NH_4NO_3$ . (Fluckinger.)

Precipitated by  $NH_4OH + Aq$  as  $Na_2SiO_3$ .

Many sodium and potassium salts, especially the chlorides and acetates, form precipitates in solutions of water glass; these precipitates are larger the more concentrated the solution is, and the greater amount of  $SiO_2$  it contains. Heating hastens the precipitation by chlorides, nitrates, and sulphates, but delays that by acetates.  $KOH + Aq$  does not precipitate.

Cold sat.  $Na_2SO_4 + Aq$  does not precipitate even on heating, but 1 pt. anhydrous  $Na_2SO_4$  dissolved in 2 pts.  $H_2O$  precipitates a hot solution of  $Na_2SiO_3$ .

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$\text{NaNO}_3$  dissolved in 1 pt.  $\text{H}_2\text{O}$  precipitate  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  of 1.392 sp. gr.;  $\text{NaNO}_3$  in 2 pts.  $\text{H}_2\text{O}$  when mixed with a solution of  $\text{Na}_2\text{SiO}_3$ , as above, if the two are present in equal vols., causes no ppt. in the cold, but solidifies when warmed to  $54^\circ$ , and redissolves on cooling rapidly, but if 2 vols.  $\text{NaNO}_3 + \text{Aq}$  are present to 1 vol.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ , the precipitate does not disappear on cooling.

If 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  (0.921 sp. gr.) is added to 10 pts.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ , no ppt. forms, but by increasing the amt. of  $\text{NH}_4\text{OH} + \text{Aq}$  to 2 pts., the greater pt. of the  $\text{Na}_2\text{SiO}_3$  is pptd., but redissolves on heating to  $90^\circ$ , separating again on cooling. When 1 pt.  $\text{NH}_4\text{OH} + \text{Aq}$  is added to 6-8 pts.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  and heated to  $30^\circ$ , a clear liquid is formed which separates into two layers at ordinary temp.

The most sol. K, Na, Li, and  $\text{NH}_4$  salts separate  $\text{SiO}_2$  from conc.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ . Most of these salts lose this power by dilution, but the  $\text{NH}_4$  salts and  $\text{KSON}$  keep this power until the solution is very dil. This is especially the case with  $\text{NH}_4\text{Cl}$  and  $\text{NH}_4\text{NO}_3$ .

Bromine, chlorine, propyl amine, creosote, phenole dissolved in glycerine, chloral hydrate, dil. albumen solution, and glue solution ppt.  $\text{SiO}_2$  from  $\text{Na}_2\text{SiO}_3 + \text{Aq}$ ; but sugar, dextrine, glycerine, urea, al. alkaline solution of urea nitrate, conine, nicotine, saponine, convolvuline, jalappine, and colophonium dissolved in  $\text{KOH} + \text{Aq}$  do not ppt.  $\text{SiO}_2$ . (Flückinger, Arch. Pharm. (2) 144. 97.)

Alcohol ppts. water glass as such from its aqueous solution, even when this is very dil., but there is some decomposition, the alcohol tending to hold in solution a portion of a silicate more alkaline than that previously dissolved in  $\text{H}_2\text{O}$ , while the ppt. formed contains more  $\text{SiO}_2$  than the original silicate.

Many neutral K or Na salts ppt. water glass as such when added to aqueous solutions. Like alcohol, these solutions exert a decomposing action, the ppt. being always more siliceous than the original silicate. Na silicate yields a larger deposit than K silicate; when a silicate of one base is pptd. by a salt of the other, both bases enter into the composition of the ppt, and the relative proportion of Na and K is very nearly the same as in the average of the liquids mixed.

Different salts have very unequal pptg. power, the acetates and chlorides being particularly efficient. Heat increases the pptg. power of the chlorides, sulphates, and nitrates, and diminishes that of the acetates. The alkali acetates are somewhat more efficient than the chlorides, but  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$  gives only a slight ppt. with  $\text{Na}_2\text{O}$ ,  $2\frac{1}{2}\text{SiO}_2$ , even after some time.

$\text{NaNO}_3$  has but little effect on the more alkaline silicates.

$\text{Na}_2\text{SO}_4$  has still less power than  $\text{NaNO}_3$ .  $\text{Na}_2\text{CO}_3$  has no pptg. power, and  $\text{Na}_2\text{AsO}_4$  or  $\text{Na}_3\text{PO}_4$  have very little effect.

$\text{MH}_2\text{SO}_4$ ,  $\text{MHCO}_3$ ,  $\text{M}_2\text{HPO}_4$ ,  $\text{M}_2\text{HASO}_4$ , ppt.  $\text{SiO}_2$ .  $\text{NH}_4$  salts also have that effect.

Pptd. water glass, as mentioned above, is much more sol. in  $\text{H}_2\text{O}$  than ordinary water glass, and dissolves in  $\text{H}_2\text{O}$  without decomp. For numerous further details, see articles by Ordway in Sill. Am. J. Sci. vols. 32 and 33; also Storer's Dict.

Sp. gr. of water glass solution containing 14-15%  $\text{SiO}_2$ , 13-14%  $\text{Na}_2\text{O}$ , and 70-72%  $\text{H}_2\text{O}$  is 1.30-1.35. (Hager, Comm. 1883.)

Sp. gr. of sat.  $\text{Na}_2\text{SiO}_3 + \text{Aq}$  freshly prepared at  $18^\circ$  is 1.2600, and 1 litre contains 4.5 gramme-equivalents  $\frac{1}{2}\text{Na}_2\text{SiO}_3$ .

Sp. gr. of sat. solution of  $\text{Na}_2\text{O}$ ,  $3.4\text{SiO}_2$  is 1.366, and 1 litre contains 3.7 gramme-equivalents  $\frac{1}{2}(\text{Na}_2\text{O}, 3.4\text{SiO}_2)$ . (Kohlrausch, Z. phys. Ch. 12. 773.)

**Sodium zirconium silicate**,  $\text{Na}_2\text{O}$ ;  $\text{ZrO}_2$ ;  $\text{SiO}_2$ .

Decomp. by hot  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . (Gibbs, Pogg. 71. 559.)

$\text{Na}_2\text{O}$ ,  $8\text{ZrO}_2$ ,  $\text{SiO}_2 + 11\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{SO}_4$ . (Melliss.)

**Strontium silicate**,  $\text{SrSiO}_3$ .

(Stein, Z. anorg. 1907, 55. 164.)

$+ \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Jordis and Kanter, Z. anorg. 1903, 35. 90.)

$\text{SrSiO}_4$ . (Stein, Z. anorg. 1907, 55. 167.)

$3\text{SrO}$ ,  $\text{SiO}_2$ . Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Vauquelin.)

**Thallous silicate**,  $3\text{Tl}_2\text{O}$ ,  $10\text{SiO}_2$ .

100 pts. of a solution of  $\text{Tl}_2\text{O}$  dissolve 4.17 pts.  $\text{SiO}_2$  by 24 hours' boiling. Sol. in  $\text{H}_2\text{O}$ . (Flemming, J. B. 1868. 251.)

**Thorium silicate**,  $\text{ThO}_2$ ,  $\text{SiO}_2$ .

Insol. in acids. Attacked by  $\text{KHSO}_4$ . (Troost and Ouvrard, C. R. 105. 255.)

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Min. *Thorite*. Decomp. by  $\text{HCl} + \text{Aq}$ .

$\text{ThO}_2$ ,  $2\text{SiO}_2$ . Insol. in acids or  $\text{KHSO}_4$ . (T. and O.)

**Yttrium silicate**,  $\text{Y}_2\text{O}_3$ ,  $\text{SiO}_2$ .

Attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Duboin, C. R. 107. 99.)

**Zinc silicate**,  $\text{ZnSiO}_3$ .

(Stein, Z. anorg. 1907, 55. 165.)

$\text{Zn}_2\text{SiO}_4$ . Min. *Willemite*. Gelatinizes with  $\text{HCl} + \text{Aq}$ ; sol. in  $\text{KOH} + \text{Aq}$ .

Decomp. by cold sat. citric acid +  $\text{Aq}$ . (Bolton, C. N. 1881, 43. 34.)

$+ \text{H}_2\text{O}$ . Min. *Calamine*. Sol. in  $\text{HCl} + \text{Aq}$  with separation of gelatinous  $\text{SiO}_2$ ,  $x\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , and  $\text{KOH} + \text{Aq}$ .

Insol. in  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Brandhorst, Zeit. angew. Ch. 1904, 17. 513.)

$\text{ZnO}$ ,  $3\text{SiO}_2$ . (Bornträger, Ch. Z. 1893, 8. 186.)



**Zirconium silicate,  $\text{SiO}_2$ ,  $\text{ZrO}_2$ .**

Min. *Zircon*. Insol. in acids, except  $\text{H}_2\text{SO}_4$ , in which it is very slowly and sl. sol.  
 $3\text{SiO}_2$ ,  $2\text{ZrO}_2$ . Min. *Auerbachite*.

**"Silicium oxide,"  $\text{Si}_2\text{H}_2\text{O}_2$ .**

(Geuther, J. pr. 95. 430.) This substance is identical with silicoformic anhydride according to Otto-Graham's Handb. anorgan. Chem. 7te Aufl. 2. 953.

**Siliciuretted hydrogen.**

See Silicon hydride.

**Silicobromoform,  $\text{HSiBr}_3$ .**

Fumes on air; decomp. by  $\text{H}_2\text{O}$ .

**Silicochloroform,  $\text{HSiCl}_3$ .**

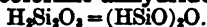
Decomp. by  $\text{H}_2\text{O}$  and alcohol.  
 Completely miscible with  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ ,  $\text{SiCl}_4$ ,  $\text{SnCl}_4$ ,  $\text{TiCl}_4$ , and  $\text{AsCl}_3$ . (Ruff, B. 1905, 38. 2230.)

**Silicoethane.**

See Silicon hydride.

**Silicofluoroform,  $\text{SiHF}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Decomp. by  $\text{NaOH}$  and abs. alcohol with evolution of hydrogen. Decomp. by abs. ether. Sol. in toluene. (Ruff, B. 1905, 38. 63.)

**Silicoformic anhydride,**

Somewhat sol. in  $\text{H}_2\text{O}$ . Acids, even conc.  $\text{HNO}_3$  + Aq. have no action, except  $\text{HF}$ , which dissolves it easily with evolution of hydrogen. Solutions of alkali hydrates, ammonium hydrate, and alkali carbonates + Aq. also dissolve with evolution of hydrogen. (Ruff and Wöhler, A. 104. 101.)

**Silicoidoform,  $\text{HSiI}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{CS}_2$ . (Friedel, A. 149. 96.)  
 Miscible with  $\text{C}_6\text{H}_6$  and  $\text{CS}_2$ . (Ruff, B. 1908, 41. 3739.)

**Silicomethane,  $\text{SiH}_4$ .**

See Silicon hydride.

**Silicomethyl chloride,  $\text{SiH}_3\text{Cl}$ .**

Decomp. by  $\text{H}_2\text{O}$  and by alkalis. (Besson and Fournier, C. R. 1909, 148. 556.)

**Silicomethylene chloride,  $\text{SiH}_2\text{Cl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and by alkalis. (Besson and Fournier, C. R. 1909, 148. 556.)

**Silicomolybdic acid,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $26\text{H}_2\text{O}$ .**

Very easily sol. in  $\text{H}_2\text{O}$  and dil. acids. (Parmentier, C. R. 94. 213.)

Forms a solution with a little ether, which separates into two layers by addition of  $\text{H}_2\text{O}$  or more ether. (Parmentier, C. R. 104. 686.) (Copaux, Bull. Soc. Min. 1906, 29. 79.)  
 +  $32\text{H}_2\text{O}$ . Decomp. by alkali. (Asch, Z. anorg. 1901, 28. 293.)  
 +  $33\text{H}_2\text{O}$ . (Copaux, Bull. Soc. Min. 1906, 29. 79.)

**Aluminum silicomolybdate,  $2\text{Al}_2\text{O}_3$ ,  $3(\text{SiO}_2$ ,  $12\text{MoO}_3)$  +  $93\text{H}_2\text{O}$ .**

(Copaux, A. ch. 1906, (8) 7. 118.)

**Aluminum sodium silicomolybdate,  $4(\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ ,  $2\text{SiO}_2$ ),  $\text{Na}_2\text{MoO}_4$  +  $7\text{H}_2\text{O}$ .**

Sol. in  $\text{HCl}$  + Aq. (Thugutt, Z. anorg. 1892, 2. 87.)

**Ammonium silicomolybdate.**

Sol. in  $\text{H}_2\text{O}$ . (Parmentier, C. R. 94. 213.)

**Barium silicomolybdate,  $2\text{BaO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $16\text{H}_2\text{O}$ .**

(Copaux, A. ch. 1906, (8) 7. 118.)  
 +  $22\text{H}_2\text{O}$ . Sol. in 4 pts.  $\text{H}_2\text{O}$ . (Copaux, Bull. Soc. Min. 1906, 29. 80.)  
 +  $24\text{H}_2\text{O}$ . Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Asch, Z. anorg. 1901, 28. 282.)  
 +  $29\text{H}_2\text{O}$ . Efflorescent. (Copaux, A. ch. 1906, (8) 7. 118.)

**Cadmium silicomolybdate,  $2\text{CdO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $22\text{H}_2\text{O}$ .**

Very unusually sol. in  $\text{H}_2\text{O}$ . (Copaux, A. ch. 1906, (8) 7. 140.)

**Cæsium silicomolybdate.**

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in silicomolybdic acid + Aq.

**Calcium silicomolybdate,  $2\text{CaO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $24\text{H}_2\text{O}$ .**

Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Asch, Z. anorg. 1901, 28. 282.)  
 +  $26\text{H}_2\text{O}$ . (Copaux, A. ch. 1906, (8) 7. 118.)  
 +  $31\text{H}_2\text{O}$ . (Copaux.)

**Chromium silicomolybdate,  $2\text{Cr}_2\text{O}_3$ ,  $3(\text{SiO}_2$ ,  $12\text{MoO}_3)$  +  $93\text{H}_2\text{O}$ .**

(Copaux.)

**Cupric silicomolybdate,  $2\text{CuO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $31\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Copaux.)

**Lithium silicomolybdate,  $2\text{Li}_2\text{O}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $29\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Copaux.)

**Magnesium silicomolybdate,  $2\text{MgO}$ ,  $\text{SiO}_2$ ,  $12\text{MoO}_3$  +  $30\text{H}_2\text{O}$ .**

(Asch, Z. anorg. 1901, 28. 282.)  
 +  $31\text{H}_2\text{O}$ . Very efflorescent and sol. in  $\text{H}_2\text{O}$ . (Copaux.)

**Potassium silicomolybdate**,  $2K_2O, SiO_2, 12MoO_3 + 16H_2O$ .

Efflorescent. Very sol. in  $H_2O$ . (Asch, Z. anorg. 1901, 28, 282.)

$1.5K_2O, SiO_2, 12MoO_3 + 14H_2O$ . (Asch.)

Sol. in  $H_2O$  with decomp. (Copaux.)

**Potassium silver silicomolybdate**,  $K_2O, 3Ag_2O, 2(SiO_2, 12MoO_3) + 14H_2O; + 22H_2O; + 30H_2O$ .

Sol. in  $H_2O$  with decomp. Sol. unchanged in dil. mother liquor. (Copaux, Bull. Soc. Min. 1907, 30, 293.)

**Rubidium silicomolybdate**.

Sl. sol. in  $H_2O$ .

**Silver silicomolybdate**,  $1.5Ag_2O, SiO_2, 12MoO_3 + 11H_2O$ .

Sol. in cold  $H_2O$ . (Asch.)

$2Ag_2O, SiO_2, 12MoO_3 + 12H_2O$ . Decomp. by boiling  $H_2O$ . Sol. in  $NH_4OH + Aq$ .

$4Ag_2O, SiO_2, 12MoO_3 + 15H_2O$ . (Asch.)

**Sodium silicomolybdate**,  $2Na_2O, SiO_2, 12MoO_3 + 14H_2O$ .

(Copaux.)

$2Na_2O, SiO_2, 12MoO_3 + 21H_2O$ . Very sol. in  $H_2O$ . Efflorescent. (Asch.)

$+ 22H_2O$ . (Copaux.)

$1.5Na_2O, SiO_2, 12MoO_3 + 17H_2O$ . (Asch.)

$3Na_2O, 2(SiO_2, 12MoO_3) + 17H_2O$ . (Copaux.)

**Strontium silicomolybdate**,  $2SrO, SiO_2, 12MoO_3 + 26H_2O$ .

(Copaux.)

**Zinc silicomolybdate**,  $2ZnO, SiO_2, 12MoO_3 + 31H_2O$ .

Extremely sol. in  $H_2O$ . (Copaux.)

**Silicon, Si.**

*Amorphous*. Insol. in  $H_2O$ . Sol. before igniting in cold HF. Insol. in other mineral acids and aqua regia. Sol. in conc. KOH + Aq. When amorphous Si is ignited, it becomes insol. in HF and KOH + Aq.

Amorphous Si is sol. in aqua regia and in a mixture of  $HNO_3$  and HF. (Vigouroux-Moissan, C. R. 1895, 120, 367.)

Insol. in liquid  $CO_2$ . (Buchner, Z. phys. Ch. 1906, 54, 674.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20, 830.)

*Graphitic*. Sol. in  $HNO_3 + HF$ . (Berselius, A. 49, 247.)

*Crystalline*. Insol. in all acids, except a mixture of HF and  $HNO_3$ . Sol. in moderately conc. KOH + Aq even when cold. (Deville.)

Although it has been generally understood that crystallised Si is not attacked by HF, it is now found that this applies only to HF +

Aq. Gaseous HF readily attacks cryst. Si. (Newth, C. N. 1896, 72, 287.)

Si cryst. from Ag is incompletely sol. in HF. According to the temp. to which the Ag Si mixture has been heated, the following percentages of Si are dissolved in HF: 970°, 58.02%; 1150°, 27.66%; 1250°, 19%; 1470°, 16%. (Moissan and Siemens, C. R. 1904, 138, 657, 1300.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20, 830.)

**Silicon amide**,  $Si(NH_3)_4$ .

Unstable; decomp. by  $H_2O$  and partially decomp. by  $HNO_3$ ; sol. in most organic solvents. (Lengfeld, Am. Ch. J. 1899, 21, 531.)

Decomp. by  $H_2O$ ; insol. in liquid  $NH_3$ . (Vigouroux, C. R. 1903, 136, 1670.)

**Silicon triboride**,  $SiB_3$ .

Slowly attacked by  $HNO_3$ . Decomp. by hot conc.  $H_2SO_4$  or fused KOH. (Moissan, C. R. 1900, 131, 142.)

**Silicon hexaboride**,  $SiB_6$ .

Readily attacked by  $HNO_3$ . Slowly decomp. by hot conc.  $H_2SO_4$ . Not attacked by fused KOH. (Moissan, C. R. 1900, 131, 142.)

**Silicon tribromide**,  $Si_2Br_6$ .

Decomp. by KOH + Aq. (Friedel and Ladenburg, A. 203, 253.)

$HSiBr_3$ . See *Silicobromoform*.

**Silicon tetrabromide**,  $SiBr_4$ .

Rapidly decomp. by  $H_2O$ ; decomp. in several days by  $H_2SO_4$ . (Friedel and Ladenburg, A. 147, 362.)

**Silicon bromide**,  $Si_2Br_6$ .

(Besson, C. R. 1910, 151, 1056.)

$Si_2Br_{10}$ . (Besson.)

**Disilicon hydrogen pentabromide**,  $HSi_2Br_5$  or  $Si_2Br_6$  (?).

Decomp. by  $H_2O$ . (Mahn, Zeit. Chem. (2) 5, 279.)

**Silicon tetrabromide ammonia**,  $SiBr_4, 6NH_3$ .

Decomp. by  $H_2O$ . (Lay, Dissert. 1910.)

$SiBr_4, 7NH_3$ . Decomp. by  $H_2O$ . (Besson, C. R. 110, 240.)

**Silicon bromodide**,  $SiBr_3$ .

Decomp. by  $H_2O$ . Sol. in  $CS_2$ . (Friedel, B. 2, 60.)

$SiBr_3I_2$ . As above. (F.)

$SiBr_3$ . As above. (F.)

**Silicon bromosulphide**,  $SiSBr_3$ .

Decomp. in moist air. Violently decomp. by  $H_2O$ . Sol. in  $CS_2$  and other organic solvents. (Blix, B. 1903, 36, 4218.)

**Silicon carbide, SiC.**

Very stable; insol. in  $H_2SO_4$  and  $HNO_3$ ; sol. in fused KOH at red heat. (Moissan, Bull. Soc. 1894, (3) 11. 997.)

Cryst. modification. Insol. in acids; sol. in fused alkalis. (Moissan, C. R. 1893, 117. 427.)

Insol. in all acids; sol. in molten alkalis. (Muhlhaeuser, Z. anorg. 1894, 5. 116.)

See *Silundum*.

**Silicon subchloride,  $SiCl_2$  (?).**

Decomp. by  $H_2O$ . (Troost and Haute-feuille, A. ch. (5) 7. 463.)

**Silicon trichloride,  $Si_2Cl_4$ .**

Decomp. by  $H_2O$  and alkalis. (Troost and Hautefeuille, A. ch. (5) 7. 459.)

$SiHCl_3$ . See *Silicochloroform*.

**Silicon tetrachloride,  $SiCl_4$ .**

Decomp. by  $H_2O$  and alcohol.

**Silicon octochloride,  $Si_2Cl_{10}$ .**

"Perchlorsilicopropane." Decomp. by  $H_2O$ . (Gattermann, B. 1894, 27. 1947.)

**Silicon chloride,  $Si_2Cl_6$ .**

(Besson, C. R. 1909, 149. 36.)

$Si_2Cl_6$ . "Perchlorsilicobutane." Decomp. by  $H_2O$ . Fumes in the air. (Besson.)

$Si_2Cl_6$ . "Perchlorsilicohexane." Decomp. by  $H_2O$ . (Besson, C. R. 1909, 148. 841.)

**Silicon trichloride ammonia,  $Si_2Cl_6 \cdot 5NH_3$ .**

Slowly decomp. by  $H_2O$ . (Besson, C. R. 110. 516.)

**Silicon tetrachloride ammonia,  $SiCl_4 \cdot 6NH_3$ .**

Decomp. by  $H_2O$ . (Persoz, A. ch. 44. 319.)

**Silicon tetrachloride hydrazine,  $SiCl_4 \cdot 4N_2H_4$ .**

Extremely hygroscopic and quickly decomp. by  $H_2O$ . (Lay, Dissert. 1910.)

**Silicon chlorobromide,  $SiCl_2Br_2$ .**

Decomp. by  $H_2O$ . (Friedel and Ladenburg, A. 145. 187.)

$SiCl_2Br_2$ . As above. (Friedel and Ladenburg.)

$SiBr_3Cl$ . Decomp. by  $H_2O$ . (Reynolds, Chem. Soc. 51. 590.)

**Silicon chlorobromide ammonia,  $2SiCl_2Br_2 \cdot 11NH_3$ .**

Decomp. by  $H_2O$ . (Besson, C. R. 112. 788.)

$SiCl_2Br_2 \cdot 5NH_3$ . As above. (B.)

$2SiCl_2Br_2 \cdot 11NH_3$ . As above. (B.)

**Silicon chlorohydrosulphide,  $SiCl_2SH$ .**

Decomp. by  $H_2O$  or alcohol. (Pierre, A. ch. (3) 24. 286.)

**Silicon chloriodide,  $SiCl_2I_2$ .**

Decomp. by  $H_2O$ . (Besson, C. R. 112. 611.)

$SiCl_2I_2$ . As above. (B.)

$SiClI_3$ . As above. (B.)

**Silver chloriodide ammonia,  $2SiCl_2I_2 \cdot 11NH_3$  (Besson.)**

$SiCl_2I_2 \cdot 5NH_3$ .

**Silicon chloronitride,  $Si_2N_2Cl_2$ .**

(Schützenberger, C. R. 92. 1508.)

**Silicon chlorosulphide,  $Si_2Cl_2S_2$ .**

Decomp. violently by  $H_2O$ . Sol. in  $CCl_4$ . (Besson, C. R. 113. 1040.)

$SiSCl_2$ . Violently decomp. by  $H_2O$ ; sol. in  $CS_2$ . (Blix, B. 1903, 36. 4223.)

**Silicon difluoride,  $SiF_2$  (?).**

Decomp. by  $H_2O$  or  $NH_4OH + Aq$ . (Troost and Hautefeuille, A. ch. (5) 7. 464.)

**Silicon tetrafluoride,  $SiF_4$ .**

Abundantly absorbed by  $H_2O$  with decomp. 100 pts.  $H_2O$  absorb 140.6 pts.  $SiF_4$  in 24 hours (Berzelius); 124.1 pts.  $SiF_4$  in 24 hours (Davy).

Absorbed abundantly by  $HNO_3 + Aq$ . (Kuhlmann, A. 39. 319.)

Absorbed abundantly by alcohol, without separation of silicic acid, if the alcohol contains less than 8% of water.

Sol. in conc.  $HF + Aq$ . Absorbed by ether. Sl. sol. in naphtha, and oil of turpentine.

**Silicon hydrogen fluoride,  $H_2SiF_4$ .**

See *Fluosilicic acid*.

**Silicon fluoride with MF.**

See *Fluosilicate, M*.

**Silicon fluoride ammonia,  $SiF_4 \cdot 2NH_3$ .**

Decomp. by  $H_2O$ . (Davy.)

**Silicon hydride,  $SiH_4$ .**

Insol. in  $H_2O$ . Decomp. by  $KOH + Aq$ . Not changed by  $NH_4OH + Aq$ ,  $H_2SO_4 + Aq$ , or  $HCl + Aq$ .

$Si_2H_6$ . "Silicoacetylene."

Sol. in 20%  $NaOH + Aq$  with evolution of  $H$ . (Bradley, C. N. 1900, 62. 149.)

$Si_2H_6$ . "Silicoethane." (Lebeau, C. R. 1909, 148. 44.)

Sl. sol. in  $H_2O$ . Best solvent is ethyl orthosilicate. (Moissan, Bull. Soc. 1903, (2) 29. 443.)

**Silicon nitrogen hydride,  $SiHN$ .**

Decomp. by  $H_2O$  and  $NaOH$ . (Ruff, B. 1905, 38. 2241.)

**Silicon hydroxide,  $\text{SiO}_2 \cdot x\text{H}_2\text{O}$ .**

See Silicic acid.

$\text{Si}_2\text{H}_2\text{O}_4$ . See Silicooxalic acid.

$\text{Si}_2\text{H}_2\text{O}_3$ . See Silicoformic anhydride.

$\text{Si}_4\text{H}_4\text{O}_8$ . See Silicene.

**Silicon imide,  $(\text{Si}(\text{NH})_2)_x$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Vigouroux, C. R. 1903, 136. 1671.)

**Silicondisimide,  $\text{Si}(\text{NH})_2$ .**

Decomp. by  $\text{H}_2\text{O}$  with evolution of much heat. (Blix, B. 1903, 36. 4224.)

**Silicon imide hydrochloride,  $\text{Si}(\text{NH})_2 \cdot 2\text{HCl}$ .**

Rather stable in air. (Blix, B. 1903, 36. 4225.)

**Silicon diiodide,  $\text{SiI}_2$ .**

Insol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$ ,  $\text{C}_6\text{H}_6$ , and  $\text{SiCl}_4$ . (Friedel and Ladenburg, A. 203. 247.)

**Silicon triiodide,  $\text{SiI}_3$ .**

Decomp. with  $\text{H}_2\text{O}$  even at  $0^\circ$ .  
100 pts.  $\text{CS}_2$  dissolve 19 pts.  $\text{SiI}_3$  at  $19^\circ$ ;  
26 pts.  $\text{SiI}_3$  at  $27^\circ$ . (Friedel and Ladenburg, Bull. Soc. (2) 12. 92.)  
 $\text{HSiI}_3$ . See Silicoiodoform.

**Silicon tetraiodide,  $\text{SiI}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . Acts on alcohol and ether.

1 pt.  $\text{CS}_2$  dissolves 2.2 pts.  $\text{SiI}_4$  at  $27^\circ$ . (Friedel, A. 149. 96.)

**Silicon nitride,  $\text{Si}_3\text{N}_4$ .**

Partially decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ .

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalis + Aq. (Weiss, Z. anorg. 1910, 65. 89.)

$\text{Si}_2\text{N}_2$ . Partially decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ .

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalis + Aq. (Weiss, Z. anorg. 1910, 65. 89.)

$\text{Si}_2\text{N}_4$ . Not attacked by  $\text{H}_2\text{O}$ .

Partially decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ .

Not attacked by dil. acids with the exception of HF. Decomp. by HF.

Partially decomp. by boiling with alkalis + Aq. (Weiss, Z. anorg. 1910, 65. 89.)

**Silicon nitrimide,  $\text{Si}_2\text{N}_2\text{H}_4$ .**

"Silicam."

Sol. in HF, and rapidly in  $\text{KOH} + \text{Aq}$ . (Schutzenberger, C. R. 92. 1508.)

Decomp. by cold, more rapidly by hot  $\text{H}_2\text{O}$  and much more rapidly by alkalis. Sol. in  $\text{HF} + \text{Aq}$ . Not attacked by  $\text{HNO}_3$ . Decomp. by conc.  $\text{H}_2\text{SO}_4$ . (Lay, Dissert. 1910.)

Not decomposed by  $\text{H}_2\text{O}$ .

Sol. in hot alkalis + Aq with decomp. (Blix, B. 1903, 36. 4227.)

**Silicon suboxide,  $\text{Si}_2\text{O}_3$ .**

(Honigschmid, M. 1909, 30. 509.)

**Silicon monoxide,  $\text{SiO}$ .**

Much less easily sol. in  $\text{HF} + \text{Aq}$  but more easily sol. in alkalis + Aq than  $\text{SiO}_2$ . (Potter, C. C. 1907, II. 1952.)

**Silicon dioxide,  $\text{SiO}_2$ .**

See also Silicic acid.

(a) *Crystalline*. Min. Quartz, Tridymite.

Insol. in  $\text{H}_2\text{O}$ , and acids, except HF.

Sl. sol. in boiling  $\text{K}_2\text{CO}_3 + \text{Aq}$ , and  $\text{KOH} + \text{Aq}$ ; see below.

Insol. in cold  $\text{KOH} + \text{Aq}$ ; extremely slowly sol. in boiling  $\text{KOH} + \text{Aq}$ . (Fuchs.)

Sol. in HF with formation of  $\text{SiF}_4$  and  $\text{H}_2\text{O}$ .

Insol. in sugar + Aq, contrary to assertion of Verdeil and Rissler. (Petzholdt, J. pr. 60. 368.)

(b) *Amorphous*. Min. Opal, etc.

Insol. in  $\text{H}_2\text{O}$ , and acids except HF.

100 pts.  $\text{H}_2\text{O}$  containing  $\text{CO}_2$  dissolve 0.078 pt. amorphous  $\text{SiO}_2$  (Maschke); 0.0136 pt. (Struckmann).

100 pts. cold  $\text{HCl} + \text{Aq}$  of 1.088 sp. gr. dissolve 0.017 pt.  $\text{SiO}_2$ . (Struckmann.) 100 pts.  $\text{HCl} + \text{Aq}$  of 1.115 sp. gr. dissolve in the cold 0.009 pt.  $\text{SiO}_2$ , and 0.018 pt. on boiling. 100 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  (containing 10%  $\text{NH}_3$ ) dissolve 0.017 pt. quartz and 0.38 pt. ignited  $\text{SiO}_2$ . (Pribram, Z. anal. 6. 119.)

Sol. in boiling  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3 + \text{Aq}$ , separating out on cooling as a gelatinous mass. (Pfaß, Schw. J. 29. 383.) The different forms of  $\text{SiO}_2$  have different degrees of solubility in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . Unignited amorphous  $\text{SiO}_2$  from  $\text{SiF}_4$  dissolves most readily, then come opal, ignited amorphous  $\text{SiO}_2$ , fused  $\text{SiO}_2$ , and tridymite; quartz powder is the most difficultly soluble. (Rose.) A similar behaviour is shown to  $\text{KOH} + \text{Aq}$ .

Opal is much more sol. in  $\text{KOH} + \text{Aq}$  than quartz, and hyalite is the least sol. of the varieties of opal. (Fuchs.)

Opal is easily sol. in  $\text{KOH} + \text{Aq}$ , even after ignition. (Schaffgotsch, Pogg. 68. 147.)

Rammelsberg (Pogg. 112. 177) made the following experiments on the solubility of  $\text{SiO}_2$  in  $\text{KOH} + \text{Aq}$ . The  $\text{KOH} + \text{Aq}$  used contained 1 pt.  $\text{KOH}$  to 3 pts.  $\text{H}_2\text{O}$ . 1 pt. of the powdered mineral was boiled half an hour in a silver dish with such an amount of the  $\text{KOH} + \text{Aq}$  that 20 pts.  $\text{KOH}$  were present.

7.75% of milky white quartz was dissolved by repeating the above process three times.

12.8–15% of gray hornstone was dissolved by twice boiling; 2.43% of moderately finely powdered agate of 2.661 sp. gr. was dissolved by once boiling; 9.7% of unignited hyalite remained undissolved after thrice boiling;

21% of ignited hyalite remained undissolved after thrice boiling; 7.21% of semi-opal of 2.101 sp. gr. remained undissolved after thrice boiling; 18.5-19.2% of impure semi-opal of 2.101 sp. gr. remained undissolved after thrice boiling; 79.9% of chalcedony of 2.624 sp. gr. remained undissolved after thrice boiling; 6.12% of chalcedony of 2.567 sp. gr. remained undissolved after fourth boiling; 14.4% chrysoprase of 2.623 sp. gr. remained undissolved after once boiling; 49.41% of chrysoprase of 2.635 sp. gr. remained undissolved after thrice boiling; 6.62% of flint of 2.603 sp. gr. remained undissolved after twice boiling; 38.1% of fire-opal of 2.625 sp. gr. remained undissolved after fourth boiling; 26.6% of fire-opal of 2.625 sp. gr. remained undissolved after fifth boiling.

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, **54**, 674.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)

The solubility of crystals of quartz on different faces in HF has been determined by Lebrun. (Belg. Acad. Bull. 1913, 953.)

#### Silicon thorium oxide.

See Silicate, thorium.

#### Silicon zirconium oxide.

See Silicate, zirconium.

#### Silicon oxychloride, $\text{Si}_2\text{OCl}_4$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Miscible with  $\text{CS}_2$ ,  $\text{SiCl}_4$ ,  $\text{CCl}_4$ ,  $\text{CHCl}_3$ , or ether. (Friedel and Ladenburg, A. 147, 355.)

$\text{Si}_4\text{O}_3\text{Cl}_{10}$ ;  $\text{Si}_4\text{O}_4\text{Cl}_8$ ;  $\text{Si}_4\text{O}_5\text{Cl}_6$ ;  $(\text{Si}_2\text{O}_3\text{Cl}_2)_n$ .  
 $\text{Si}_4\text{O}_7\text{Cl}_2$ . Sol. in above oxychlorides. (Troost and Hautefeuille, Bull. Soc. (2) **35**, 360.)

#### Silicon oxyfluorhydrin, $\text{Si}_2\text{O}_2\text{F}_2\text{OH}$ .

(Landolt, A. Suppl. **4**, 27.)

#### Silicon selenide, $\text{SiSe}_2$ .

Decomp. by  $\text{H}_2\text{O}$  or  $\text{KOH} + \text{Aq.}$  (Sabatier, C. R. **113**, 132.)

#### Silicon sulphide, $\text{SiS}_2$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. Acts on alcohol or ether in the cold. (Fremy, A. ch. (3) **38**, 314.)

$\text{SiS}$ . Decomp. by  $\text{H}_2\text{O}$ ; easily sol. in dil. alkalies. (Schützenberger, Bull. Soc. (2) **38**, 56.)

#### Silicon sulphodiamide, $\text{SiS}(\text{NH}_2)_2$ .

Slowly decomp. in the air. Insol. in cold liquid  $\text{NH}_3$ . (Blix, B. 1903, **36**, 4219.)

#### Silicon sulphobromide.

See Silicon bromosulphide.

#### Silicon sulphochloride.

See Silicon chlorosulphide.

#### Silicon sulphourea, $\text{SiS}(\text{NH}_2)_2$ .

Slowly decomp. in air.

Decomp. by  $\text{H}_2\text{O}$ .

Insol. in cold liquid  $\text{NH}_3$ . (Blix, B. 1903, **36**, 4219.)

#### Silicone, $\text{Si}_4\text{H}_4\text{O}_3$ .

Insol. in  $\text{H}_2\text{O}$ , but gives off hydrogen when warmed therewith. Not attacked by chlorine or nitric or sulphuric acids even on heating, but is gradually sol. in HF. Decomp. by alkalies, even by the most dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  with greatest violence and evolution of heat and hydrogen gas. Insol. in alcohol,  $\text{SiCl}_4$ ,  $\text{PCl}_5$ , or  $\text{CS}_2$ . (Wöhler, A. 127, 257.)

$\text{H}_2\text{Si}_2\text{O}_3$ . Decomp. by  $\text{H}_2\text{O}$  and by dil. acids. Violently decomp. by fuming  $\text{HNO}_3$ . Not attacked by conc.  $\text{H}_2\text{SO}_4$ . Very slowly decomp. by conc.  $\text{HCl}$ , rapidly by alkalies +  $\text{Aq.}$  and by pyridine. (Honigschmid, M. 1909, **30**, 509.)

Insol. in  $\text{H}_2\text{O}$ , alcohol.  $\text{SiCl}_4$ ,  $\text{PCl}_5$ , and  $\text{CS}_2$ . Not attacked by acids except HF. (Donath and Liesner, C. C. 1909, II, 1707.)

$\text{H}_2\text{Si}_2\text{O}_3$ . Scarcely attacked by acids, but easily decomp. by hot  $\text{H}_2\text{O}$ ,  $\text{NaOH} + \text{Aq.}$  etc. but not by  $\text{NH}_4\text{OH} + \text{Aq.}$  (Kolb, Z. anorg. 1909, **64**, 353.)

$\text{H}_{10}\text{Si}_4\text{O}_8$ . (Kolb.)

$\text{H}_2\text{Si}_2\text{O}_3$ . As  $\text{H}_{12}\text{Si}_4\text{O}_8$ . (Kolb.)

#### Silicomesoxalic acid, $\text{Si}(\text{OH})_2(\text{SiO.OH})_2$ .

Insol. in cold  $\text{H}_2\text{O}$ , decomp. by hot  $\text{H}_2\text{O}$ . (Gattermann, B. 1899, **32**, 1116.)

#### Silicooxalic acid, $\text{Si}_2\text{H}_2\text{O}_4 = \text{Si}_2\text{O}_3(\text{OH})_2$ .

Decomp. by bases with evolution of hydrogen. Takes up  $\text{HNO}_3$  to form compound, but not  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . (Troost and Hautefeuille, A. ch. (5) **7**, 463.)

#### Silicophosphoric acid, $\text{SiO}_3\text{P}_2\text{O}_5$ .

Slowly decomp. by  $\text{H}_2\text{O}$ . Unchanged by alcohol. Exists also in two modifications which are not attacked by  $\text{H}_2\text{O}$ . (Hautefeuille and Margottet, C. R. **99**, 789.)

$\text{SiO}_3\text{P}_2\text{O}_5 + 4\text{H}_2\text{O}$ . Decomp. by moist air. Sol. in  $\text{H}_2\text{O}$  at  $0^\circ$ , but decomp. by warming to ordinary temp. (Hautefeuille and Margottet, C. R. **104**, 56.)

#### Calcium silicophosphate.

See Phosphate silicate, calcium.

#### Silicostannic acid.

#### Calcium silicostannate, $\text{Ca}(\text{Si.Sn})\text{O}_3$ .

Not attacked by acids,  $\text{KHSO}_4$ , or alkalies +  $\text{Aq.}$  (Bourgeois, Bull. Soc. (2) **47**, 297.)

**Silicodectungstic acid**,  $H_2W_{10}SiO_{38} + 3H_2O = 4H_2O, SiO_2, 10WO_3 + 3H_2O$ .

Sometimes sol. in  $H_2O$ , but usually separates out gelatinous silica. (Marignac, A. ch. (4) 3. 55.)

See also **Silicoduodectungstic acid**.

**Ammonium silicodectungstate**,  $(NH_4)_2W_{10}SiO_{38} + 8H_2O$ .

Sol. in 4.5 pts.  $H_2O$  at  $18^\circ$ . Very sol. in hot  $H_2O$ . (Marignac, A. ch. (4) 3. 59.)  
 $(NH_4)_2H_2W_{10}SiO_{38} + 9H_2O$ . (Marignac.)

**Ammonium potassium** —,  $(NH_4)_2K_2HSiW_{10}O_{38} + 15H_2O$ . (Marignac.)

**Barium** —,  $Ba_2SiW_{10}O_{38} + 22H_2O$ .  
 Precipitate. Insol. in  $H_2O$ . (Marignac.)

**Potassium** —,  $K_2SiW_{10}O_{38} + 17H_2O$ .  
 Sol. in  $H_2O$ . (Marignac.)  
 $K_2H_2SiW_{10}O_{38} + 8H_2O$ . Sol. in  $H_2O$ . (Marignac.)

**Potassium** — **silicotungstate** (?),  $K_2SiW_{11}O_{38} + 14H_2O$ .  
 $K_2H_2SiW_{11}O_{38} + 10H_2O$ . (Marignac.)

**Silver** —,  $Ag_2W_{10}SiO_{38} + 3H_2O$ .  
 Not appreciably sol. in cold  $H_2O$ . (Marignac, A. ch. (4) 3. 65.)

**Silicotungstic acid or Silicoduodectungstic acid**,  $H_2SiW_{11}O_{42}$ .

( $H_2SiW_{10}O_{40}$ , according to Copaux. (Bull. Soc. 1908, (4) 3. 101.)

+  $20H_2O$ . Sol. in  $H_2O$ ; very sol. in alcohol; behaves with ether as the acid with  $22H_2O$ . (Marignac, A. ch. (4) 3. 10.)

+  $22H_2O$ . Solubility as acid with  $29H_2O$ . 100 pts. deliquesce with 13 pts. ether. To this mixture 20–25 pts. of ether can be added, but a further quantity no longer mixes with, but floats above the mixture. Ethereal solution is miscible with  $H_2O$ . Ether is taken up by a saturated aqueous solution with evolution of heat, until the volume has become doubled; more ether floats on the mixture. By warming the latter a liquid separates out which forms a layer between the two original layers. Alcoholic solution of the acid mixes with an equal vol. of ether, but on adding more ether a conc. ethereal solution separates as a syrupy layer. (Marignac, A. ch. (4) 3. 10.)

+  $29H_2O$ . Efflorescent. Sol. in  $H_2O$ . Saturated solution at  $18^\circ$  contains 1 pt. crystallized acid to 0.104 pt.  $H_2O$ , and has 2.843 sp. gr. Melts in crystal  $H_2O$ . Easily sol. in absolute alcohol and anhydrous ether.

+  $xH_2O$ . (Drechsel, B. 1887, 20. 1452.)

**Aluminum silicotungstate**,  $Al_4H_{12}(SiW_{12}O_{42})_2 + 75H_2O$ .

Not deliquescent; very sol. in  $H_2O$ . (Marignac.)

$Al_4(SiW_{12}O_{42})_2 + 60H_2O$ . (Wyruboff. Chem. Soc. 1897, 72, (2) 174.)

+  $87H_2O$ . (Wyruboff.)  
 +  $93H_2O$ . Very efflorescent. (Wyruboff.)

**Aluminum ammonium** —,  $Al_4(NH_4)_{12}(SiW_{12}O_{42})_2 + 75H_2O$ .  
 Sol. in  $H_2O$ . (Marignac.)

**Ammonium** —, basic,  $(NH_4)_4SiW_{12}O_{46} + 4NH_4OH + 14H_2O$ . (Wyruboff, Chem. Soc. 1897, 72, (2) 174.)

**Ammonium** —,  $(NH_4)_2SiW_{12}O_{42} + 16H_2O$ .  
 Very sol. in hot  $H_2O$ . (Marignac, A. ch. (4) 3. 17.)

$(NH_4)_2H_2SiW_{12}O_{42} + 6H_2O$ . Less soluble in  $H_2O$  than the preceding salt. (Marignac.)

$(NH_4)_4SiW_{12}O_{46} + 8H_2O$ . (Wyruboff, Chem. Soc. 1897, 72, (2) 174.)

**Barium** —,  $Ba_2H_2SiW_{12}O_{42} + 14H_2O$ .  
 Sol. in  $H_2O$ .  
 +  $22H_2O$ . Gradually efflorescent. (Marignac.)

Sol. in cold  $H_2O$ , 1 : 0.7 pts. (Copaux, Bull. Soc. Min. 1906, 29. 80.)

Sol. in 4 pts. cold  $H_2O$ . (Wyruboff, Bull. Soc. Min. 1896, 19. 278.)

$Ba_2SiW_{12}O_{42} + 27H_2O$ . Nearly insol. in cold, sl. sol. in hot  $H_2O$ . (Marignac.)

$Ba_2SiW_{12}O_{46} + 16H_2O$ . (Wyruboff.)

**Barium potassium** —,  $Ba_2K_2SiW_{12}O_{46} + 17H_2O$ . (Wyruboff, Chem. Soc. 1897, 72, (2) 176.)

**Barium sodium** —,  $Na_2Ba_2SiW_{12}O_{42} + 28H_2O$ .

$H_2O$  gradually dissolves out sodium silicotungstate.

**Cadmium** —,  $Cd_2SiW_{12}O_{46} + 23H_2O$ , and +  $27H_2O$ .

(Wyruboff.)  
 $4CdO, 3(SiO_2, 12WO_3) + 4H_2O$ . (Wyruboff.)

**Cesium** —,  $Cs_2SiW_{12}O_{42}$ .

100 pts.  $H_2O$  dissolve only 0.005 pt. at  $20^\circ$ ; 0.52 pt. at  $100^\circ$ .

Completely insol. in alcohol, and  $HCl + Aq$ . Somewhat sol. in dil.  $NH_4OH + Aq$ . (Godefroy, B. 9. 1363.)

**Cadmium hydrogen** —,  $2Cd_2SiW_{12}O_{46}, H_2SiW_{12}O_{46} + 42H_2O$ .

(Wyruboff.)

- Calcium silicotungstate**,  $\text{Ca}_2\text{H}_4\text{SiW}_{12}\text{O}_{42} + 20\text{H}_2\text{O}$ .  
Not deliquescent. Extremely easily sol. in  $\text{H}_2\text{O}$ . (Marignac.)  
 $\text{Ca}_2\text{SiW}_{12}\text{O}_{40} + 18, 24$  and  $27\text{H}_2\text{O}$ . (Wyruboff.)
- Calcium silicotungstate nitrate**,  $\text{Ca}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{Ca}(\text{NO}_3)_2 + 15\text{H}_2\text{O}$ .  
(Wyruboff.)
- Cerous** —,  $\text{Ce}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$ .  
(Wyruboff.)  
 $\text{Ce}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{CeH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$ .  
(Wyruboff.)
- Chromium** —,  $\text{Cr}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60, 87$  and  $93\text{H}_2\text{O}$ .  
(Wyruboff.)
- Cupric** —,  $\text{Cu}_2\text{SiW}_{12}\text{O}_{40} + 18, 27$  and  $29\text{H}_2\text{O}$ .  
Very efflorescent. (Wyruboff.)
- Didymium** —,  $\text{Di}_2\text{SiW}_{12}\text{O}_{40} + 26$  and  $27\text{H}_2\text{O}$ .  
(Wyruboff.)  
 $\text{Di}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{DiH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$ .  
(Wyruboff.)
- Gallium** —,  $\text{Ga}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60, 87$ , and  $93\text{H}_2\text{O}$ .  
(Wyruboff.)
- Glucinum** —,  $\text{Gl}_4(\text{SiW}_{12}\text{O}_{40})_3 + 45, 87$  and  $93\text{H}_2\text{O}$ .  
(Wyruboff.)
- Indium** —,  $\text{In}_2\text{O}_3$ ,  $\text{H}_2\text{O}$ ,  $2(\text{SiO}_2, 12\text{WO}_3) + 40\text{H}_2\text{O}$ .  
(Wyruboff.)  
 $2\text{In}_2\text{O}_3$ ,  $3(\text{SiO}_2, 12\text{WO}_3) + 63$  and  $93\text{H}_2\text{O}$ .  
(Wyruboff.)
- Iron (ferric)** —,  $\text{Fe}_4(\text{SiW}_{12}\text{O}_{40})_3 + 60$  and  $93\text{H}_2\text{O}$ .  
(Wyruboff.)
- Lanthanum** —,  $\text{La}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}$ .  
Efflorescent. (Wyruboff.)  
 $\text{La}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{LaH}_2\text{SiW}_{12}\text{O}_{40} + 34\text{H}_2\text{O}$ .  
(Wyruboff.)
- Lead** —, basic,  $\text{Pb}_2\text{SiW}_{12}\text{O}_{40}$ ,  $2\text{PbO} + 20\text{H}_2\text{O}$ .  
Sl. sol. in  $\text{H}_2\text{O}$ . (Wyruboff.)
- Lead** —,  $\text{Pb}_2\text{SiW}_{12}\text{O}_{40} + 21\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Wyruboff.)
- Lithium** —,  $\text{Li}_2\text{O}$ ,  $\text{SiO}_2$ ,  $12\text{WO}_3 + 14$  and  $24\text{H}_2\text{O}$ .  
(Wyruboff.)
- Magnesium** —,  $\text{Mg}_2\text{H}_4\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$ .  
Stable on the air. (Marignac.)
- Mercurous silicotungstate, basic**,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{40}$ ,  $2\text{Hg}_2\text{O} + 5\text{H}_2\text{O}$ .  
Insol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3$ . Slowly sol. in conc. warm.  $\text{HNO}_3$ . (Wyruboff.)
- Mercurous** —,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{42}$ .  
Insol. in  $\text{H}_2\text{O}$ . Scarcely sol. in dil.  $\text{HNO}_3$  + Aq. (Marignac, A. ch. (4) 3. 43.)
- Mercuric** —,  $\text{Hg}_2\text{SiW}_{12}\text{O}_{40} + 15\text{H}_2\text{O}$ .  
Very sol. in  $\text{H}_2\text{O}$ . Solution decomp. on boiling. (Wyruboff.)
- Potassium** —, basic,  $\text{K}_2\text{SiW}_{12}\text{O}_{40}$ ,  $4\text{KOH} + 12\text{H}_2\text{O}$ .  
1 pt. is sol. in 10 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Wyruboff.)
- Potassium** —,  $\text{K}_2\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$ .  
Sol. in 10 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and less than 3 pts. at  $100^\circ$ . (Marignac.)  
 $+ 20\text{H}_2\text{O}$ . Much less sol. in cold than hot  $\text{H}_2\text{O}$ . Extremely sol. in hot  $\text{H}_2\text{O}$ . More sol. than above comp. (Marignac.)  
 $\text{K}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$ . Solubility as preceding salt.  
 $\text{K}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 16\text{H}_2\text{O}$ . Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ .  
 $\text{K}_2\text{H}_{10}(\text{SiW}_{12}\text{O}_{42})_3 + 25\text{H}_2\text{O}$ . Decomp. by dissolving in  $\text{H}_2\text{O}$ . (Marignac.)  
 $\text{K}_2\text{SiW}_{12}\text{O}_{40} + 6$  and  $15\text{H}_2\text{O}$ . (Wyruboff.)  
 $\text{K}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{K}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 29\text{H}_2\text{O}$ .  
(Wyruboff.)
- Rubidium** —,  $\text{Rb}_2\text{SiW}_{12}\text{O}_{42}$ .  
Sol. in 145–150 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  and in 19–20 pts. at  $100^\circ$ . Insol. in alcohol; difficultly sol. in acidified, but extremely easily in ammoniacal  $\text{H}_2\text{O}$ . (Godeffroy, B. 9. 1363.)  
 $\text{Rb}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 5\text{H}_2\text{O}$ . (Wyruboff.)  
 $\text{Rb}_2\text{SiW}_{12}\text{O}_{40}$ ,  $\text{Rb}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 22\text{H}_2\text{O}$ .  
(Wyruboff.)
- Silver** —,  $\text{Ag}_4\text{H}_4\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$ .  
Very sl. sol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{HNO}_3$  + Aq. (Marignac.)  
Sl. sol. in  $\text{H}_2\text{O}$ . (Wyruboff.)
- Sodium** —, basic,  $\text{Na}_2\text{SiW}_{12}\text{O}_{40}$ ,  $4\text{NaOH} + 5\text{H}_2\text{O}$ .  
(Wyruboff.)
- Sodium** —,  $\text{Na}_2\text{SiW}_{12}\text{O}_{42} + 7\text{H}_2\text{O}$ .  
The saturated solution at  $19^\circ$  contains 0.21 pt.  $\text{H}_2\text{O}$  to 1 pt. of the salt dried at  $100^\circ$ , and has sp. gr. = 3.05. (Marignac.)  
 $\text{Na}_4\text{H}_2\text{SiW}_{12}\text{O}_{42} + 11\text{H}_2\text{O}$ . Stable on air.  
 $+ 18\text{H}_2\text{O}$ . Efflorescent. (Marignac.)  
 $\text{Na}_2\text{H}_2\text{SiW}_{12}\text{O}_{42} + 14\text{H}_2\text{O}$ . Decomp. by dissolving in  $\text{H}_2\text{O}$ . (Marignac.)  
 $\text{Na}_2\text{SiW}_{12}\text{O}_{40} + 14, 16$  and  $20\text{H}_2\text{O}$ . (Wyruboff.)

**Sodium silicotungstate nitrate,**  
 $3\text{Na}_2\text{H}_2\text{SiW}_{12}\text{O}_{42}, 4\text{NaNO}_3 + 39\text{H}_2\text{O}.$   
 Slightly deliquescent. (Marignac.)

**Strontium —,**  $\text{Sr}_2\text{SiW}_{12}\text{O}_{40} + 16, 17, 23$  and  $27\text{H}_2\text{O}.$   
 (Wyrouboff.)

**Thallium —,**  $\text{Tl}_2\text{H}_2\text{SiW}_{12}\text{O}_{40} + 9\text{H}_2\text{O}.$   
 (Wyrouboff.)

**Thorium —, basic.**  
 Insol. in  $\text{H}_2\text{O}.$  (Wyrouboff.)

**Thorium —,**  $\text{Th}_2\text{SiW}_{12}\text{O}_{40} + 27\text{H}_2\text{O}.$   
 Very sol. in  $\text{H}_2\text{O}.$  (Wyrouboff.)  
 $\text{Th}_2\text{SiW}_{12}\text{O}_{40}, 2\text{H}_2\text{SiW}_{10}\text{O}_{40} + 45\text{H}_2\text{O}.$   
 (Wyrouboff.)

**Uranium —.**  
 Thirteen salts are described by Wyrouboff.

**Uranyl —.**  
 Seven salts are described by Wyrouboff.

**Zinc —,**  $\text{Zn}_2\text{SiW}_{12}\text{O}_{40} + 18, 27$  and  $29\text{H}_2\text{O}.$   
 (Wyrouboff.)

### Silicovanadiomolybdic acid.

**Ammonium silicovanadiomolybdate,**  
 $3(\text{NH}_4)_2\text{O}, \text{SiO}_2, \text{V}_2\text{O}_5, 9\text{MoO}_3 + 20\text{H}_2\text{O}.$   
 Sp. gr. of sat. solution containing 0.32016 g. salt in 1 ccm. at  $18^\circ = 1.21322.$  (Friedheim, B. 1900, 33. 1624.)

$3(\text{NH}_4)_2\text{O}, \text{SiO}_2, \text{V}_2\text{O}_5, 10\text{MoO}_3 + 21\text{H}_2\text{O}.$   
 Sp. gr. of sat. solution containing 0.35026 g. of salt in 1 ccm. at  $18^\circ = 1.25275.$  (Friedheim.)

$3(\text{NH}_4)_2\text{O}, \text{V}_2\text{O}_5, \text{SiO}_2, 11\text{MoO}_3 + 27\text{H}_2\text{O}.$   
 Sp. gr. of sat. solution containing 0.38086 g. salt in 1 ccm. at  $18^\circ = 1.29266.$  (Friedheim.)

$3(\text{NH}_4)_2\text{O}, \text{V}_2\text{O}_5, \text{SiO}_2, 15\text{MoO}_3 + 24\text{H}_2\text{O}.$   
 Sp. gr. of sat. solution containing 0.48997 g. salt in 1 ccm. at  $18^\circ = 1.43761.$  (Friedheim.)

**Ammonium potassium —,**  $(\text{NH}_4)_2\text{O}, 2\text{K}_2\text{O}, \text{SiO}_2, \text{V}_2\text{O}_5, 9\text{MoO}_3 + 20\text{H}_2\text{O}.$

Sp. gr. of sat. solution containing 0.24021 g. salt in 1 ccm. at  $18^\circ = 1.17031.$  (Friedheim.)

$(\text{NH}_4)_2\text{O}, 2\text{K}_2\text{O}, \text{SiO}_2, \text{V}_2\text{O}_5, 10\text{MoO}_3 + 21\text{H}_2\text{O}.$  Sp. gr. of sat. solution containing 0.25914 g. salt in 1 ccm. at  $18^\circ = 1.19184.$  (Friedheim.)

$(\text{NH}_4)_2\text{O}, 2\text{K}_2\text{O}, \text{SiO}_2, \text{V}_2\text{O}_5, 11\text{MoO}_3 + 12\text{H}_2\text{O}.$  Sp. gr. of sat. solution containing 0.27914 g. salt in 1 ccm. at  $18^\circ = 1.21378.$  (Friedheim.)

**Ammonium zinc —,**  $4(\text{NH}_4)_2\text{O}, 2\text{ZnO}, 2\text{SiO}_2, 3\text{V}_2\text{O}_5, 18\text{MoO}_3 + 15\text{H}_2\text{O}.$

Sl. sol. in  $\text{H}_2\text{O}.$  (Blum, Dissert. 1904.)

### Silicovanadiotungstic acid.

**Ammonium silicovanadiotungstate,**  $3(\text{NH}_4)_2\text{O}, \text{SiO}_2, \text{V}_2\text{O}_5, 9\text{WO}_3 + 24\text{H}_2\text{O}.$

Can be cryst. from  $\text{H}_2\text{O}.$  (Friedheim, B. 1902, 35. 3244.)

$(\text{NH}_4)_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 21\text{H}_2\text{O}.$  1 cc. of sat. solution in  $\text{H}_2\text{O}$  at  $17.5^\circ$  contains 0.6652 g. of the hydrated salt. Sp. gr. of this solution = 1.4505. Decomp. by conc. acid and alkali. (Friedheim.)

**Ammonium barium potassium —,**  
 $(\text{NH}_4)_2\text{K}_2\text{BaSiV}_2\text{W}_{10}\text{O}_{40} + 25\text{H}_2\text{O}.$

Sl. sol. in  $\text{H}_2\text{O}.$  Decomp. by conc. acids and alkalies. (Friedheim.)

**Ammonium potassium —,**  
 $(\text{NH}_4)_2\text{K}_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 23\text{H}_2\text{O}.$

1 ccm. of sat. solution at  $17.5^\circ$  contains 0.5072 g. of the salt. Sp. gr. of the solution at  $20^\circ = 1.3462.$  Can be cryst. from  $\text{H}_2\text{O}.$  Decomp. by conc. acids and alkalies. (Friedheim.)

**Barium —,**  $\text{Ba}_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 28\text{H}_2\text{O}.$

1 ccm. of the sat. solution in  $\text{H}_2\text{O}$  at  $17.5^\circ$  contains 0.0384 g. of the salt. Sp. gr. of the solution = 1.0307. Decomp. by conc. acids and alkalies. (Friedheim, B. 1902, 35. 3245.)

$6\text{BaO}, 2\text{SiO}_2, 3\text{V}_2\text{O}_5, 18\text{WO}_3 + 50\text{H}_2\text{O}.$  Sl. sol. in  $\text{H}_2\text{O}.$  (Friedheim.)

$7\text{BaO}, 2\text{SiO}_2, 3\text{V}_2\text{O}_5, 18\text{WO}_3 + 83\text{H}_2\text{O}.$  Sl. sol. in  $\text{H}_2\text{O}.$  (Friedheim.)

**Potassium —,**  $\text{K}_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 22\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}.$  Can be cryst. from  $\text{H}_2\text{O}$  without decomp. Decomp. by conc. acids and alkalies. (Friedheim.)

$6\text{K}_2\text{O}, 2\text{SiO}_2, 3\text{V}_2\text{O}_5, 18\text{WO}_3 + 31\text{H}_2\text{O}.$  Sol. in  $\text{H}_2\text{O}.$  (Friedheim.)

$7\text{K}_2\text{O}, 2\text{SiO}_2, 3\text{V}_2\text{O}_5, 18\text{WO}_3 + 42\text{H}_2\text{O}.$  Sol. in  $\text{H}_2\text{O}.$  (Friedheim.)

**Sodium —,**  $\text{Na}_2\text{SiV}_2\text{W}_{10}\text{O}_{40} + 29\text{H}_2\text{O}.$

Very sol. in  $\text{H}_2\text{O}.$  Decomp. by conc. acids and alkalies. (Friedheim.)

**Silundum,  $\text{Si}_2\text{C}_v.$**

Not attacked by hot Cl or conc. acids. (Amberg, Z. Elektrochem. 1909, 15. 725.)

### Silver, Ag.

Not attacked by  $\text{H}_2\text{O}.$  Absolutely insol. in  $\text{HCl}$  or  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}.$  (Lea, Sil. Am. J. 144. 444.) Easily sol. in  $\text{HNO}_3 + \text{Aq}$  on warming, if not too conc. Only a minute trace is dissolved in an hour by cold dil.  $\text{HNO}_3 + \text{Aq}$  (1 pt.  $\text{HNO}_3 + \text{Aq}$  of sp. gr. 1.40 : 10 pts.  $\text{H}_2\text{O}.$ ) (Lea.) Sol. in hot conc.  $\text{H}_2\text{SO}_4$  with evolution of  $\text{SO}_2.$  Sl. sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  (1. 4), but with more dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  the different forms of Ag behave differently. (Lea.)

Sol. in  $\text{HI} + \text{Aq}$  at ordinary temperature.



Sol. in KI+Aq with access of air. Sol. in hot KCN+Aq. (Christomanos, Z. anal. 7. 301.)

Sol. in chromic, iodic, chloric and bromic acids. Dil.  $\text{H}_2\text{SO}_4$  alone is incapable of dissolving finely divided Ag, and the seeming solvent action is due to the oxygen of the air, oxygen dissolved in the acid, or derived from some external source. (Hendrixson, J. Am. Chem. Soc. 1903, 25. 637.)

Boiling  $\text{H}_2\text{SO}_4$  dissolves pure Ag only when concentration equals  $60^\circ \text{B}$ . More dil. acid dissolves only the impure metal. (Pannani, Gazz. ch. it. 1909, 39. (2) 234.)

Slowly decomp. into AgCl by alkali chlorides+Aq; also by  $\text{CuCl}_2$ , etc.+Aq.

Somewhat sol. in  $\text{NH}_4\text{OH}$ +Aq in presence of O. (Lea, Sill. Am. J. 144. 444.)

Sol. in  $\text{KMnO}_4$ +dil.  $\text{H}_2\text{SO}_4$ +Aq. (Friedheim, B. 20. 2554.)

Sol. in  $\text{Fe}_2(\text{SO}_4)_3$ +Aq, especially on heating, but completely insol. in  $\text{FeSO}_4$ +Aq. (Vogel.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

**Allotropic forms**—(a). Very sol. in  $\text{H}_2\text{O}$ . Solution is pptd. by saline solutions or almost any neutral substance. Alkali sulphates, nitrates, and citrates ppt. it in a sol. form, while  $\text{MgSO}_4$ ,  $\text{CuSO}_4$ ,  $\text{FeSO}_4$ ,  $\text{NiSO}_4$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ ,  $\text{K}_4\text{Fe}(\text{CN})_6$ ,  $\text{Ba}(\text{NO}_3)_2$ , and even  $\text{AgNO}_3$ +Aq ppt. it in an insol. form, which, however, may be made sol. again by treatment with many substances, as  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{K}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ +Aq.  $\text{NaNO}_3$ +Aq ppts. the Ag from its solution in a perfectly insol. form.

(b). The ppt. from aqueous solution by salts is sol. in  $\text{NH}_4\text{OH}$ +Aq. (Lea, Sill. Am. J. 137. 476.)

Many other allotropic forms exist. (Lea.)

Pure colloidal silver is also sol. in alcohol. (Schneider, B. 25. 1164.)

Entirely sol. in  $\text{H}_2\text{O}$ , even when dry. (Schneider, Z. anorg. 1894, 7. 339.)

### Silver acetylide, $\text{Ag}_2\text{C}_2$ .

Sol. in KCN+Aq with evolution of  $\text{C}_2\text{H}_2$ . Decomp. by HCl+Aq. (Arth, C. R. 1897, 124. 1535.)

### Silver amide, $\text{AgNH}_2$ .

Ppt.; sol. in ammonium salts+Aq and in excess of potassium amide. Sol. in liquid  $\text{NH}_3$ . Insol. in Ag salts+Aq. (Franklin, J. Am. Chem. Soc. 1905, 27. 833.)

Sol. in excess of  $\text{KNH}_2$ . (Franklin, Z. anorg. 1905, 46. 16.)

### Silver antimonide, $\text{Ag}_3\text{Sb}$ or $\text{Ag}_2\text{Sb}$ .

Min. *Discrasite*. Sol. in  $\text{HNO}_3$ +Aq.  $\text{Ag}_3\text{Sb}$ . Insol. in HCl+Aq; decomp. by  $\text{HNO}_3$ +Aq. (Christoffe.)

### Silver azoimide, $\text{AgN}_3$ .

Insol. in hot or cold  $\text{H}_2\text{O}$  or dil. acids; sol. in conc. mineral acids. Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Curtius, B. 23. 3023.)

### Silver bromide, $\text{AgBr}$ .

Insol. in  $\text{H}_2\text{O}$ , or  $\text{H}_2\text{O}$  acidulated with  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2$ , between  $0^\circ$  and  $33^\circ$ . If flocculent or pulverulent, it is sensibly sol. therein above  $33^\circ$ , but if granular only above  $50^\circ$ , and then very slightly. (Stas, A. ch. (5) 3. 289.) Ag can be detected as AgBr in 10,000,000 pts.  $\text{H}_2\text{O}$ . (Stas.)

Calculated from the electrical conductivity of AgBr+Aq, AgBr is sol. in 1,971,658 pts.  $\text{H}_2\text{O}$  at  $26.2^\circ$ , and 775,400 pts. at  $38^\circ$ . (Holleman, Z. phys. Ch. 12. 133.)

By same method Kohlrausch and Rose calculate that 1 l.  $\text{H}_2\text{O}$  dissolves 0.4 mg. AgBr at  $18^\circ$ . (Z. phys. Ch. 12. 240.)

Solubility in  $\text{H}_2\text{O}$  = 0.109 mg. per l. (Prudhomme, J. chim. Phys. 9. 519.)

Solubility in  $\text{H}_2\text{O}$  =  $6.6 \times 10^{-7}$  at  $25^\circ$ . (Goodwin, Z. phys. Ch. 1894, 13. 645.)

Solubility of AgBr in  $\text{H}_2\text{O}$  at  $25^\circ$  equals  $8.1 \times 10^{-7}$  g. mols. per l. (Thiel, Z. anorg. 1900, 24. 57.)

Aq. solution sat. at  $21.1^\circ$  contains  $0.57 \times 10^{-4}$  g. equiv. per litre. (Kohlrausch, C. C. 1901, II. 1299.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.000137 g. AgBr at  $25^\circ$ . (Abegg and Cox, Z. phys. Ch. 1903, 48. 11.)

$0.84 \times 10^{-4}$  g. are dissolved per liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 48. 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.107 mg. AgBr at  $21^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

3.7 mg. AgBr are contained in 1 liter of sat. solution at  $100^\circ$ . (Böttger, Z. phys. Ch. 1906, 56. 93.)

1 mg. in 1 l. of sat. solution at  $21^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Solubility in  $\text{H}_2\text{O}$  =  $8.8 \times 10^{-7}$  g. mol. per litre at  $25^\circ$ . (A. E. Hill, J. Am. Chem. Soc. 1906, 30. 74.)

Boiling  $\text{H}_2\text{O}$  dissolves 0.00003502 of its weight of AgBr.  $\text{HNO}_3$ +Aq (1%  $\text{HNO}_3$ ) dissolves 0.0000543 of its weight of AgBr at  $100^\circ$  with sl. decomposition. The solution is pptd. by  $\text{AgNO}_3$ +Aq or HBr (or MBr)+Aq, but not completely. 1 pt. of AgBr in solution requires 3 pts. of Br as MBr (or HBr), or of Ag as  $\text{AgNO}_3$ , in order to be wholly precipitated. (Stas.)

Not attacked by boiling  $\text{HNO}_3$ +Aq; sl. sol. in conc. HBr or HCl+Aq (Löwig). Boiling conc.  $\text{H}_2\text{SO}_4$  decomposes it (Balard), hardly acts on it (Dumas), dissolves a small quantity, which is repptd. by  $\text{H}_2\text{O}$  (Berzelius.)

Very sl. sol. in dil., easily in conc.  $\text{NH}_4\text{OH}$ +Aq. 100 pts.  $\text{NH}_4\text{OH}$ +Aq (0.986 sp. gr.) dissolve 0.51 pt. AgBr (dried at  $100^\circ$ ) at  $80^\circ$ , and about double that amount of freshly pptd. AgBr. (Pohl, W. A. B. 41. 267.)

1 g. freshly pptd. AgBr is sol. in 250 cc. 10%  $\text{NH}_4\text{OH}$ +Aq, but insol. in an ammoniacal solution of AgCl. (Seiner, Pharm. J. Trans. (3) 14. 1.)

1 g. AgBr dissolves in 8779.4 g. 5%  $\text{NH}_4\text{OH}$ +Aq (sp. gr. = 0.998) at  $12^\circ$ , and in 288.5 g.

10%  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. = 0.96) at  $12^\circ$ .  
(Longi, Gazz. ch. it. 18. 87.)

Solubility of AgBr in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $15^\circ$ .  
G. mols. per l.

$\text{NH}_3$	AgBr	Sp. gr. $15.5^\circ$
1.066	0.0011	0.9932
2.365	0.0031	0.9853
3.410	0.0050	0.9793
4.590	0.0074	0.9720
5.725	0.0101	0.9655

(Bodländer, Z. phys. Ch. 1892, 9. 734.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $0^\circ$ .

10 ccm. of the solution contain g.  $\text{NH}_3$  and mg. Ag Br.

g. $\text{NH}_3$	Mg. AgBr	g. $\text{NH}_3$	Mg. AgBr
0.307	8.0	2.627	106.7
0.488	9.6	3.126	156.8
0.669	17.2	3.389	198.7
0.829	21.2	3.652	266.9
1.151	34.9	3.722	288.8
1.532	55.7	3.770	293.0
1.809	72.2	3.926	289.2
1.953	74.1	3.995	285.0

(Jarry, A. ch. 1899, (7) 17. 364.)

Solubility of AgBr in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

G. mols. per l.

$\text{NH}_3$	AgBr	$\text{NH}_3$	AgBr
0.1932	0.00060	1.965	0.00692
0.3849	0.00120	3.024	0.01163
0.7573	0.00223	5.244	0.02443

(Bodländer and Fittig, 1902, Z. phys. Ch. 39. 597.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

g. at. Ag per l.	Mols. $\text{NH}_3$ per l.
0.00170	0.450
0.00159	0.497
0.000941	0.268
0.00107	0.273
0.000391	0.115
0.000386	0.118
0.000276	0.0764
0.000264	0.0777

(Whitney and Melcher, J. Am. Chem. Soc. 1903, 25. 79.)

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ . Very sl. sol. in  $\text{NH}_4$  carbonate, sulphate, or succinate + Aq, and still less in nitrate. (Wittstein.) Not very easily sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  when suspended in much  $\text{H}_2\text{O}$ , and is separated out again by KBr + Aq. (Field, C. N. 3. 17.)

Sol. in KCN + Aq. Sl. sol. in conc. KCl,

KBr, NaCl, NaBr,  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{Br} + \text{Aq}$ ; but insol. when dilute.

Traces only dissolve in alkali nitrates + Aq. (Fresenius, Quant. Anal.)

Abundantly sol. in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ . 100 ccm.  $\text{H}_2\text{O}$  containing 10 ccm. normal  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  dissolve 0.0383 g. AgBr. (Stas.)

Solubility of AgBr in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

G. mols. per l.

$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	AgBr	$\text{Hg}(\text{NO}_3)_2$ $\text{HNO}_3$	AgBr
1	0.03660	0.025	0.00459
0.10	0.00873	0.0125	0.00329
0.05	0.00639	0.0100	0.00306

$\text{HNO}_3$  was present in all cases, and it was found that there was no difference in solubility of AgBr with concentrations between 0.1N and 2N  $\text{HNO}_3$ . Cryst. and amorphous AgBr showed the same solubility. (Morse, Z. phys. Ch. 1902, 45. 708.)

Difficultly sol. in hot conc.  $\text{AgNO}_3 + \text{Aq}$ . (Risse, A. 111. 39.)

100 ccm. of a 3-N solution of  $\text{AgNO}_3$  dissolve 0.04 g. AgBr at  $25^\circ$ . Much less sol. in  $\text{AgNO}_3 + \text{Aq}$  than AgI. (Hellwig, Z. anorg. 1900, 25. 176.)

Solubility in  $\text{AgNO}_3 + \text{Aq}$ .

Volumetric measurements

$\text{AgNO}_3$	N/10 KBr ccm.	Opalescent at	G. AgBr retained per 100 g. $\text{AgNO}_3$
10 g. made up to 32 g. per 100 g. of solution	0.65	22°	0.129
	0.72	35	0.144
	0.8	44	0.159
	0.9	62	0.178
	1.0	67	0.188
	1.1	77	0.207
10 g. made up to 70 g. per 100 g. of solution	1.2	79	0.226
	6.0	37	1.13
	8.0	53	1.50
	10.0	67	1.88
	11.25	72	2.12
	12.0	74	2.26
	12.75	79	2.40
	13.5	82	2.54
	15.5	85.5	2.92
	17.5	90	3.29

Gravimetric measurements at  $14.5^\circ$

G. $\text{AgNO}_3$	ccm. $\text{H}_2\text{O}$	Strength of $\text{AgNO}_3$ %	G. AgBr re- tained per 100 g. $\text{AgNO}_3$
7.326	9.32	44	0.144
8.290	7.65	52	0.185
7.255	4.84	60	0.283
7.35	3.95	65	0.365

(Lowry, Roy. Soc. Proc. 1914, 91. A, 65.)

100 g. KBr in conc. KBr+Aq dissolve 3019 mg. AgBr at 15°; 95 g. NaCl+10 g. KBr dissolve only 75 mg. AgBr at 15°. (Schierholz, W. A. B. 101, 2b. 4.)

#### Solubility in KBr+Aq at 25°.

Mol. KBr in 1 litre	G. AgBr in 1 litre
4.864	26.44
4.44	17.95
4.18	13.50
3.68	7.50
2.81	2.34
2.76	2.20

(Hellwig, Z. anorg. 1900, 25. 183.)

Sol. in conc. KBr or NaBr+Aq (Lowig), but less than AgI in KI+Aq (Field).

100 g. NaCl in conc. NaCl+Aq dissolve 474 mg. AgBr at 15°; 100 g. NaCl in 21% NaCl+Aq dissolve 188 mg. AgBr at 15°. (Schierholz, W. A. B. 101, 2b. 4.)

#### Solubility of AgBr in Na<sub>2</sub>SO<sub>3</sub>+Aq at 25°.

G. formula weights per l.

So <sub>3</sub>	Ag	So <sub>3</sub>	Ag
0.232	0.0025	0.466	0.0053
0.406	0.0023	0.474	0.0055
0.448	0.0023	0.675	0.0084

(Luther and Leubner, Z. anorg. 1912, 74. 393.)

#### Solubility of AgBr in Na<sub>2</sub>SO<sub>3</sub> at (?)°.

(g. salts per l. of solution.)

Na <sub>2</sub> SO <sub>3</sub>	AgBr	Na <sub>2</sub> SO <sub>3</sub>	AgBr
83.75	0.790	2.08	0.0159
70.75	0.570	1.13	0.0086
38.2	0.265	0.59	0.0045
17.65	0.116	0.3	0.0039
9.47	0.0526	0.17	0.0022
4.85	0.0329	0.08	0.00075

(Mees and Piper, Photog. J. 1912, 36. 234.)

#### Solubility in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+Aq at 35°.

g. Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> in 1 liter	g. AgBr corresponding to each g. Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> .
100	0.376
200	0.390
300	0.397
500	0.427

(Richards and Faber, Am. Ch. J. 1899, 21. 169.)

(NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+Aq. dissolves AgBr more rapidly than does Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>+Aq. (Lumiére and Seyewitz, C. C. 1908, II. 1138.)

#### Solubility in salts+Aq.

Solvent	% Conc.	Grams AgBr sol. in 100 grams solvent
Sodium thiosulphate	1	0.35
" " "	5	1.90
" " "	10	3.50
" " "	15	4.20
" " "	20	5.80
Sodium sulphite	10	0.04
" " "	20	0.08
Ammonium sulphite	10	Traces
Potassium cyanide	5	6.55
Ammonium sulphocyanide	5	0.21
" " "	10	2.04
" " "	15	5.30
Potassium " "	10	0.73
Calcium " "	10	0.53
Barium " "	10	0.35
Aluminum " "	10	4.50
Thiocarbamide	10	1.87
Thiosinamine	1	0.08
"	5	0.35
"	10	0.72

(Valenta, M. 1894, 15. 250.)

Solubility of AgBr in salts+Aq at (?)°.  
(G. AgBr sol. in 1 l. of 1% solution of salts.)

NaSCN	2.06
NH <sub>4</sub> SCN	0.03
(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>	0.004
Na <sub>2</sub> SO <sub>4</sub>	0.055

(Mees and Piper, Photog. J., 1912, 36. 234.)

In a solution of NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq, containing 10 ccm. of sat. NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq at 15° and 20 ccm. normal HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq mixed with 970 ccm. H<sub>2</sub>O, about double the amt. of flocculent AgBr is dissolved in the cold that is dissolved by boiling H<sub>2</sub>O from granular AgBr. This solution required 3 pts. of Ag or Br to ppt. the AgBr in solution. Pulverulent or granular AgBr are wholly insol. in dil. or conc. acetates+Aq. (Stas.)

Sol. in Hg(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq.

100 ccm. H<sub>2</sub>O containing 10% of normal Hg(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>+Aq dissolves 0.0122 g. AgBr at 20°. (Schierholz.)

Very sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Solubility in 10 cc. methylamine+Aq of different concentrations at 11.5°

g. NH <sub>2</sub> CH <sub>3</sub>	4.844	4.311	3.562	3.258
mg. AgBr	289	127	73	55

g. NH <sub>2</sub> CH <sub>3</sub>	1.797	1.513	1.317	1.101
mg. AgBr	28	16	12	7

(Jarry, A. ch. 1899, (7) 17. 378.)

## Solubility in methylamine + Aq at 25°.

G. mol. per l.	
CH <sub>3</sub> NH <sub>2</sub>	AgBr
0.02	0.00026
0.04	0.00034
0.074	0.000395
0.0947	0.00041
0.1950	0.00045

(Wuth, B. 1902, 35. 2416.)

## Solubility of AgBr in methylamine + Aq at 25°.

G. mol. per l.			
CH <sub>3</sub> NH <sub>2</sub>	AgBr	CH <sub>3</sub> NH <sub>2</sub>	AgBr
1.017	0.0025	0.102	0.00026
0.508	0.0013	0.051	0.00012
0.203	0.00049		

(Bodländer and Eberlein, B. 1903, 36. 3948.)

## Solubility in ethylamine + Aq at 25°.

G. mol. per l.	
C <sub>2</sub> H <sub>5</sub> NH <sub>2</sub>	AgBr
0.01272	0.0000867
0.03942	0.000137
0.05512	0.000193
0.08572	0.000258
0.10300	0.000711

(Wuth, B. 1902, 35. 2416.)

At 25°, 1 l. ethylamine + Aq containing 0.483 g. mol. C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub> dissolves 0.00231 g. mol. AgBr; 0.200 g. mol. C<sub>2</sub>H<sub>5</sub>NH<sub>2</sub>, 0.0097 g. mol. AgBr. (Bodländer and Eberlein, B. 1903, 36. 3948.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in acetone. (Eidmann, C. C. 1899; II, 1014); (Naumann, B. 1904, 37. 4329.)

Sol. in alcoholic thiourea. (Reynolds, Chem. Soc. 1892, 61. 251.)

Insol. in methyl acetate. (Bezold, Dissert. 1906); (Naumann, B. 1909, 42. 3790.) ethyl acetate. (Hamers, Dissert. 1906); (Naumann B. 1910, 43. 314.)

1.49 g. AgBr is dissolved in 1 l. of 1% thio-carbamide + Aq. (Mees and Piper, Photog. J. 1912, 36. 239.)

Insol. in warm pyridine.

Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, 15. 16.)

Min. Bromyrite, Bromite.

Silver bromide ammonia, AgBr, NH<sub>3</sub>.

(Joannis and Crosier, C. R. 894, 118. 1150.)

AgBr, 1½ NH<sub>3</sub>... (Jarry, A. ch. 1899, (7) 17. 356.)

2AgBr, 3NH<sub>3</sub>. (Joannis and Crosier.)

AgBr, 3NH<sub>3</sub>. Decomp. by H<sub>2</sub>O. Sl. sol. in liquid NH<sub>3</sub>. (Jarry.)

AgBr, 5NH<sub>3</sub>. (Jarry, C. R. 1898, 126. 1141.)

Silver carbide, Ag<sub>2</sub>C.

(Gay-Lussac.)

Ag<sub>2</sub>C(?). Sol. in HNO<sub>3</sub> + Aq with residue of C. (Liebig, A. 38. 129.)

Ag<sub>2</sub>C<sub>3</sub>. Sol. in HNO<sub>3</sub> + Aq with residue of C. (Regnault, A. 19. 153.)

Silver subchloride, Ag<sub>2</sub>Cl<sub>3</sub>.

NH<sub>4</sub>OH + Aq dissolves the greater part, the residue (20%) being sol. in HNO<sub>3</sub> + Aq. KCN dissolves the greater part; H<sub>2</sub>SO<sub>4</sub> dissolves about 2%; acetic acid and KOH are without action. (Bibra, J. pr. 1875, (2) 12. 52.)

Argentous chloride, Ag<sub>2</sub>Cl.

Obtained in a pure state by Guntz (C. R. 112. 861). Dil. HNO<sub>3</sub> + Aq does not attack but warm conc. HNO<sub>3</sub> + Aq decomp. Easily sol. in KCN + Aq. (Guntz, C. R. 112. 1212.)

The following data are for a more or less impure Ag<sub>2</sub>Cl.

Boiling conc. HCl + Aq, NaCl + Aq, or NH<sub>4</sub>OH + Aq dissolve out AgCl, and leave Ag. (Scheele, Wetslar. Dulk, Wöhler.)

According to Berthollet, wholly sol. in NH<sub>4</sub>OH + Aq. Sol. for the most part in NH<sub>4</sub>OH + Aq, and the residue is sol. in HNO<sub>3</sub> + Aq (= Ag + AgCl). (v. Bibra, B. 7. 741.)

## Silver chloride, AgCl.

Nearly insol. in H<sub>2</sub>O.

When AgCl is left in contact for some hours with pure H<sub>2</sub>O at 20-22°, and especially at 75°, traces go into solution; more Cl is dissolved than Ag. When 1 pt. Ag is pptd. as AgCl in presence of 1 million pts. H<sub>2</sub>O a slight bluish milkiness is observed; but in order to have a distinct ppt. 4 pts. Ag should be present.

Dil. HNO<sub>3</sub> + Aq does not increase the solubility of AgCl, but AgCl is not absolutely insol. in stronger HNO<sub>3</sub> + Aq. (Mulder.)

1 pt. AgNO<sub>3</sub>, when mixed with HCl + Aq in presence of 120,000 (Pfaff), 240,000 (Harting), pts. H<sub>2</sub>O, causes an opalescence.

1 pt. Ag gives a slight turbidity with HCl + Aq in presence of 200,000 pts. H<sub>2</sub>O, a scarcely opalescent cloudiness with 400,000 pts. H<sub>2</sub>O, and the same after the lapse of 15 minutes in presence of 800,000 pts. H<sub>2</sub>O. (Lassaigne.)

1 pt. Ag can be detected as AgCl in 1 million parts H<sub>2</sub>O at ordinary temp., but not in 2 million parts. In NaNO<sub>3</sub> + Aq containing 0.79 pt. NaNO<sub>3</sub> in 200,000 pts. H<sub>2</sub>O, 1 pt. Ag can be detected as AgCl. This dissolves at 75°, and is visible again on cooling.

If the same liquid contains 1574 pts. NaNO<sub>3</sub>, the AgCl remains in solution after cooling.

In 100 ccm.  $H_2O$  containing 0.787 g.  $NaNO_3$ , 13 drops of  $NaCl$  and silver solution, each drop of which contains 0.05 mg.  $Ag$ , cause a precipitate at  $5^\circ$ , 20 drops at  $15-17^\circ$ , 60 drops at  $45-55^\circ$ .

$AgCl$  is somewhat less sol. in  $HNO_3 + Aq$  than in  $NaNO_3 + Aq$  when the amount of  $H_2O$  remains the same.

Therefore, if  $HCl$  is used instead of  $NaCl$ , about  $\frac{1}{2}$  less  $AgCl$  remains in solution.

In 100,000 pts. of  $H_2O$ , which contain  $HNO_3$ , and an amount of  $HCl$  corresponding to the amount of  $Ag$  salt, 1.596 pts.  $AgCl$  dissolve at  $25^\circ$ . The solution is precipitated by either  $AgNO_3$  or  $HCl$ . (Mulder, Silber Probir-methode, Leipzig, 1859. 62.)

(For further older data, see Storer's Dictionary.)

White flaky  $AgCl$  is appreciably sol. in hot  $H_2O$ , 1000 ccm. boiling  $H_2O$  dissolving about 2 mg.  $AgCl$ . Far less sol. in  $H_2O$  containing  $AgNO_3$ , being practically insol. in  $H_2O$  containing 0.1 g.  $AgNO_3$  in a litre. Solubility is also diminished one-half by addition of  $HCl$ . (Cooke, Sil. Am. J. (3) 21. 220.)

Solubility in  $H_2O$  rapidly diminishes as the temp. falls. (Cooke, l. c.)

Not completely insol. in  $H_2O$ . According to Stas (C. R. 73. 998) there are four modifications: (1) gelatinous; (2) cheesy-flocculent; (3) pulverulent; (4) granular, crystalline, or fused. (4) is almost absolutely insol. in  $H_2O$  at the ordinary temp., but the solubility increases with the temp., and is considerable at  $100^\circ$ ; (2), which is formed by the precipitation of a cold dilute  $Ag$  solution, has the greatest solubility in pure  $H_2O$ ; and it changes its solubility by standing, or if made pulverulent by shaking with  $H_2O$ ; (3) is also sol. in  $H_2O$ ; the solution of (2) or (3) in pure  $H_2O$ , or  $H_2O$  acidified with  $HNO_3$ , is precipitated by  $AgNO_3$ , or  $NaCl + Aq$ .

In order to ppt. 1 pt.  $AgCl$  in above solution 3 pts. of  $Cl$  as chloride or  $Ag$  as nitrate are necessary; the pptn. is then complete.

Solubility of granular variety in boiling  $H_2O$  is proportionately large, and pptn. is brought about by 3 pts.  $Cl$  or  $Ag$  as above, but the pptn. in this case is not complete.

The salts formed simultaneously with the  $AgCl$  have no influence on the solubility of the  $AgCl$ . Presence of  $HNO_3$  does not increase the solubility of (2), but has that effect on (3) in proportion to the amt. of  $HNO_3$  present. (Stas, C. R. 73. 998.)

Further determination by Stas are as follows:—

Between  $0^\circ$  and  $30^\circ$  granular  $AgCl$  is insol. in pure  $H_2O$ , or  $H_2O$  acidulated with  $HNO_3$ .

Between  $0^\circ$  and  $30^\circ$  the flocculent and pulverulent forms of  $AgCl$  dissolve without alteration in pure  $H_2O$ , in acidulated  $H_2O$ , in alkali acetates +  $Aq$ , and in  $Hg(C_2H_3O_2)_2 + Aq$  containing an alkali acetate. Their degree of solubility is a function of the state of the chloride, of the temp., and of the nature

and quantity of the solvent within these limits of temp. ( $0^\circ-30^\circ$ ). These solvents, if they contain either  $Ag$  in the state of an  $Ag$  salt, or  $Cl$  as chloride or  $HCl$  in an amount three times that which they can dissolve as  $AgCl$ , exercise no solvent action on any of the modifications of  $AgCl$ . And reciprocally sat.  $AgCl + Aq$  is pptd. instantly by a decinormal solution of  $AgNO_3$ , or  $MCl$  (or  $HCl$ ). The  $AgCl$  is wholly pptd. when the quantity of the  $Ag$  or  $Cl$  thus added is equal to three times the quantity of the  $Ag$  or  $Cl$  dissolved as  $AgCl$ .

Between  $50^\circ$  and  $100^\circ$ , however, decinormal solutions of  $Ag$  or chlorides, which cause instant ppts. in solutions sat. with any of the modifications of  $AgCl$ , do not eliminate all the dissolved  $AgCl$ . At  $100^\circ$ , they only ppt. 60% of the amt. dissolved. (Stas, A. ch. (5) 3. 323.)

Calculated from electrical conductivity of  $AgCl + Aq$ ,  $AgCl$  is sol. in 715,800 pts.  $H_2O$  at  $13.8^\circ$ , and 384,100 pts. at  $26.5^\circ$ . (Holleman, Z. phys. Ch. 12. 132.)

Calculated in the same way, 1. l.  $H_2O$  dissolves 0.76 mg. at  $2^\circ$ ; 0.97 mg. at  $10^\circ$ ; 1.52 mg. at  $18^\circ$ ; 2.24 mg. at  $26^\circ$ ; 3.03 mg. at  $34^\circ$ ; 4.05 mg. at  $42^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 242.)

Solubility in  $H_2O = 1.25 \times 10^{-4}$  mol./l. at  $25^\circ$ . (Goodwin, Z. phys. Ch. 1894. 13. 645.)

Solubility of  $AgCl$  in  $H_2O$  at  $25^\circ$  is  $1.41 \times 10^{-4}$  (in normality). (Thiel, Z. anorg. 1900, 24. 57.)

$2.16 \times 10^{-5}$  moles are sol. in 1 liter  $H_2O$  at  $25^\circ$ . (Noyes and Kohr, Z. phys. Ch. 1903, 42. 341.)

$1.53 \times 10^{-3}$  g. per liter are dissolved in sat. aq. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $H_2O$  dissolves 1.6 mg.  $AgCl$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

21.8 milligrams are dissolved in 1 liter of sat. solution at  $100^\circ$ . (Pöttger, Z. phys. Ch. 1906, 56. 93.)

1.34 mg. are contained in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

1 l. sat. solution at  $t^\circ$  contains mg.  $AgCl$ .

$t^\circ$	mg. $AgCl$	$t^\circ$	mg. $AgCl$
1.55	0.56	17.51	1.31
4.68	0.66	25.86	1.935
9.97	0.89	34.12	2.74

(Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Solubility in  $H_2O = 1.6 \times 10^{-4}$  g.-mol. per litre at  $25^\circ$ . (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

1 l.  $H_2O$  dissolves 0.00154 g.  $AgCl$  at  $21^\circ$ ; 0.0217 g. at  $100^\circ$ . (Whitby, Z. anorg. 1910, 67. 108.)

Calculated from electrical conductivity of AgCl + Aq, 1 l. H<sub>2</sub>O dissolves:

0.0105 milli-equivalents AgCl at 18°.

0.0365 " " " " 50°.

0.147 " " " " 100°.

(Melcher, J. Am. Chem. Soc. 1910, **32**, 55.)

1 l. H<sub>2</sub>O dissolves  $1.02 \times 10^{-5}$  g. equiv. at 18°;  $1.429 \times 10^{-5}$  g. equiv. at 25°. (van Rossen, C. C. 1912, I. 1539.)

The most probable average value for solubility of AgCl in H<sub>2</sub>O is  $1.04 \times 10^{-5}$  g. equiv. per l. at 18°, and  $1.43 \times 10^{-5}$  g. equiv. per l. at 25°. (van Rossen, C. C. 1912, II. 1807.)

$1.20 \times 10^{-5}$  g. AgCl are sol. in 1 l. H<sub>2</sub>O at 18°. (Głowczyński, C. A. 1915, 741.)

More sol. in H<sub>2</sub>O than AgSCN. (Normand, Chem. Soc. 1912, 101. 1853.)

Sol. in conc. HCl + Aq, and also when not very conc.; thus the solution of 1 pt. AgNO<sub>3</sub> + Aq in 15,000 pts. H<sub>2</sub>O is clouded by a little HCl + Aq, but clears up by the addition of more. (Reinsch, J. pr. 13. 133.)

1 pt. AgCl dissolves in 200 pts. conc. HCl + Aq and in 600 pts. HCl + Aq diluted with 2 pts. H<sub>2</sub>O. (Pierre, J. Pharm. (3) 12. 237.)

Somewhat sol. in hot alcohol, to which HCl has been added, but is precipitated on cooling. (Erdmann, J. pr. 19. 341.)

100 pts. sat. HCl + Aq (sp. gr. 1.165) dissolve 0.2980 pt. AgCl, or AgCl is sol. in 336 pts. HCl + Aq at ord. temp.; 100 pts. HCl + Aq (sp. gr. 1.165) at b.-pt. dissolve 0.56 g. AgCl, or AgCl is sol. in 178 pts. HCl + Aq.

Solubility of AgCl in dil. HCl + Aq. 100 ccm. HCl + Aq (sp. gr. 1.165), to which the given amt. H<sub>2</sub>O has been added, dissolve g. AgCl.

ccm. HCl	ccm. H <sub>2</sub> O	g. AgCl	Pts. HCl which dissolve 1 pt. AgCl
100	10	0.056	1,785
100	20	0.018	5,555
100	30	0.0089	11,235
100	50	0.0035	18,571

(Vogel, N. Rep. Pharm. **23**, 335.)

If HCl is added to a solution in which  $\frac{1}{1,000,000}$  pt. Ag is suspended, the milkiness disappears. Solubility in HCl + Aq increases with the temp., the AgCl separating out on cooling. (Mulder.)

The amounts of AgCl which dissolve in HCl + Aq are directly proportional to the volumes of acid (of fixed concentration) used. (Barlow, J. Am. Chem. Soc. 1906, **28**, 1448.)

1 l. 1% HCl dissolves 0.0002 g. AgCl at 21°.

1 l. 5% HCl dissolves 0.0033 g. AgCl at 21°.

1 l. 10% HCl dissolves 0.0555 g. AgCl at 21°.

(Whitby, Z. anorg. 1910, **67**, 108.)

### Solubility in HCl + Aq at 25°.

HCl g.-equivalents per l.	Ag $\times 10^{-5}$ g.-equivalents per l.
0.649	0.032
1.300	0.126
1.911	0.266
2.149	0.374
2.599	0.610
2.975	0.814
3.576	1.358
4.182	2.147
4.735	3.168
5.508	4.126

(Forbes, J. Am. Chem. Soc. 1911, **33**, 1941.)

### Solubility in 20% HCl + Aq.

HCl	N/10 AgNO <sub>3</sub> ccm.	Opalescent at t°	G. AgCl to 100 g. anhydrous HCl
20 g. of 20% acid	1.0	...	...
	1.1	0.0	0.39
	2.0	29.5	0.72
	3.0	51.5	1.076
	3.75	70.0	1.346
	4.25	82.0	1.525
	4.75	90.0	1.74
	5.80	107.0	2.06

(Lowry, Roy, Soc. Proc. 1914, **91**, A. 62.)

Sl. sol. in conc. HBr + Aq. (Löwig.)

Insol. in HNO<sub>3</sub> + Aq. (Wackenroder.)

Entirely unacted upon by HNO<sub>3</sub> of 1.43 sp. gr. (Wurts, Am. J. Sci. (2) **25**, 382.)

Solubility in dil. HNO<sub>3</sub> + Aq is the same as solubility in H<sub>2</sub>O, i. e.  $\frac{1}{1,000,000}$  pt. of Ag cannot be detected in H<sub>2</sub>O with or without HNO<sub>3</sub>, but  $\frac{1}{1,000,000}$  pt. can be detected in both cases. (Mulder.)

1 pt. Ag in the form of AgCl dissolves at 25° in 83,000 pts. H<sub>2</sub>O containing free HNO<sub>3</sub> and 0.33 pt. of HCl. (Mulder.)

100,000 pts. conc. HNO<sub>3</sub> + Aq dissolve about 2 pts. AgCl, and solubility is not sensibly affected by lower nitrogen oxides. (Thorpe, Chem. Soc. (2) **10**, 453.)

### Solubility of AgCl in HNO<sub>3</sub> + Aq at 25°.

G. per liter			
HNO <sub>3</sub>	AgCl	HNO <sub>3</sub>	AgCl
0.0315	0.001647	18.9	0.00225
0.063	0.001705	94.5	0.0245
0.630	0.00176		

(Głowczyński, Kolloidchem. Beih. 1914, **6**, 147.)

Insol. in cold conc.  $\text{H}_2\text{SO}_4$ , but on boiling is in part decomp. and in part dissolved, and does not separate on cooling.

$\text{AgCl}$  is not more sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in dil.  $\text{HNO}_3 + \text{Aq}$ .

Unacted upon by cold  $\text{H}_2\text{SO}_4 + \text{Aq}$ , and but slightly decomp. on heating. (Vogel.)

Abundantly sol. in  $\text{H}_2\text{PtCl}_6 + \text{Aq}$  without decomp. (Birnbbaum, Z. Ch. 1887. 520.)

Insol. in cold dil. caustic alkalies +  $\text{Aq}$  but decomp. by hot conc. solutions. (Gregory.)

Decomp. by  $\text{K}_2\text{CO}_3 + \text{Aq}$ .

Sl. sol. in cold  $\text{K}_2\text{CO}_3 + \text{Aq}$ .

Easily sol. even in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ .

1 pt.  $\text{AgCl}$  dissolves in 1288 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.89 sp. gr. (Wallace and Lamont, Chem. Gas. 1893. 137.)

100 pts.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.986 sp. gr. dissolve at  $80^\circ$  1.492 pts.  $\text{AgCl}$ , dried at  $100^\circ$ . (Pohl, W. A. B. 41. 627.)

1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.949 sp. gr. dissolves 51.6 g.  $\text{Ag}$  as freshly precipitated  $\text{AgCl}$ , and 47.6 g. when diluted with 1 l.  $\text{H}_2\text{O}$ .

1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.924 sp. gr. dissolves 58 g.  $\text{Ag}$  as freshly precipitated  $\text{AgCl}$ ; 1 l.  $\text{NH}_4\text{OH} + \text{Aq}$  of 0.899 sp. gr. dissolves 49.6 g.; 0.5 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (of 0.049 sp. gr.) + 0.5 l. saturated  $\text{NaCl} + \text{Aq}$  dissolves 20.8 g.; 0.5 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (of 0.949 sp. gr.) + 0.5 l. saturated  $\text{KCl} + \text{Aq}$  dissolves 20.4 g.; 0.5 l.  $\text{NH}_4\text{OH} + \text{Aq}$  (of 0.949 sp. gr.) + 0.5 l. saturated  $\text{NH}_4\text{Cl} + \text{Aq}$  dissolves 22.4 g.  $\text{Ag}$  as freshly pptd.  $\text{AgCl}$ . (Millon and Commaille, C. R. 56. 309.)

1 g.  $\text{AgCl}$  dissolves in 428.64 g. 5%  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.998) at  $12^\circ$ ; 1 g.  $\text{AgCl}$  dissolves in 12.76 g. 10%  $\text{NH}_4\text{OH} + \text{Aq}$  (sp. gr. 0.96) at  $18^\circ$ . (Longi, Gazz. ch. it. 13. 87.)

1 g. freshly pptd.  $\text{AgCl}$  is sol. in 17 ccm. 10%  $\text{NH}_4\text{OH} + \text{Aq}$ . Solubility is diminished by presence of  $\text{AgBr}$ . (Senier, Pharm. J. Trans. (3) 14. 1.)

#### Solubility in $\text{NH}_4\text{OH} + \text{Aq}$ at $0^\circ$ .

G. per 100 g. solution.

$\text{NH}_3$	$\text{AgCl}$	$\text{NH}_3$	$\text{AgCl}$
1.45	0.49	28.16	5.69
1.94	1.36	29.80	7.09
5.60	3.44	30.19	7.25
6.24	4.00	32.43	5.87
11.77	4.68	34.56	4.77
16.36	5.18	37.48	3.90

(Jarry, A. ch. 1899, (7) 17. 342.)

Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  increases with the temp. (Jarry.)

#### Solubility in $\text{NH}_4\text{OH} + \text{Aq}$ at $25^\circ$ .

g. at. $\text{Ag}$ per l.	Mols. $\text{NH}_3$ per l.	g. at. $\text{Ag}$ per l.	Mols. $\text{NH}_3$ per l.
0.151	2.042	0.0140	0.253
0.149	2.017	0.0140	0.253
0.149	2.013	0.0140	0.252
0.147	1.991	0.0139	0.252
0.0616	0.961	0.00621	0.118
0.0583	0.916	0.00621	0.118
0.0584	0.909	0.00619	0.118
0.0572	0.903	0.00625	0.118
0.0569	0.896	0.00304	0.0590
0.0555	0.873	0.00297	0.0589
0.0541	0.863	0.00300	0.0585
0.0514	0.818	0.00149	0.0288
0.0249	0.428	0.00143	0.0287
0.0240	0.416	0.00142	0.0285
0.0235	0.411	0.00141	0.0282
0.0227	0.397	.....	.....

(Whitney and Melcher, J. Am. Chem. Soc. 1903, 25. 78.)

#### Solubility of $\text{AgCl}$ in $\text{NH}_4\text{OH} + \text{Aq}$ at $25^\circ$ .

$\text{Ag} = \text{g. at. Ag}$  in 1000 g.  $\text{H}_2\text{O}$ .

$\text{NH}_3 = \text{g. mol. NH}_3$  in 1000 g.  $\text{H}_2\text{O}$ .

Conc. = Molecular concentration of free  $\text{NH}_3$ .

$\text{Ag}$	$\text{NH}_3$	Conc.	Solid phase
0.023	0.437	0.391	$\text{AgCl}$
0.025	0.428	0.378	"
0.1197	1.700	1.461	"
0.1308	1.688	1.426	"
0.372	3.782	3.038	"
0.378	3.945	3.181	"
0.574	5.10	3.95	"
0.609	5.33	4.11	"
0.633	5.545	4.279	"
0.745	6.26	4.77	$\text{AgCl} + 2\text{AgCl}, 3\text{NH}_3$
0.754	6.27	4.76	"
0.757	6.25	4.74	"
0.760	6.25	4.73	"
0.775	6.52	4.97	$2\text{AgCl}, 3\text{NH}_3$
0.848	8.28	6.58	"
0.968	11.19	9.25	"
0.980	11.78	9.82	"
0.978	12.23	10.27	"
0.965	12.26	10.33	"
1.03	12.68	10.62	"
1.09	12.96	10.78	"
1.049	14.34	12.24	"
1.039	14.47	12.39	"

(Straub, Z. phys. Ch. 1911, 77. 332.)

Easily (Brett), difficultly (Wittstein), sol in  $\text{NH}_4\text{Cl} + \text{Aq}$ , but not in other  $\text{NH}_4$  salts.

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $15^\circ$ .

% $\text{NH}_4\text{Cl}$	% $\text{AgCl}$
10.0	0.0050
14.29	0.0143
17.70	0.0354
19.23	0.0577
21.98	0.110
25.31	0.228
28.45	0.340*
Sat.	0.177

\* $24.5^\circ$ .

(Schierholz, W. A. B., 1890, 101. 2b. 8.)

Solubility in  $\text{NH}_4\text{Cl} + \text{Aq}$  (26.31%) at  $t^\circ$ .

$t^\circ$	% $\text{AgCl}$
15	0.276
40	0.329
60	0.421
80	0.592
90	0.711
100	0.856
110	1.053

(Schierholz.)

At  $25^\circ$ , 1 l.  $\text{NH}_4\text{Cl} + \text{Aq}$  containing 0.00053 g.  $\text{NH}_4\text{Cl}$  dissolves 0.001604 g.  $\text{AgCl}$ ; 0.00530 g.  $\text{NH}_4\text{Cl}$ , 0.002379 g.  $\text{AgCl}$ . (Glowczynski, Kolloidchem. Beih. 1914, 6. 147.)

See also Forbes, page 826.

1 l.  $\text{KClO}_3 + \text{Aq}$  dissolves 1.8 mg. (Guye, J. Chim. Phys. 10. 145.)

Sl. sol. in conc.  $\text{KCl} + \text{Aq}$ ,  $\text{NaCl} + \text{Aq}$ , and certain other chlorides.

$\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{CaCl}_2$ ,  $\text{ZnCl}_2 + \text{Aq}$ , etc., dissolve appreciable quantities of  $\text{AgCl}$ , especially if hot and concentrated, but it separates out for the most part on cooling.

Sol. in solutions of all the metallic chlorides which are sol. in  $\text{H}_2\text{O}$ , thus  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{CaCl}_2$ ,  $\text{SrCl}_2$ , and  $\text{BaCl}_2 + \text{Aq}$  all dissolve  $\text{AgCl}$ , especially if hot.  $\text{MgCl}_2$ ,  $\text{NH}_4\text{Cl}$ , and  $\text{HgCl}_2$  (least) also dissolve  $\text{AgCl}$ . (Mulder.)

Sol. in conc.  $\text{CaCl}_2 + \text{Aq}$ . (Wetslar.)

Sol. in rosecobaltic chloride  $+ \text{Aq}$ . (Gibbs and Genth.)

Insol. in  $\text{SnCl}_4$ ,  $\text{HgCl}_2$ ,  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ ,  $\text{CdCl}_2$ ,  $\text{NiCl}_2$ , or  $\text{CoCl}_2 + \text{Aq}$ . (Vogel.)

Solubility of  $\text{AgCl}$  in sat. solutions of chlorides at ordinary temperatures.

Salt	100 pts. sat. solution dissolve pts. $\text{AgCl}$	Pts. solution required to dissolve 1 pt. $\text{AgCl}$
$\text{BaCl}_2$	0.0143	6.993
$\text{SrCl}_2$	0.0884	1.185
$\text{CaCl}_2$	0.0930	1.075
$\text{NaCl}$	0.0950	1.050
$\text{KCl}$	0.0475	2.122
$\text{NH}_4\text{Cl}$	0.1575	634
$\text{MgCl}_2$	0.1710	584
$\text{HCl}$	0.2980	336

(Vogel, N. Rep. Pharm. 23. 335.)

Experiments by Hahn give different results from those of Vogel as follows:—

Solubility in various salts  $+ \text{Aq}$ .

Salt	% salt	Sat. at $t^\circ$	% $\text{AgCl}$
$\text{KCl}$	24.95	19.6	0.0776
$\text{NaCl}$	25.96	"	0.1053
$\text{NH}_4\text{Cl}$	28.45	24.5	0.3397
$\text{CaCl}_2$	41.26	"	0.5713
$\text{MgCl}_2$	36.35	"	0.5313
$\text{BaCl}_2$	27.32	"	0.0570
$\text{FeCl}_2$	...	...	0.1686
$\text{FeCl}_3$	...	...	0.0058
$\text{MnCl}_2$	...	24.5	0.1996
$\text{ZnCl}_2$	...	...	0.0134
$\text{CuCl}_2$	...	24.5	0.0532
$\text{PbCl}_2$	...	"	0.0000

(Hahn, Wyandotte Silver Smelting Works, 1877.)

1 l.  $4\text{-N KCl} + \text{Aq}$  dissolves 0.915 g.  $\text{KCl}$  at  $25^\circ$ . (Hellwig, Z. anorg. 1900, 25. 166.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	G. equiv. per l.	
	$\text{Ag} \times 10^{-2}$	$\text{KCl}$
1.0	1.734	3.325
25.0	2.415	3.083
35.0	2.786	2.955

(Forbes, J. Am. Chem. Soc. 1911, 33. 1937.)

Solubility in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ .

G. per liter.

$\text{KCl}$	$\text{AgCl}$	$\text{KCl}$	$\text{AgCl}$
0.00236	0.00184	0.01491	0.00305
0.00471	0.00218	0.02984	0.00321

(Glowczynski, Kolloidchem. Beih. 1914, 6. 147.)

Solubility in  $\text{CaCl}_2 + \text{Aq}$ .

$t^\circ$	G. equiv. per l.	
	$\text{Ag} \times 10^2$	$\frac{\text{CaCl}_2}{2}$
1.0	0.964	3.512
25.0	1.514	3.320
35.0	1.896	3.221

(Forbes, l. c.)

Sat.  $\text{CuCl}_2 + \text{Aq}$  at  $0^\circ$  dissolves 2.835 g.  $\text{AgCl}$  per l; at  $100^\circ$ , 8.147 g. Solubility in sat.  $\text{MgCl}_2 + \text{Aq}$  is still greater. (Hahn, Eng. Min. J. 65. 434.)



More sol. in  $\text{HgCl}_2 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Finzi, Gazz. ch. it. 1902, 32. (2) 324.)

At  $15^\circ$ , 100 g.  $\text{NaCl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 485 mg.  $\text{AgCl}$ ; 100 g.  $\text{KCl}$  in 300 ccm.  $\text{H}_2\text{O}$  dissolve 334 mg.; 100 g.  $\text{NH}_4\text{Cl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 1051 mg.

The solubility decreases with dilution rapidly at first until about an equal vol. of  $\text{H}_2\text{O}$  has been added, and then much more slowly to a minimum quantity, when the dilution is 1 : 10 for  $\text{NaCl}$  and  $\text{KCl}$ , and 1 : 20 for  $\text{NH}_4\text{Cl}$ .

100 g.  $\text{NaCl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 2170 mg.  $\text{AgCl}$  at  $109^\circ$ ; 100 g.  $\text{NH}_4\text{Cl}$  in 280 ccm.  $\text{H}_2\text{O}$  dissolve 4000 mg.  $\text{AgCl}$  at  $110^\circ$ ; 100 g.  $\text{NaCl}$  in 620 ccm.  $\text{H}_2\text{O}$  (14% solution) dissolve 15 mg.  $\text{AgCl}$  at  $15^\circ$ , and 774 mg. at  $104^\circ$ . (Schierholz, W. A. B. 101, 2b. 4.)

The solubility of  $\text{AgCl}$  in  $\text{NaCl} + \text{Aq}$  decreases with diminishing concentration of  $\text{NaCl} + \text{Aq}$ . (Barlow, J. Am. Chem. Soc. 1906, 28. 1448.)

#### Solubility in $\text{NaCl} + \text{Aq}$ .

##### Gravimetric measurements, $15^\circ$

Strength of salt solution	G. $\text{AgCl}$ retained per 100 g. $\text{NaCl}$
15% $\text{NaCl}$	0.063
20% $\text{NaCl}$	0.134
28% $\text{NaCl}$	0.279

##### Volumetric measurements

$\text{NaCl}$	N/10 $\text{AgNO}_3$ ccm.	Opalescent at $1^\circ$	G. $\text{AgCl}$ retained per 100 g. $\text{NaCl}$
20 g. of 15% solution	0.25	28	0.119
	0.4	40	0.191
	0.7	64	0.335
	1.0	78	0.478
	1.25	89	0.598
	1.7	102.5	0.812
20 g. of 20% solution	0.43	17.0	0.156
	0.65	26.0	0.234
	0.82	37.0	0.295
	1.2	51.5	0.430
	1.6	67.0	0.524
	2.12	79.5	0.765
	2.52	88.5	0.910
	3.08	97.0	1.10
20 g. of 28% solution	3.52	105.0	1.27
	2.25	36.5	0.675
	2.75	45.0	0.704
	3.5	56.0	0.896
	4.5	69.0	1.153
	5.5	84.0	1.411
	6.5	94.0	1.664
	7.75	107.5	1.958

#### Solubility in salts + $\text{Aq}$ at $25^\circ$ .

C = concentration of the salt in salt solution in g.-equivalents per litre.

Salt	C	$\text{Ag} \times 10^{-3}$ g.-equivalents per l.
$\text{NaCl}$	0.933	0.086
	1.190	0.130
	1.433	0.184
	1.617	0.245
	1.871	0.348
	2.094	0.446
	2.272	0.570
	2.449	0.684
	2.658	0.851
	2.841	1.040
	3.000	1.194
	3.270	1.583
$\text{CaCl}_2$ 2	3.471	1.897
	3.747	4.462
	3.977	2.879
	4.170	3.335
	4.363	3.810
	4.535	4.298
	5.039	6.039
	1.748	0.289
	2.201	0.501
	2.741	0.900
	3.264	1.463
	3.737	2.182
$\text{NH}_4\text{Cl}$	4.033	2.802
	4.538	4.175
	5.005	5.823
	0.513	0.042
	0.926	0.113
	1.141	0.172
	1.574	0.365
	2.143	0.842
	2.566	1.425
	2.918	2.160
	3.162	2.795
	3.510	4.029
$\text{SrCl}_2$ 2	4.363	9.353
	4.902	14.92
	5.503	24.04
	5.764	30.17
	0.550	0.033
	0.989	0.092
	1.359	0.173
	1.572	0.236
	1.698	0.284
	1.818	0.348
	2.140	0.510
	2.476	0.747
	2.992	1.252
	3.404	2.018
	4.152	3.594
	5.216	8.174
	5.775	12.04

## Solubility in salts + Aq. at 25°—Continued.

Salt	C	Ag $\times 10^{-3}$ g.-equivalents per l.
KCl	1.111	0.141
	1.425	0.235
	1.713	0.391
	2.022	0.616
	2.396	1.050
	2.628	1.390
	2.850	1.845
	3.081	2.435
	3.424	3.602
	3.843	5.725
BaCl <sub>2</sub> 2	1.248	0.186
	1.610	0.339
	2.676	1.274
	3.260	2.366

(Forbes, J. Am. Chem. Soc. 1911, 33, 1940).

Sol. in NaNO<sub>3</sub>, KNO<sub>3</sub>, Ca(NO<sub>3</sub>)<sub>2</sub>, Mg(NO<sub>3</sub>)<sub>2</sub>, and NH<sub>4</sub>NO<sub>3</sub> + Aq; sl. sol. at ord. temp., but solubility is much increased by heat.

Solubility in NaNO<sub>3</sub> + Aq at 15–20°.

ccm. H <sub>2</sub> O	g. NaNO <sub>3</sub>	mg. AgCl dissolved
100	0.787	1.33
200	0.787	1.93
300	2.361	3.99
100	2.787	2.53

## Solubility increases with ascending temp.

Temp.	ccm. H <sub>2</sub> O	g. NaNO <sub>3</sub>	mg. AgCl dissolved
5°	100	0.787	0.86
15–17°	100	0.787	1.33
18°	100	0.787	1.46
30°	100	0.787	2.33
45–55°	100	0.787	3.99

(Mulder.)

At 25°, 100,000 pts. H<sub>2</sub>O containing a little free HNO<sub>3</sub> and 0.787 g. NaNO<sub>3</sub> dissolve 2.128 mg. AgCl. By adding 2 g. more NaNO<sub>3</sub> to above solution, 2,5269 mg. ( $\frac{1}{10}$  more) AgCl are dissolved. (Mulder.)

Solubility in H<sub>2</sub>O is not appreciably influenced by  $\frac{1}{10}$  N to N-KNO<sub>3</sub> or NH<sub>4</sub>NO<sub>3</sub> + Aq. (van Rossen, C. C. 1912, II. 1807.)

In presence of NaNO<sub>3</sub> and excess of HCl, 1 l. H<sub>2</sub>O dissolves 0.03 mg. AgCl. (Richards and Wells.)

Hg(NO<sub>3</sub>)<sub>2</sub> + Aq dissolves considerable quantities of AgCl, but the other nitrates do not. (Mulder.)

Much more sol. in hot than in cold Hg(NO<sub>3</sub>)<sub>2</sub> + Aq, and much more sol. therein than in NH<sub>4</sub>NO<sub>3</sub> + Aq. NaCl ppts. AgCl from this solution; much less sol. therein in

presence of NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> or NH<sub>4</sub>OH + Aq. AgCl is pptd. from above solution by NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Mulder.)

Sol. in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq (Wackenroder, A. 41. 317); in considerable amount (Liebig, A. 81. 128); and is precipitated by HCl, NH<sub>4</sub>Cl, NaCl, KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (Debray, C. R. 70. 849); incompletely precipitated by AgNO<sub>3</sub> and not by HNO<sub>3</sub> (Wackenroder).

Solubility of AgCl in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq at 25°.

(G. mols. per l.)

Hg(NO <sub>3</sub> ) <sub>2</sub> HNO <sub>3</sub>	AgCl	Hg(NO <sub>3</sub> ) <sub>2</sub> HNO <sub>3</sub>	AgCl
0.0100	0.00432	0.050	0.00914
0.0125	0.00499	0.100	0.01395
0.025	0.00690	1.000	0.04810

HNO<sub>3</sub> was present in all cases, and it was found that there was no difference in solubility of AgCl with concentrations between 0.1N and 2N HNO<sub>3</sub>. (Morse, Z. phys. Ch. 1902, 45. 708.)

Not sol. to appreciable extent in Cu(NO<sub>3</sub>)<sub>2</sub>, Fe<sub>2</sub>(NO<sub>3</sub>)<sub>6</sub>, Mn(NO<sub>3</sub>)<sub>2</sub>, Co(NO<sub>3</sub>)<sub>2</sub>, Zn(NO<sub>3</sub>)<sub>2</sub>, or Ni(NO<sub>3</sub>)<sub>2</sub> + Aq; insol. or exceedingly sl. sol. in Pb(NO<sub>3</sub>)<sub>2</sub> + Aq. (Mulder.)

Imperfectly sol. in AgNO<sub>3</sub> + Aq. (Wackenroder.)

Conc. AgNO<sub>3</sub> + Aq dissolves AgCl perceptibly.

Less sol. in AgNO<sub>3</sub> + Aq than AgBr. (Risse, A. 111. 39.)

Solubility in 0.02N AgNO<sub>3</sub> + Aq = 0.15  $\times 10^{-7}$  g. mols. per l. (Böttger.)

100 ccm. of 3-N solution of AgNO<sub>3</sub> dissolve 0.08 g. AgCl at 25°. More dil. solutions dissolve very slight amounts of AgCl. (Hellwig, Z. anorg. 1900, 25. 177.)

Solubility in 2-N AgNO<sub>3</sub> + Aq at ord. temp. = 0.03  $\times 10^{-3}$  g. equiv. AgCl. (Forbes, J. Am. Chem. Soc. 1912, 33. 1946.)

Solubility in AgNO<sub>3</sub> + Aq at t°.

(Det. by volumetric method.)

AgNO<sub>3</sub>:H<sub>2</sub>O = 2:1

G. AgNO <sub>3</sub>	n/10 NaCl ccm.	t°	g. AgCl retained per 100 g. AgNO <sub>3</sub>
6	2	57	0.478
7	2	45	0.410
8	2	40	0.359
9	2	35	0.319
11	2	30	0.261
7	1	26	0.205
10	1	22	0.143
10	4	65	0.572
10	5	86	0.715

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at  $t^\circ$ .—Continued.

$\text{AgNO}_3:\text{H}_2\text{O} = 1:1$			
5	1	94	0.286
6	1	84	0.239
7	1	75	0.205
8	1	66	0.179
9	1	58	0.159
5.5	0.5	48	0.130
6.5	0.5	40	0.110
12	0.5	23	0.060

$\text{AgNO}_3:\text{H}_2\text{O} = 1:2$			
6	0.5	104	0.120
7	0.5	92	0.103
8	0.5	85	0.090
10	0.5	73	0.072
12	0.5	61	0.060
8	0.25	45	0.045
12	0.25	28	0.030

(Lowry, Roy, Soc. Proc. 1914, 91. A, 58.)

Solubility in  $\text{AgNO}_3 + \text{Aq}$  at  $20^\circ$ .

(Det. by gravimetric method.)

g. $\text{AgNO}_3$	g. $\text{H}_2\text{O}$	g. $\text{AgCl}$ retained per 100 g. $\text{AgNO}_3$
220	110	0.1372
220	165	0.1009
220	220	0.0722
220	330	0.0402
220	440	0.0294

(Lowry, Roy, Soc. Proc. 1914, 91. A, 56.)

Insol. in  $\text{Na}_2\text{SO}_4 + \text{Aq}$ .Solubility of  $\text{AgCl}$  in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

G. formula weights per l.

$\text{SO}_4$	Ag	$\text{SO}_4$	Ag
0.080	0.011	0.483 *	0.059 *
0.106	0.017	0.470	0.070
0.220	0.033	0.652	0.103
0.234	0.036	0.890	0.140
0.478 *	0.057 *	0.937	0.142

\* In presence of 0.05 Cl.

(Luther and Leubner, Z. anorg. 1912, 74. 393.)

Easily sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  or  $\text{KCN} + \text{Aq}$ .

When freshly pptd., very sol. in solutions of soluble thiosulphates, and especially in conc  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$ , which dissolves  $\text{AgCl}$  almost as readily as  $\text{H}_2\text{O}$  dissolves sugar.  $\text{K}_2\text{S}_2\text{O}_3 + \text{Aq}$ , even when very dil., also dissolves  $\text{AgCl}$ ; also  $\text{SrS}_2\text{O}_3 + \text{Aq}$ . (Herschel, 1819.)

Sol. in  $\text{KAsO}_2 + \text{Aq}$ . (Reynoso.)

Cold  $\text{NaHSO}_4 + \text{Aq}$  dissolves a considerable amount of  $\text{AgCl}$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 78.)

Sol. in cold sat.  $(\text{NH}_4)_2\text{S}_2\text{O}_8 + \text{Aq}$ . (Rosen-

heim and Steinhäuser, Z. anorg. 1900, 25. 103.)

Solubility in  $\text{Na}_2\text{thiosulphate} + \text{Aq}$  at  $16^\circ$ .

g. $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ in 100 cc. water	g. dissolved $\text{AgCl}$	
	experimental	calculated
2.08	0.29	0.80
4.16	0.64	1.60
6.24	0.88	2.40
8.35	1.26	3.21
16.70	2.54	6.42
20.83	3.28	7.99

(Abney, Z. phys. Ch. 1895, 18. 65.)

A solution of  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  containing 200 g.  $\text{Na}_2\text{S}_2\text{O}_3$  per liter, dissolves 0.454 g.  $\text{AgCl}$  per g. of  $\text{Na}_2\text{S}_2\text{O}_3$  at  $35^\circ$ . (Richards and Faber, Am. Ch. J. 1899, 21. 170.)

Solubility in salts +  $\text{Aq}$ .

Solvent	% Conc.	Grams $\text{AgCl}$ sol. in 100 grams solvent
Sodium thiosulphate	1	0.40
" " "	5	2.00
" " "	10	4.10
" " "	20	6.10
Ammonium thiosulphate	1	0.57
" " "	5	1.32
" " "	10	3.92
Sodium sulphite	10	0.44
" "	20	0.95
Ammonium sulphite	10	Trace
" carbonate	10	0.05
Ammonia + $\text{Aq}$	3	1.40
" "	15	7.58
Magnesium chloride	50	0.50
Potassium cyanide	5	2.75
Ammonium sulphocyanide	5	0.08
" " "	10	0.54
" " "	15	2.88
Potassium " " "	10	0.11
Calcium " " "	10	0.15
Barium " " "	10	0.20
Aluminum " " "	10	2.02
Thiocarbamide	10	0.83
Thioctamine	1	0.40
" "	5	1.90
" "	10	3.90

(Valenta, M. 1894, 15. 250.)

Solubility in salts +  $\text{Aq}$ .

31.71 cc. of a solution of sodium thiosulphate containing 31.869 g.  $\text{Na}_2\text{S}_2\text{O}_3$  per liter (i. e. 5 g. of the hydrate in 100 cc. of the solution) dissolve 0.6124 g.  $\text{AgCl}$ .

21.88 cc. of a solution of ammonium thiosulphate containing 50 g.  $(\text{NH}_4)_2\text{S}_2\text{O}_3$  per liter dissolve 0.7024 g.  $\text{AgCl}$ .

27.34 cc. of a solution of potassium cyanide containing 49.511 g.  $\text{KCN}$  per liter dissolve

1.4926 g. AgCl. (Cohn, Z. phys. Ch. 1895, 18. 63.)

Solubility of AgCl in sodium thiosulphate and potassium cyanide solutions may be determined without reference to experimental date. (Cohn.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in moderately dil.  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ .  
10 ccm. normal  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$  containing 0.1 g. Hg dissolve 0.01892 g. AgCl at 15°.  
(Stas.)

100 ccm. of a solution of a mixture of Na and Hg acetates dissolve 0.00175 g. AgCl.  
(Stas, A. ch. (5) 3. 145.)

Only sl. sol. in liquid  $\text{NH}_3$ .

Solubility curve for AgCl, AgCl, 3NH<sub>3</sub>, AgCl, 5NH<sub>3</sub>. (Jarry, A. ch. 1899, 17. 342.)

Insol. in alcoholic ammonia. (Bodländer, Z. phys. Ch. 1892, 9. 731.)

Nearly insol. in ether. (Mylus and Hüttner, B. 1911, 44. 1316.)

Perceptibly sol. on warming with solution of tartaric acid, but nearly the whole is deposited on cooling.

Insol. in acetone.. (Naumann, B. 1904, 37. 4329); insol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Insol. in methyl acetate. (Bezold, Dissert. 1906; Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

Sol. in methylamine + Aq. (Wurtz, A. ch. (3) 30. 453.)

Solubility of AgCl in methylamine at 11.5°.

% $\text{CH}_3\text{NH}_2$	% AgCl	% $\text{CH}_3\text{NH}_2$	% AgCl
1.78	0.16	13.70	3.29
4.44	0.62	18.69	5.43
5.51	0.83	36.69	9.93
7.66	1.32		

(Jarry, A. ch. 1899, (7) 17. 342.)

Solubility in methylamine + Aq at 25°.  
G. mols. per l.

$\text{CH}_3\text{NH}_2$	AgCl
0.0200	0.000300
0.0400	0.000370
0.0740	0.000424
0.0947	0.000447
0.1950	0.000481

(Wuth, B. 1902, 35. 2416.)

Solubility in methylamine + Aq at t°.  
G. mols. per l.

t°	$\text{CH}_3\text{NH}_2$	Ag
18	0.93	0.0315
25	0.93	0.0338
25	0.93	0.0335

(Euler, B. 1903, 36. 2880.)

At 25°, 1 l. methylamine + Aq, containing 1.017 g. mols.  $\text{CH}_3\text{NH}_2$ , dissolves 0.0387 g. mol. AgCl; 0.508 g. mol.  $\text{CH}_3\text{NH}_2$ , 0.0178 g. mol. AgCl. (Bodländer and Eberlein, B. 1903, 36. 3948.)

Solubility in ethylamine + Aq at 25°.  
G. mols. per l.

$\text{C}_2\text{H}_5\text{NH}_2$	AgCl
0.01272	0.000114
0.03942	0.000156
0.05512	0.000285
0.06572	0.000312
0.10300	0.000824

(Wuth, B. 1902, 35. 2416.)

Solubility in ethylamine + Aq at t°.  
G. mols. per l.

t°	$\text{C}_2\text{H}_5\text{NH}_2$	Ag
18	0.094	0.00458
25	0.093	0.00474
25	0.094	0.00478
18	0.236	0.0132
25	0.234	0.0136
18	0.462	0.0251

(Euler, B. 1903, 36. 2880.)

At 25°, 1 l. ethylamine + Aq, containing 0.483 g. mol.  $\text{C}_2\text{H}_5\text{NH}_2$ , dissolves 0.0314 g. mols. AgCl; 0.200 g. mol.  $\text{C}_2\text{H}_5\text{NH}_2$ , 0.0115 g. mol. AgCl; 0.100 g. mol.  $\text{C}_2\text{H}_5\text{NH}_2$ , 0.0062 g. mol. AgCl. (Bodländer and Eberlein.)

Sol. in amylamine + Aq, but less than in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol. in caprylamine + Aq.

Easily sol. on warming in ethylene diamine + Aq. (Kurnakow, Z. anorg. 1898, 17. 220.)

Easily sol. in alcoholic solution of thiocetamide. (Kurnakow; J. pr. 1895, (2) 51. 251.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Solubility in pyridine at t°.

t°	g. AgCl sol. in 100 g. pyridine	Solid phase
-52	0.70	AgCl, $2\text{C}_2\text{H}_5\text{N}$
-49	0.77	
-35	0.99	
-30	1.36	
-25	1.80	
-22	2.20	
transition point	2.75	
-20	3.71	AgCl, $\text{C}_2\text{H}_5\text{N}$
-18	3.85	
-10	4.35	
-5	5.05	
-1	5.60	

Solubility in pyridine at  $t^\circ$ .—*Continued.*

$t^\circ$	g. AgCl sol. in 100 g. pyridine	Solid phase
transition point	...	
0	5.35	AgCl
10	3.17	
20	1.91	
30	1.20	
40	0.80	
50	0.53	
60	0.403	
70	0.32	
80	0.25	
90	0.22	
100	0.18	
110	0.12	

(Kahlenberg, J. phys. Chem. 1909, **13**, 423.)Easily sol. in warm piperidine. (Varet, C. R. 1892, **115**, 335.)Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, **15**, 16.)Quinoline dissolves traces of AgCl. (Varet, C. R. 1893, **116**, 60.)As sol. in coniine + Aq as in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Blyth, Chem. Soc. 1. 350.)Sol. in sinamine, and thiosinamine + Aq. Min. *Cerargyre*.**Silver chloride ammonia,  $\text{AgCl} \cdot 2\text{NH}_3$ .**Decomp. by  $\text{H}_2\text{O}$ . (Terreil, A. Phys. Beibl. **7**, 149.) $2\text{AgCl} \cdot 3\text{NH}_3$ . Decomp. on air and in  $\text{H}_2\text{O}$  to AgCl. Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it can be crystallised. (Rose.)Insol. in alcohol. (Bodländer, Z. phys. Ch. **9**, 730.) $\text{AgCl} \cdot 3\text{NH}_3$ . More easily decomp. than  $2\text{AgCl} \cdot 3\text{NH}_3$ .Sl. sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) **17**, 343.) $\text{AgCl} \cdot 5\text{NH}_3$ . Sl. sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) **17**, 336.)**Silver chlorobromiodides.**(Rodwell, Proc. Roy. Soc. **25**, 292.)**Silver subfluoride (argentous fluoride),  $\text{Ag}_2\text{F}$ .**Decomp. by  $\text{H}_2\text{O}$  into Ag and AgF. (Guntz, C. R. **110**, 1337.)Decomp. by  $\text{H}_2\text{O}$ .Insol. in abs. alcohol, ether, acetone and xylene. (Wöhler and Rodewald, Z. anorg. **1909**, **61**, 63.)Decomp. by  $\text{H}_2\text{O}$  until the solution contains 64.5% AgF, independent of temp. (Guntz, C. R. **1913**, **157**, 981.)**Silver fluoride, AgF.**

Extremely deliquescent. (Gore.)

Sol. in 0.55 pt.  $\text{H}_2\text{O}$  at  $15.5^\circ$  with evolution of heat. Sp. gr. of sat. solution at  $15.5^\circ = 2.61$ . (Gore.)Solubility of AgF in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
G. per 100 g.  $\text{H}_2\text{O}$ .

$t^\circ$	AgF	Solid phase
-14.2	60	Ice + AgF, $4\text{H}_2\text{O}$
+18.5	165	AgF, $4\text{H}_2\text{O}$
18.65	169.5	" + AgF, $2\text{H}_2\text{O}$
20	172	AgF, $2\text{H}_2\text{O}$
24	178	"
25	179.5	"
28.5	215	"
32	193	"
39.5	222	AgF, $2\text{H}_2\text{O} + \text{AgF}$
108	205	AgF

(Guntz, A. ch. 1914, (9) **2**, 101.)Sp. gr. AgF + Aq at  $18^\circ$ .

% AgF	Sp. gr.
7.20	1.07
29.60	1.38
49.20	1.82
56.40	2.09
66.20	2.62

(Guntz, A. ch. 1914, (9) **2**, 104.)Data on solubility of AgF in  $\text{HF} + \text{Aq}$  are given by Guntz (*l. c.*).Sl. sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. **1898**, **20**, 829.)+  $\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Guntz, A. ch. 1914, (9) **2**, 101.)+  $2\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Guntz.)+  $4\text{H}_2\text{O}$ . Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Guntz.)+  $\frac{1}{2}\text{H}_2\text{O}$ . Unstable in the presence of crystals of  $\text{AgF} + 2\text{H}_2\text{O}$ . (Guntz, A. ch. 1914, (9) **2**, 101.)**Silver hydrogen fluoride, AgF, HF.**

(Guntz.)

AgF,  $3\text{HF}$ . Very unstable.Sol. in HF. (Guntz, Bull. Soc. **1895**, (3) **13**, 114.)**Silver stannic fluoride.**

See Fluostannate, silver.

**Silver tungstyl fluoride.**

See Fluortungstate, silver.

**Silver, fulminating.**

See Silver nitride.

**Silver hydride,  $\text{AgH}$ .**Not decomp. by  $\text{H}_2\text{O}$ . (Bartlett, Am. Ch. J. **1896**, **19**, 52.)**Argentous hydroxide,  $\text{Ag}_2\text{O} \cdot \text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . Known only in solution. (Weltzein, A. **142**, 105.)**Silver hydroxide,  $\text{AgOH}$ .**Decomp. into  $\text{Ag}_2\text{O}$  and  $\text{H}_2\text{O}$  above  $-40^\circ$ . See Silver oxide.

**Argentous iodide, Ag<sub>2</sub>I.**

(Guntz, C. R. 112. 861.)

**Silver imidosulphamide, AgN(SO<sub>2</sub>NH<sub>2</sub>)<sub>2</sub> + 1½H<sub>2</sub>O.**

Decomp. slowly in the air. Somewhat sol. in hot, more sol. in boiling H<sub>2</sub>O, from which it cryst. unchanged on cooling. In aqueous solution is stable toward alkali. Decomp. by acids. Difficultly sol. in dry pyridine; easily sol. in pyridine + Aq. (Hantzsch, B. 1905, 38. 1035.)

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub>H<sub>4</sub>Ag<sub>2</sub> + 5½H<sub>2</sub>O. Nearly insol. in hot H<sub>2</sub>O. (Ephraim and Michel, B. 1909, 42. 3845.)

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub>H<sub>4</sub>Ag<sub>2</sub> + 4H<sub>2</sub>O. (Ephraim and Michel.)

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub>H<sub>4</sub>Ag<sub>2</sub> + 1½, 11, and 28 H<sub>2</sub>O.

Easily sol. in HNO<sub>3</sub> and NH<sub>4</sub>OH + Aq. Sl. sol. in pyridine. Very sol. in pyridine containing pyridine nitrate and can be recryst. therefrom. (Ephraim and Michel.)

(SO<sub>2</sub>)<sub>2</sub>N<sub>2</sub>H<sub>4</sub>Ag<sub>2</sub> + 8H<sub>2</sub>O. (Ephraim and Michel.)

**Silver iodide, AgI.**

Insol. in H<sub>2</sub>O.

Calculated from electrical conductivity of AgI + Aq, AgI is sol. in 1,074,040 pts. H<sub>2</sub>O at 28.4°, and 420, 260 pts. at 40°. (Holleman, Z. phys. Ch. 12. 130.)

1 l. H<sub>2</sub>O dissolves 0.1 mg. AgI at 18°. (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Solubility in H<sub>2</sub>O = 1 × 10<sup>-4</sup> N. (Rolla.)

Solubility in H<sub>2</sub>O = 0.97 × 10<sup>-4</sup> g. mols. per l. at 25°. (Goodwin, Z. phys. Ch. 1894, 13. 645.)

Solubility of AgI in H<sub>2</sub>O at 25° is 1.05 × 10<sup>-4</sup> (in normality). (Thiel, Z. anorg. 1900, 24. 57.)

A sat. aq. solution at 20.8° contains 0.0020 × 10<sup>-4</sup> g. equiv. per l. (Kohlrausch, C. C. 1901, II. 1299.)

1 l. H<sub>2</sub>O dissolves 0.0035 mg. AgI at 21°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

1 l. H<sub>2</sub>O dissolves 0.00253 mg. AgI at 60°. (Sammet, Z. phys. Ch. 1905, 53. 644.)

Solubility in H<sub>2</sub>O = 1.23 × 10<sup>-4</sup> g.-mol. per litre at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

0.003 mg. are contained in 1 l. of sat. solution at 21°. (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Insol. in dil. HNO<sub>3</sub> + Aq or H<sub>3</sub>PO<sub>4</sub> + Aq. Decomp. by hot. conc. HNO<sub>3</sub> + Aq or H<sub>2</sub>SO<sub>4</sub>. Easily sol. in conc. HI + Aq.

1 pt. AgI dissolves in 2510 pts. NH<sub>4</sub>OH + Aq of 0.96 sp. gr. (Martini, Schw. J. 56. 154); in 2453 pts. of 0.89 sp. gr. (Wallace and Lamont, Ch. Gaz. 1859. 137.)

1 g. AgI dissolves in 26,300 g. 10% NH<sub>4</sub>OH + Aq (sp. gr. = 0.96) at 12°. Insol. in 5% NH<sub>4</sub>OH + Aq. (Longi, Gazz. ch. it. 13. 87.)

Coefficient of solubility in NH<sub>4</sub>OH + Aq (density, 0.926) is found lower than previously obtained and of the order of 1/60000 at 16°. (Baubigny, Bull. Soc. 1908, (4) 3. 772.)

According to Field, insol. in cold conc. KCl or NaCl + Aq, and only in traces on boiling, and separates out on cooling.

100 g. NaCl in conc. NaCl + Aq dissolve 0.95 mg. AgI at 15°; 100 g. NH<sub>4</sub>Cl in conc. NH<sub>4</sub>Cl + Aq dissolve 2.9 mg. AgI at 15°; 95 g. NaCl + 10 g. KBr in conc. solution dissolve 1.2 mg. AgI at 15°; 100 g. KBr + 225 g. H<sub>2</sub>O dissolve 430 mg. AgI at 15°; 100 g. KBr in conc. KBr + Aq dissolve 525 mg. AgI at 15°; 100 g. KI + 69 g. H<sub>2</sub>O dissolve 89.8 g. AgI at 15°; 100 g. KI + 92 g. H<sub>2</sub>O dissolve 54.0 g. AgI at 15°; 100 g. KI + 366 g. H<sub>2</sub>O dissolve 7.25 g. AgI at 15°. (Schierholz, W. A. B. 101, 2b. 4.)

Sol. in conc. KI + Aq, from which it is precipitated by H<sub>2</sub>O. (Field, C. N. 3. 17.)

KI gives a ppt. with AgNO<sub>3</sub> in presence of 30,000 pts. H<sub>2</sub>O. (Harting.)

**Solubility in KI + Aq at 15°.**

% KI	% AgI	% KI	% AgI
59.16	53.13	33.3	7.33
57.15	40	25.0	2.75
50.0	25.0	21.74	1.576
40.0	13.0	20	0.80

(Schierholz, W. A. B. 1890, 101. 2b. 10.)

**Solubility in KI + Aq at 25°.**

Mol. KI per l.	g. AgI per l.
1.937	46.42
1.6304	24.01
1.482	15.46
1.406	12.55
1.018	3.47
1.008	3.32
0.734	1.032
0.586	0.512
0.335	0.0853

Hellwig, Z. anorg. 1900, 25. 180.)

**Solubility in KI + Aq.**

t = 50°		
% AgI	% KI	Solid phase
2.5	24.8	AgI
16.0	33.8	"
28.0	36.7	"
39.0	38.1	"
51.8	36.2	"
53.5	36.5	"
53.5	36.6	AgI + AgI, KI
53.5	37.1	AgI, KI
53.4	37.6	KI + AgI, KI
50.4	40.2	KI
45.0	43.2	"
38.0	47.1	"
22.8	55.5	"
10.7	59.1	"

t = 30°		
% AgI	% KI	Solid phase
0.1	10.2	AgI
10.0	31.4	"
29.4	37.6	"
42.8	38.8	"
49.7	38.6	AgI + AgI, 2KI
49.6	39.5	AgI, 2KI
47.7	40.9	"
46.3	41.4	"
44.1	43.2	AgI, 2KI + KI
42.8	43.9	KI
35.8	46.9	"
16.0	55.5	"
0	60.35	"

t = 0°		
% AgI	% KI	Solid phase
0.2	9.8	AgI
1.5	20.5	"
6.5	26.1	"
26.6	34.6	"
28.1	36.4	"
38.0	41.3	AgI + AgI, KI
37.9	42.0	AgI, KI
37.6	42.7	"
37.9	44.0	AgI, KI + KI
31.3	46.6	KI
21.7	50.5	"
18.0	51.2	"
9.0	53.0	"
0	56.1	"
27.5	48.7	AgI, 2KI + KI
21.0	50.3	AgI, 2KI

(Van Dam and Donk, Chem. Weekbl. 1911, 8, 848.)

Very sol. in KI<sub>3</sub> + Aq. (Muth, Dissert. 1895.)  
 Very sol. in H<sub>2</sub>O in presence of NaI. (Kur-  
 nakow, Ch. Z. 1900, 24, 60.)

#### Solubility in KI + Aq at 15°.

Composition of the sat. solution in mols. per 1000 mols. H <sub>2</sub> O		Solid phase
Mols. NaI <sub>2</sub>	Mols. AgI <sub>2</sub>	
35.63	8.14	AgI
40.54	10.94	"
61.55	25.15	"
80.55	38.19	"
94.25	47.79	"
107.52	57.52	AgI + AgI, NaI, 3½H <sub>2</sub> O
117.96	51.70	AgI, NaI, 3½H <sub>2</sub> O
134.40	46.82	"
135.83	46.36	AgI, NaI, 3½H <sub>2</sub> O + NaI
133.81	43.03	NaI
129.02	34.85	"
122.56	22.82	"
117.11	11.93	"
111.52	...	"

(Krym, J. Russ. Phys. Chem. Soc. 1909, 41, 382.)

Traces are dissolved by alkali nitrates + Aq. Easily sol. in hot KOH + Aq, from which it is pptd. by H<sub>2</sub>O or alcohol. Not decomp. by boiling KOH + Aq. (Vogel, N. Rep. Pharm. 20, 129.)

100 pts. of AgNO<sub>3</sub> + Aq sat. at 11° dissolve 2.3 pts. AgI in the cold, and 12.3 pts. on boiling. (Schnauss.)

#### Solubility of AgI in AgNO<sub>3</sub> + Aq at 25°.

Mol. AgNO <sub>3</sub> in 1 l.	g. AgI in 1 l.	Solid phase
0.20	0.0680	AgI
0.25	0.080	
0.30	0.090	
0.35	0.125	
0.40	0.167	
0.45	0.224	
0.50	0.299	
0.55	0.400	
0.60	0.528	
0.65	0.672	
0.70	0.850	
1.215	3.08	Ag <sub>3</sub> INO <sub>3</sub>
1.63	6.26	
2.04	10.90	
2.54	16.1	Ag <sub>3</sub> I(NO <sub>3</sub> ) <sub>2</sub>
3.115	22.7	
3.75	33.2	
4.055	40.0	
4.69	53.2	
5.90	85.0	

(Hellwig, Z. anorg. 1900, 25, 171.)

Solubility of AgI in 25% AgNO<sub>3</sub> + Aq reaches a maximum at about 60° and at the point of maximum solubility the quantity dissolved amounts to about 5 g. AgI per 100 g. AgNO<sub>3</sub>. (Lowry, Roy. Soc. Proc. 1914, 91, A, 66.)

Sol. in hot Hg(NO<sub>3</sub>)<sub>2</sub> + Aq, from which it crystallizes on cooling.

#### Solubility of AgI in Hg(NO<sub>3</sub>)<sub>2</sub> + Aq at 25°.

Mols. Hg(NO <sub>3</sub> ) <sub>2</sub> per l.	g. AgI per l.	Mols. Hg(NO <sub>3</sub> ) <sub>2</sub> per l.	g. AgI per l.
0.010	0.800	0.050	1.737
0.0125	0.841	0.100	2.730
0.025	1.118	1.000	25.160

Solubility is not affected by presence of 0.1 to 2N HNO<sub>3</sub>.

(Morse, Z. phys. Ch. 1902, 41, 708.)

Sol. in KCN + Aq.

Sl. sol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq when suspended in much H<sub>2</sub>O, but separates again on addition of KI + Aq. (Field.)

Insol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq. (Fogh, C. R. 1890, 110, 711.)

## Solubility in salts + Aq.

Solvent	% Conc.	grams AgI sol. in 100 grams solvent
Sodium thiosulphate	1	0.03
" " "	5	0.15
" " "	10	0.30
" " "	15	0.40
" " "	20	0.60
Sodium sulphite	10	0.01
" " "	20	0.02
Ammonium sulphite	10	Traces
Potassium cyanide	5	8.23
Ammonium sulphocyanide	5	0.02
" " "	10	0.08
" " "	15	0.13
Potassium " " "	10	"
Calcium " " "	10	0.03
Barium " " "	10	0.02
Aluminium " " "	10	0.02
Thiocarbamide	10	0.79
Thioisamine	1	0.008
"	5	0.05
"	10	0.09

(Valenta, M. 1894, 15. 250.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829; Jarry, A. ch. 1899, (7) 17. 370.)

Easily sol. in liquid  $\text{NH}_3$ . (Ruff and Geisel, B. 1905, 38. 2662.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014); (Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Besold, Dissert. 1906); (Naumann, B. 1909, 42. 3790.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

Much less sol. in hot alcoholic thiourea than  $\text{AgCl}$  and  $\text{AgBr}$ . (Reynolds, Chem. Soc. 1892, 61. 253.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Slowly sol. in piperidine at  $100^\circ$ . (Varet, C. R. 1892, 115. 336.)

0.10 pts. is sol. in 100 pts. pyridine at  $10^\circ$ . 8.60 pts. are sol. in 100 pts. pyridine at  $121^\circ$ . (Laszczyński, B. 1894, 27. 2288.)

Mol. wt. determined in piperidine. (Werner, Z. anorg. 1897, 15. 16.)

Min. *Iodyrite*.

**Silver hydrogen iodide,  $3\text{AgI}$ ,  $\text{HI} + 7\text{H}_2\text{O}$ .**  
(Berthelot, C. R. 91. 1024.)

**Silver sodium iodide,  $2\text{AgI}$ ,  $\text{NaI}$ .**

Very sol. in acetone. (Marsh, Chem. Soc. 1913, 103. 784.)

$\text{AgI}$ ,  $\text{NaI} + 3\frac{1}{2}\text{H}_2\text{O}$ . (Krym, J. Russ. Phys. Chem. Soc. 1909, 41. 382.)

See  $\text{AgI} + \text{NaI}$  under  $\text{AgI}$ .

**Silver iodide ammonia,  $\text{AgI}$ ,  $\text{NH}_3$ .**

Sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) 17. 371.)

$2\text{AgI}$ ,  $\text{NH}_3$ . (Rammelsberg, Pogg. 48. 170.)

Composition is  $\text{AgI}$ ,  $\text{NH}_3$ . (Longi, Gazz. ch. it. 13. 86.)

Sol. in liquid  $\text{NH}_3$ . (Jarry, A. ch. 1899, (7) 17. 371.)

$\text{AgI}$ ,  $2\text{NH}_3$ . (Terreil, C. R. 98. 1279.)

**Silver nitride,  $\text{Ag}_3\text{N}$ .**

Berthollet's "knallsilber." Very explosive. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KCN} + \text{Aq}$ . Slowly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Raschig, A. 233. 93.) (Angeli, Chem. Soc. 1894, 66. (2) 93.)

**Argentous oxide,  $\text{Ag}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids into argentic oxide and silver. Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ . (v. der Pfordten, B. 20. 1458.)

Contains H, and is a hydroxide  $\text{Ag}_4\text{H}_2\text{O}$ . (v. der Pfordten, B. 21. 2288.)

The above substance is a mixture, according to Friedheim (B. 20. 2557.)

**Silver oxide,  $\text{Ag}_2\text{O}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ . (Bucholz.)

Sol. in 2000 pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 509); sol. in 96 pts.  $\text{H}_2\text{O}$ . (Abl.)

Sol. in 15,360 pts.  $\text{H}_2\text{O}$ . (Levi, Gazz. ch. it. 1901, 31. (1) 1.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 2.16 \times 10^{-4}$  mols.  $\text{AgOH}$  per litre. (Noyes, J. Am. Chem. Soc. 1902, 24. 1147.)

1 liter sat. aqueous solution at  $19.96^\circ$  contains  $2.14 \times 10^{-3}$  g.; at  $24.94^\circ$  contains  $2.5 \times 10^{-3}$  g.  $\text{Ag}_2\text{O}$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $\text{H}_2\text{O}$  at  $25^\circ$  dissolves  $1.8 \times 10^{-4}$  gram-atoms of silver. Determined from its solubility in  $\text{NH}_3$ . (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0215 g.  $\text{Ag}_2\text{O}$  at  $20^\circ$ . (Whitby, Z. anorg. 1910, 87. 108.)

The solubility of  $\text{Ag}_2\text{O}$  in  $\text{H}_2\text{O}$  varies with the method of preparation.

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of  $\text{NaOH}$ , freshly prepared by the solution of Na in  $\text{H}_2\text{O}$ , on a dil. solution of  $\text{AgNO}_3$ ) =  $2.16 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $2.97 \times 10^{-4}$  g.-mol. at  $50^\circ$ .

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of aqueous barium hydroxide on  $\text{AgNO}_3$ ) =  $2.23 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $3.09 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $50^\circ$ .

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of conc.  $\text{NaOH} + \text{Aq}$  on moist, freshly pptd.  $\text{AgCl}$ ) =  $2.32 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $3.55 \times 10^{-4}$  g.-mol. at  $50^\circ$ .

Solubility of  $\text{Ag}_2\text{O}$  (prepared by action of conc.  $\text{NaOH} + \text{Aq}$  on moist, freshly pptd.  $\text{Ag}_2\text{CO}_3$ ) =  $2.95 \times 10^{-4}$  g.-mol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ ;  $3.89 \times 10^{-4}$  g.-mol. at  $50^\circ$ . (Rebière, Bull. Soc. 1915, (4) 7. 311.)

Sol. in acids,  $\text{NH}_4\text{OH}$ , and  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Decomp. by alkali chlorides, bromides,



and iodides + Aq. Sol. in alkali cyanides, and thiosulphates + Aq. Sl. sol. in nitrates + Aq; insol. in sulphates + Aq. When freshly pptd., sol. in  $\text{NH}_4\text{SCN}$  + Aq. Sl. sol. in  $\text{NH}_4\text{NO}_3$  + Aq. Abundantly sol. in  $\text{Ba}(\text{NO}_3)_2$  + Aq without pptn. of  $\text{BaO}_2\text{H}_2$ . Sol. in boiling  $\text{Mn}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Cu}(\text{NO}_3)_2$ , and  $\text{Ce}_2(\text{NO}_3)_6$  + Aq with pptn. of oxides. (Persoz.)

Insol. in  $\text{KOH}$ , and  $\text{NaOH}$  + Aq. Sl. sol. in  $\text{BaO}_2\text{H}_2$  + Aq. (Berzelius (?)).

Solubility in  $\text{NH}_4\text{OH}$  + Aq at 25°.

G. at. Ag per l.	Mol. $\text{NH}_3$ per l.
0.0654	0.214
0.0658	0.220
0.134	0.458
0.140	0.469
0.205	0.671
0.205	0.684
0.225	0.720
0.224	0.733
0.251	0.811
0.248	0.827
0.242	0.830
0.257	0.876
0.278	0.899
0.276	0.915
0.299	0.999
0.343	1.147
0.454	1.498
0.470	1.522

(Whitney and Melcher, J. Am. Chem. Soc. 1903, 25. 78.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. ch. J. 1898, 20. 829.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014); (Naumann, B. 1904, 37. 4329.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

Sl. sol. in amylamine + Aq, easily in methylamine + Aq (Wurtz, A. ch. 30. 453); also in ethylamine, and thiosinamine + Aq.

Solubility in methylamine + Aq. at 18°.

G. mols. per l.

$\text{CH}_3\text{NH}_2$	Ag
0.1	0.0221
0.5	0.118
1.0	0.228

(Euler, B. 1903, 36. 2879.)

Solubility in ethylamine + Aq at 18°.

G. mols. per l.

$\text{C}_2\text{H}_5\text{NH}_2$	Ag
0.1	0.0322
0.5 (interpolated)	0.160
1.0	0.314
0.561	0.180
0.927	0.291

(Euler.)

Silver peroxide,  $\text{Ag}_2\text{O}_2$ .

Sol. in conc.  $\text{H}_2\text{SO}_4$  (Rose), and in pure  $\text{HNO}_3$  + Aq without decomp. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Schönbein, J. pr. 41. 321.)

Sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  with decomp. (Mulder, R. t. c. 1898, 17. 151.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Silver oxide ammonia.

See Silver nitride.

Silver oxybromide,  $\text{Ag}_2\text{OBr}$ .

Insol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$ . Sol. in hot ammonia and in  $\text{NaOCl}$  + Aq. (Seyewetz, C. R. 1912, 154. 357.)

Silver oxyfluoride,  $\text{AgF}$ ,  $\text{AgOH}$ .

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{Ag}_2\text{O}$ . (Pfaundler.)

Silver peroxyfluoride,  $2\text{Ag}_2\text{O}_4$ ,  $\text{AgF}$ .

(Tanatar, Z. anorg. 1901, 28. 335.)

$4\text{Ag}_2\text{O}_4$ ,  $3\text{AgF}$ . (Tanatar, Z. anorg. 1901, 28. 335.)

Silver oxyiodide,  $\text{Ag}_2\text{O}$ ,  $\text{AgI}$ .

(Seyewitz, Bull. Soc. 1894, (3) 11. 452.)

Silver phosphide,  $\text{AgP}_2$ .

Sol. in  $\text{HNO}_3$ . Attacked by aqua regia. (Granger, C. R. 1897, 124. 897.)

$\text{Ag}_2\text{P}_2$ . Insol. in  $\text{HCl}$  + Aq; easily sol. in  $\text{HNO}_3$  + Aq. (Schrötter, J. B. 1849. 247.)

$\text{Ag}_2\text{P}_2$ . (Hackspill, C. R. 1913, 157. 720.)

$\text{Ag}_2\text{P}$  (?). (Fresenius and Neubauer, Z. anal. 1. 340.)

Silver phosphoselenide,  $\text{Ag}_2\text{Se}$ ,  $\text{P}_2\text{Se}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$  + Aq. Sol. in  $\text{HNO}_3$  + Aq. Insol. in cold, decomp. by hot alkalies + Aq. (Hahn, J. pr. 93. 436.)

$2\text{Ag}_2\text{Se}$ ,  $\text{P}_2\text{Se}$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq; slowly sol. in red fuming  $\text{HNO}_3$ . (Hahn, J. pr. 93. 440.)

$2\text{Ag}_2\text{Se}$ ,  $\text{P}_2\text{Se}$ . Sol. only in fuming  $\text{HNO}_3$ . (Hahn.)

Silver phosphosulphide,  $2\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}$ .

$\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}$ . (Berzelius, A. 46. 254.)

$2\text{Ag}_2\text{S}$ ,  $\text{P}_2\text{S}$ . Easily sol. in  $\text{HNO}_3$  + Aq without separation of P. (Berzelius.)

$\text{Ag}_2\text{P}_2\text{S}$ . (Berzelius.)

$\text{Ag}_2\text{PS}_2$ . Easily attacked by hot conc.  $\text{HCl}$ . Sl. decomp. Insol. in hot  $\text{HNO}_3$ . Decomp. by aqua regia. (Ferrand, A. ch. 1899, (7) 17. 413.)

Silver selenide,  $\text{Ag}_2\text{Se}$ .

Sol. in boiling  $\text{HNO}_3$  + Aq as  $\text{Ag}_2\text{SeO}_3$ , which separates out by dilution with  $\text{H}_2\text{O}$ . (Berzelius.)

Insol. in  $\text{Hg}_2(\text{NO}_3)_2$  + Aq. (Wackenroder, A. 41. 327.)

Min. *Naumannite*. Insol. in dil., but sol. in conc.  $\text{HNO}_3 + \text{Aq}$ .

Silver sulphamide (silver thionyl amide),  $\text{SO}_2(\text{NHAg})_2$ .

Insol. in pyridine. (Hantzsch and Holl, B. 1901, **34**, 3436.)

+ $\text{H}_2\text{O}$ . (Ephraim and Gurevitch, B. 1910, **43**, 146.)

Argentous sulphide,  $\text{Ag}_2\text{S}$ .

Easily sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ , and in conc.  $\text{H}_2\text{SO}_4$  without separation of S. Sol. in conc.  $\text{KCN} + \text{Aq}$ . (v. der Pfordten, B. 20. 1458; Gunts, C. R. 112. 861.)

Silver sulphide,  $\text{Ag}_2\text{S}$ .

Less sol. in  $\text{H}_2\text{O}$  than  $\text{AgI}$ . (Lucas, Z. anorg. 1904, **41**, 210.)

1 l.  $\text{H}_2\text{O}$  dissolves about  $4 \times 10^{-11}$  g. at  $\text{Ag}$  as  $\text{Ag}_2\text{S}$  at  $18^\circ$ . (Bernfeld, Z. phys. Ch. 1898, **25**, 72.)

1 l.  $\text{H}_2\text{O}$  dissolves  $0.8 \times 10^{-4}$  g. mols. at  $16-18^\circ$ . (Biltz, Z. phys. Ch. 1907, **53**, 291.)

1 l.  $\text{H}_2\text{O}$  dissolves  $0.552 \times 10^{-4}$  g. mols.  $\text{Ag}_2\text{S}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, **53**, 294.)

Sol. in conc.  $\text{HNO}_3 + \text{Aq}$  with separation of S. Sol. in hot conc.  $\text{HCl} + \text{Aq}$ . Not decomp. by  $\text{CuCl}_2 + \text{Aq}$ , but by  $\text{CuCl}_2 + \text{NaCl} + \text{Aq}$ . Insol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ , or in  $\text{Hg}(\text{NO}_3)_2 + \text{Aq}$ .

Insol. in  $\text{H}_2\text{O}$ , dil. acids, alkalies, and alkali sulphides +  $\text{Aq}$ . (Fresenius.)

Sol. in  $\text{HCN} + \text{Aq}$ . (Hahn, C. C. 1870. 240.)

Pptd.  $\text{Ag}_2\text{S}$  is very sol. in  $\text{HNO}_3$  containing more than 5%  $\text{HNO}_3$ . (Gruener, J. Am. Chem. Soc. 1910, **32**, 1032.)

Only very sl. sol. in  $\text{AgNO}_3 + \text{Aq}$ , even at  $100^\circ$ . (Lowry, Roy. Soc. Proc. 1914, **91**, A. 70.)

Sol. in  $\text{KCN} + \text{Aq}$ . (Hahn, C. C. 1870. 240.)

Difficultly sol. in  $\text{KCN} + \text{Aq}$ ; less difficultly if  $\text{Ag}_2\text{S}$  is pptd. from a very dil. solution. Amt. of  $\text{KCN}$  present also has influence on the solubility.  $\text{Ag}_2\text{S}$  dissolved in conc.  $\text{KCN} + \text{Aq}$  separates out on dilution. (Béchamp, J. pr. 60. 64.)

Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Brett.)

Min. *Argentite*. *Acanthite*. Sol. in conc.  $\text{HNO}_3 + \text{Aq}$  with separation of S.

Sol. in citric acid +  $\text{Aq}$  with addition of  $\text{KNO}_3$ . (Bolton, C. N. 37. 48.)

Silver disulphide,  $\text{Ag}_2\text{S}_2$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.; also sol. with decomp. in  $\text{HCl}$ ,  $\text{HNO}_3$ .  $\text{CS}_2$  does not dissolve out S. (Hantzsch, Z. anorg. 1898, **19**, 105.)

Silver sodium sulphide,  $3\text{Ag}_2\text{S}, \text{Na}_2\text{S} + 2\text{H}_2\text{O}$ .

Sol. in conc.  $\text{Na}_2\text{S} + \text{Aq}$  with decomp.; sol. in  $\text{H}_2\text{O}$  with decomp. (Ditte, C. R. 1895, **120**, 93.)

Silver zinc sulphide,  $\text{Ag}_2\text{S}, 3\text{ZnS}$ .

(Schneider, J. pr. (2) 8. 29.)

Silver sulphimide\* (silver thionyl imide),  $\text{SO}_2\text{NAg}$ .

Very sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . Very sol. in dil.  $\text{HNO}_3$ . (Traube, B. 1892, **25**, 2474.)

Silver sulphophosphide.

See Silver phosphosulphide.

Silver telluride,  $\text{Ag}_2\text{Te}$ .

Min. *Hessite*. Sol. in warm  $\text{HNO}_3 + \text{Aq}$ .

Sodammonium,  $\text{Na}_2(\text{NH}_3)_2$ .

100 g. liq.  $\text{NH}_3$  dissolve 60.5 g. at  $-23^\circ$ ; 56.4 g. at  $0^\circ$ ; 56 g. at  $+5^\circ$ ; 55 g. at  $9^\circ$ . (Joannis A. ch. 1906, (8) 7. 41.)

Sodium,  $\text{Na}_2$ .

Violently decomposes  $\text{H}_2\text{O}$ , alcohol, etc. Insol. in hydrocarbons. Easily sol. in acids with violent action.

Solubility in fused  $\text{NaOH}$ .

G. sol. in 100 g. fused  $\text{NaOH}$  at temp.

$t^\circ$	G. per 100 g. $\text{NaOH}$
480	25.3
600	10.1
610	9.9
670	9.5
760	7.9
800	6.9

(Hevesy, Z. Elektrochem. 1909, **15**, 531.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, **54**, 674.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 829.)

1 gram atom dissolves:—

at  $+22^\circ$  in 6.14 mol. liquid  $\text{NH}_3$ .

“ 0 “ 5.87 “ “ “

“  $-30^\circ$  “ 5.52 “ “ “

“  $-50^\circ$  “ 5.39 “ “ “

“  $-70^\circ$  “ 5.20 “ “ “

“  $-105^\circ$  “ 4.98 “ “ “

(Ruff, B. 1906, **39**, 839.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0449 g. Na in 6 days. (Gates, J. phys. Chem. 1911, **15**, 143.)

Insol. in ethylamine and in secondary and tertiary amines. (Kraus, J. Am. Chem. Soc. 1907, **29**, 1561.)

Sodium acetylde acetylene,  $\text{Na}_2\text{C}_2, \text{C}_2\text{H}_2$ .

Very deliquescent. Decomp. by  $\text{H}_2\text{O}$  and by absolute alcohol. Insol. in ether, ligroin, etc. (Moissan, C. R. 1898, **127**, 915.)

**Sodium amalgam.**

$\text{NaHg}_8$ . Stable in contact with the liquid amalgam from  $0^\circ$ – $40.5^\circ$ . Can be cryst. from Hg without decomp. at any temp. between these limits.

$\text{NaHg}_8$ . Stable in contact with the liquid amalgam from  $40.5^\circ$ – $150^\circ$ . Can be cryst. from Hg without decomp. at any temp. between these limits. (Kerp, Z. anorg. 1900, 25. 68.)

**Sodium amide,  $\text{NaNH}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

**Sodium amidochloride,  $\text{Na}_2\text{NH}_2\text{Cl}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Joannis, C. R. 112. 392.)

**Sodium arsenide,  $\text{Na}_3\text{As}$ .**

Decomp.  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1900, 130. 504.)

**Sodium arsenide ammonia,  $\text{Na}_3\text{As}, \text{NH}_3$ .**

Easily sol. in liquid  $\text{NH}_3$ . (Lebeau, C. R. 1900, 130. 502.)

Sl. sol. in liquid  $\text{NH}_3$ . (Hugot, C. R. 1898, 127. 554.)

**Sodium azoimide,  $\text{NaN}_3$ .**

Not hygroscopic. Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Curtius, B. 24. 3344.)

40.16 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ .

40.7 " " " " 100 "  $\text{H}_2\text{O}$  " 15.2.

41.7 " " " " 100 "  $\text{H}_2\text{O}$  " 17.0.

0.153 pt. is sol. in 100 pts. abs. alcohol at  $16^\circ$ .

Insol. in pure ether. (Curtius, J. pr. 1898, (2) 58. 279.)

**Sodium bromide,  $\text{NaBr}$ , and  $+2\text{H}_2\text{O}$ .**

Not deliquescent. Solubility in  $\text{H}_2\text{O}$  differs according as  $\text{NaBr}$  or  $\text{NaBr}+2\text{H}_2\text{O}$  is used. The following data for anhydrous  $\text{NaBr}$  were found.

Pts.  $\text{NaBr}$  dissolved by 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{NaBr}$	$t^\circ$	Pts. $\text{NaBr}$	$t^\circ$	Pts. $\text{NaBr}$
44.1	115.6	74.5	118.4	97.2	119.9
51.5	116.2	80.5	118.6	100.3	120.6
55.1	116.8	86.0	118.8	110.6	122.7
60.3	117.0	90.5	119.7	114.3	124.0
64.5	117.3	...	...	...	...

Solubility is represented by a straight line of the formula  $S = 110.34 + 0.1075t$ .

Below  $50^\circ$  the salt usually crystallizes with

$2\text{H}_2\text{O}$ , of which the solubility in 100 pts.  $\text{H}_2\text{O}$  was found to be as follows:

$t^\circ$	Pts. $\text{NaBr}$	$t^\circ$	Pts. $\text{NaBr}$	$t^\circ$	Pts. $\text{NaBr}$
-21	71.1	+5	82.0	30	97.3
-20	71.4	10	84.5	35	101.3
-15	73.1	15	87.3	40	105.8
-10	75.1	20	90.3	45	110.6
-5	77.1	25	93.8	50	116.0
0	79.5	...	...	...	...

(Coppet, A. ch. (5) 30. 420.)

If solubility  $S$  = pts.  $\text{NaBr}$  in 100 pts. solution,  $S = 40.0 + 0.1746t$  from  $-20^\circ$  to  $+40^\circ$ ;  $S = 52.3 + 0.0125t$  from  $50^\circ$  to  $150^\circ$ . (Étard, C. R. 98. 1432.)

100 pts.  $\text{H}_2\text{O}$  dissolve: at  $0^\circ$ , 77.5 pts.  $\text{NaBr}$ ; at  $20^\circ$ , 88.4 pts.; at  $40^\circ$ , 104.2 pts.; at  $60^\circ$ , 111.1 pts.; at  $80^\circ$ , 112.4 pts.; at  $100^\circ$ , 114.9 pts. (Kremers.)

Sat. solution boils at  $121^\circ$ . (Kremers, Pogg. 97. 14.)

Sat.  $\text{NaBr} + \text{Aq}$  contains at:

-22°	-10°	+140°	163°
40.1	42.5	56.5	57.5% $\text{NaBr}$

180°	180°	210°	212°	230°
59.5	59.0	60.9	61.0	62.0% $\text{NaBr}$

(Étard, A. ch. 1894, (7) 2. 539.)

100 g. sat.  $\text{NaBr} + \text{Aq}$  at  $16.4^\circ$  contain 47 g.  $\text{NaBr}$ . (Greenish, Pharm. J. 1900, 65. 190.)

Solubility of  $\text{NaBr} + 2\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $30^\circ = 65.5\%$  anhydrous  $\text{NaBr}$ . (Cocheret, Dissert. 1911.)

Sp. gr. of  $\text{NaBr} + \text{Aq}$  at  $19.5^\circ$  containing:

5	10	15	20	25 % $\text{NaBr}$
1.040	1.080	1.125	1.174	1.226

30	35	40	45	50 % $\text{NaBr}$
1.281	1.334	1.410	1.483	1.565

(Gerlach, Z. anal. 8. 285.)

$\text{NaBr} + \text{Aq}$  containing 17.15%  $\text{NaBr}$  has sp. gr.  $20^\circ/20^\circ = 1.1473$ .

$\text{NaBr} + \text{Aq}$  containing 22.72%  $\text{NaBr}$  has sp. gr.  $20^\circ/20^\circ = 1.2060$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 278.)

Sp. gr. of  $\text{NaBr} + \text{Aq}$  at  $20.5^\circ$ .

Normality of $\text{NaBr} + \text{Aq}$	g. $\text{NaBr}$ in 100 g. of solution	Sp. gr. $20.5^\circ/4^\circ$
4.33	33.57	1.3284
3.00	25.10	1.2284
1.99	17.77	1.1526
0.98	9.41	1.0750

(Oppenheimer, Z. phys. Ch. 1898, 27. 452.)

Sp. gr. at 20° of NaBr+Aq containing  
M g. mols. NaBr per liter.

M	0.01	0.025	0.05	0.075
Sp. gr.	1.000732	1.002177	1.004074	1.005972

M	0.10	0.25	0.50	0.75
Sp. gr.	1.00788	1.01964	1.03908	1.05811

M	1.0	1.5	2.0
Sp. gr.	1.07632	1.11963	1.15240

(Jones and Pearce, Am. Ch. J. 1907, 38. 728.)

Sol. in H<sub>2</sub>SO<sub>4</sub>. (Walden, Z. anorg. 1902, 29. 384.)

100 pts. NaBr+Aq sat. at 18-19° contain 46.05 pts. NaBr; 100 pts. NaBr+NaCl+Aq sat. at 18-19° contain 46.59 pts. of the two salts; 100 pts. NaBr+NaI+Aq sat. at 18-19° contain 63.15 pts. of the two salts; 100 pts. NaBr+NaCl+NaI+Aq sat. at 18-19° contain 63.20 pts. of the three salts. (v. Hauer, J. pr. 98. 137.)

Solubility of NaBr in NaOH+Aq at 17°.  
(G. per 100 g. H<sub>2</sub>O.)

NaOH	NaBr	NaOH	NaBr
0.0	91.38	22.35	59.60
3.26	79.86	24.74	55.03
9.24	68.85	28.43	48.00
13.43	64.90	36.61	38.41
17.17	63.06	46.96	29.37
19.12	62.51	54.52	24.76

(Ditte, C. R. 1897, 124. 30.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, 46. 2.)

Very sl. sol. in alcohol.

NaBr+2H<sub>2</sub>O is sol. in 1.10 pts. H<sub>2</sub>O at 15°; in 159 pts. absolute alcohol at 15°; in 1200 pts. absolute ether at 15°. (Eder, Dingl. 221. 89.)

NaBr+2H<sub>2</sub>O is sol. in 2.25 pts. 60% alcohol, and 7 pts. 90% alcohol. NaBr is sol. in 3 pts. 60% alcohol, and 10 pts. 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 17.35 pts. at 19.5°. (de Bruyn, Z. phys. Ch. 10. 783.)

100 g. NaBr+CH<sub>3</sub>OH contain 0.9 g. NaBr at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, 72. 437.)

At room temp., 1 pt. NaBr by weight is sol. in:

4.6 pts. methyl alcohol	D <sup>15</sup> 0.7990.
14.0 " ethyl "	D <sup>15</sup> 0.8100.
49.7 " propyl "	D <sup>15</sup> 0.8160.

(Rohland, Z. anorg. 1898, 18. 325.)

Solubility in ethyl alcohol at 30°.

Wt. %		Solid phase
Alcohol	NaBr	
0	59.4	NaBr, 2H <sub>2</sub> O
11.79	42.90	"
31.78	32.12	"
43.22	26.79	"
54.69	20.83	"
65.51	16.08	"
72.36	13.41	"
76.92	12.03	NaBr, 2H <sub>2</sub> O+NaBr
87.35	7.44	NaBr
97.08	3.01	"

(Cocheret, Dissert. 1911.)

Solubility in mixtures of methyl and ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.  
G = g. NaBr in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0.00	0.293	0.8189
4.37	0.365	0.8265
10.40	0.404	0.8273
41.02	0.724	0.8593
80.69	1.251	0.9079
84.77	1.286	0.9104
91.25	1.432	0.9235
100.00	1.440	0.9238

(Hers and Kuhn, Z. anorg. 1908, 60. 155.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. NaBr in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	1.440	0.9238
11.11	1.243	0.9048
23.8	1.053	0.8887
65.2	0.442	0.8390
91.8	0.147	0.8153
93.75	0.126	0.8144
100	0.074	0.8093

(Hers and Kuhn, Z. anorg. 1908, 60. 156.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.  
G = g. NaBr in 10 ccm. of the solution.  
S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	0.293	0.8189
8.1	0.249	0.8147
17.85	0.247	0.8145
56.6	0.190	0.8107
88.6	0.111	0.8116
91.2	0.083	0.8083
95.2	0.082	0.8090
100	0.074	0.8093

(Herz and Kuhn, Z. anorg. 1908, 60. 159.)

2.05 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Sl. sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

100 g. 95% formic acid dissolve 22.3 g. NaBr at 18.5°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314); benzonitrile. (Naumann, B. 1914, 47. 1370.)

The composition of the hydrates formed by NaBr at different dilutions is calculated from determinations of the lowering of the frpt. produced by NaBr and of the conductivity and sp. gr. of NaBr+Aq. (Jones, Am. Ch. J. 1905, 34. 303.)

#### Sodium stannic bromide.

See Bromostannate, sodium.

#### Sodium uranous bromide, Na<sub>2</sub>UBr<sub>4</sub>.

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

#### Sodium zinc bromide, NaBr, ZnBr<sub>2</sub>+H<sub>2</sub>O.

Hygroscopic. (Ephraim, Z. anorg. 1906, 59. 63.)

2NaBr, ZnBr<sub>2</sub>+5H<sub>2</sub>O. Hygroscopic. (Ephraim.)

#### Sodium carbide, Na<sub>2</sub>C<sub>2</sub>.

Insol. in all neutral solvents; decomp. on heating and by H<sub>2</sub>O. (Matignon, C. R. 1897, 125. 1034.)

#### Sodium carbonyl, Na<sub>2</sub>C<sub>2</sub>O<sub>2</sub>.

Decomp. by H<sub>2</sub>O with explosion. (Joannis, C. R. 116. 1518.)

#### Sodium subchloride, Na<sub>2</sub>Cl<sub>3</sub>.

Decomp. by H<sub>2</sub>O into NaCl and NaOH+Aq. (Kreutz, B. 1897, 30. 403.)

#### Sodium chloride, NaCl.

Sol. in H<sub>2</sub>O.

100 pts. H<sub>2</sub>O at t° dissolve pts. NaCl.

t°	Pts. NaCl	Authority
0	More than at 13.89°	Gay-Lussac, A. ch. (2) 11. 310.
13.89	35.81	
16.90	35.88	
59.93	37.14	
109.73	40.38	
12	35.91	Fehling, A. 77. 382.
100	39.92	
18.75	37.731	Bischof.
10-15	35.42	Bergmann.
106+	42.86	Griffiths, 1835.
20	35.9	Schiff, A. 109. 326.
All temps.	37	Fuchs and Reichenbach 1836.
25	35.7	Kopp, A. 34. 262.
18.75	36.53	C. J. B. Karsten, 1840.
1	36.121	G. Karsten.
18.75	36.724	
100	41.076	
1.25	36.119	Unger, J. pr. 8. 285.
Boiling	39.324	
18.75	35.40	Karsten (?), cited by Unger, l.c.
100	36.95	
15.56	34.2-35.42	Ure's Diet.
100	36.16	
15	35.837	Michel and Kraft.

1 pt. NaCl is sol. in 2.789 pts. H<sub>2</sub>O at 15° (Gerlach); in 3 pts. H<sub>2</sub>O at 18.75° (Abi); in 2.8235 pts. H<sub>2</sub>O at ord. temp. (Bergmann); in 2.7647 pts. boiling H<sub>2</sub>O (Bergmann); in 2.857 pts. hot or cold H<sub>2</sub>O (Fourcroy).

Not deposited from boiling aqueous solution unless the vessel containing it is open to the air. (Unger, l.c.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
1.5	33.6	70	38.1
13.75	35.8	108.5	39.4

(Nordenfjöld, Pogg. 138. 315.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
13.89	35.8	59.93	37.1
16.90	35.9	109.73	40.4

(Gay-Lussac, A. ch. 11. 296.)

Solubility of NaCl at various pressures. The figures represent pts. NaCl in 100 pts. sat. NaCl+Aq at t° and A pressure in atmospheres.

A	0°	9°	12°	15°	20°	25°	30°
1	26.25	26.32	26.35	26.30	26.35	26.37	26.47
20	26.35	26.38	..	26.39	26.37	26.47	26.53
40	26.44	..	..	26.40	..	..	..

(Müller, Pogg. 117. 386.)

100 pts. H<sub>2</sub>O dissolve at t°.

t°	Pts. NaCl	t°	Pts. NaCl
-15	32.73	40	36.64
-10	33.49	50	36.98
-5	34.22	60	37.25
0	35.52	70	37.88
5	35.63	80	38.22
9	35.74	90	38.87
14	35.87	100	39.61
25	36.13	109.7	40.35

(Poggiale, A. ch. (3) 8. 649.)

100 pts. H<sub>2</sub>O dissolve at:

0°	9°	12°	15°
35.59	35.72	35.77	35.68 pts. NaCl,

20°	25°	30°
35.77	35.81	36.00 pts. NaCl.

(Müller, Pogg. 122. 337.)

100 pts. H<sub>2</sub>O dissolve 35.76-36.26 pts. NaCl at 15.6°, and the sp. gr. of sat. solution = 1.204. (Page and Keightley, Chem. Soc. (2) 10. 566.)

100 pts. NaCl + Aq sat. at 18-19° contain 26.47 pts. NaCl. (v. Hauer, J. pr. 98. 137.)

Solubility of NaCl in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
0	35.7	30	36.3	60	37.3
1	35.7	31	36.3	61	37.3
2	35.7	32	36.3	62	37.4
3	35.7	33	36.4	63	37.4
4	35.7	34	36.4	64	37.5
5	35.7	35	36.4	65	37.5
6	35.7	36	36.5	66	37.6
7	35.7	37	36.5	67	37.7
8	35.7	38	36.5	68	37.7
9	35.7	39	36.6	69	37.8
10	35.8	40	36.6	70	37.9
11	35.8	41	36.6	71	37.9
12	35.8	42	36.7	72	38.0
13	35.8	43	36.7	73	38.0
14	35.8	44	36.8	74	38.1
15	35.9	45	36.8	75	38.2
16	35.9	46	36.8	76	38.2
17	35.9	47	36.9	77	38.2
18	35.9	48	36.9	78	38.2
19	36.0	49	36.9	79	38.3
20	36.0	50	37.0	80	38.4
21	36.0	51	37.0	81	38.4
22	36.0	52	37.0	82	38.5
23	36.1	53	37.1	83	38.6
24	36.1	54	37.1	84	38.6
25	36.1	55	37.1	85	38.7
26	36.1	56	37.2	86	38.7
27	36.2	57	37.2	87	38.8
28	36.2	58	37.2	88	38.9
29	36.2	59	37.3	89	39.0

Solubility of NaCl in 100 pts. H<sub>2</sub>O at t°.—  
*Continued.*

t°	Pts. NaCl	t°	Pts. NaCl	t°	Pts. NaCl
90	39.1	97	39.5	104	40.0
91	39.1	98	39.6	105	40.1
92	39.2	99	39.7	106	40.1
93	39.3	100	39.8	107	40.2
94	39.3	101	39.8	108	40.3
95	39.4	102	39.9	109	40.3
96	39.4	103	40.0	109.7	40.4

(Calculated by Mulder from his own and other observations, Scheik. Verhandel. 1864. 37.)

Solubility in 100 pts. H<sub>2</sub>O at:

0-4°	20°	40°	60°	80°
35.630	35.825	36.32	37.06	38.00

(Andreae, J. pr. (2) 29. 456.)

Solubility in 100 pts. H<sub>2</sub>O from most careful experiments.

0°	20°	60°	80°
35.571	35.853	37.091	38.046

(Raupenstrauch, M. Ch. 6. 563.)

Solubility of NaCl in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. NaCl	t°	Pts. NaCl
-14.0	32.5	44.75	36.64
-13.8	32.15	52.5	37.04
-6.25	34.22	55.0	36.99
-5.95	34.15	59.75	37.31
0	35.7	71.3	37.96
3.6	35.79	74.45	37.96
5.3	35.8	82.05	38.41
14.45	35.94	86.7	38.47
20.85	35.63	93.65	38.90
25.45	35.90	101.7	40.76
38.55	36.52	...	...

Solubility above 20° is represented by the formula  $S = 34.359 + 0.0527t$ . (Coppet, A. ch. (5) 30. 426.)

Solubility of NaCl in 100 pts. H<sub>2</sub>O at high temp.

t°	Pts. NaCl	t°	Pts. NaCl
118	39.8	160	43.6
140	42.1	180	44.9

(Tilden and Shenstone, Phil. Trans. 1864. 23.)

Sat. NaCl+Aq contains % NaCl at  $t^{\circ}$ .

$t^{\circ}$	% NaCl	$t^{\circ}$	% NaCl
-21	23.7	77	28.0
-21	23.4	90	28.2
-18	23.5	115	29.1
-17	23.3	135	28.9
-7	25.5	140	28.8
0	25.8	150	29.6
+15	26.7	180	30.2
55	26.8	215	31.6

(Étard, A. ch. 1894, (7) 2. 532.)

100 g.  $H_2O$  dissolve 0.616 gram-equivalent NaCl at  $25^{\circ}$ . (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, 49. 315.)

Solubility of NaCl in  $H_2O$  at  $t^{\circ}$ .

Most careful experiments.

$t^{\circ}$	g. NaCl per 100 g. $H_2O$	Sp. gr.	$t^{\circ}$	g. NaCl per 100 g. $H_2O$	Sp. gr.
0.35	35.75	1.2090	61.70	37.28	1.1823
15.20	35.84	1.2020	75.65	37.82	1.1764
30.05	36.20	1.1956	90.50	38.53	1.1701
45.40	36.60	1.1891	107	39.65	1.1631

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203. A. 189.)

Sat. NaCl+Aq. at  $25^{\circ}$  contains 26.5% NaCl. (Foote, Am. Ch. J. 1906, 35. 239.)

100 g.  $H_2O$  dissolve 35.80 g. NaCl at  $25^{\circ}$ . (Cameron, Bell and Robinson, J. phys. Ch. 1907, 11. 396.)

100 g. NaCl+Aq. sat. at  $15^{\circ}$  contains 26.3 g. NaCl; at  $30^{\circ}$ , 26.47 g. (Schreinemakers, Arch. neér. Sc. 1910, (2) 15. 81.)

5.456 g. mol. are contained in 1 l. NaCl+Aq sat. at  $25^{\circ}$ . (Herz, Z. anorg. 1911, 73. 274.)

5.40 g. mol. are contained in 1 l. NaCl+Aq sat. at  $30^{\circ}$ . (Masson, Chem. Soc. 1911, 99. 1136.)

26.47 g. NaCl are contained in 100 g. NaCl+Aq. sat. at  $30^{\circ}$ . (Cocheret, Dissert. 1911.)

35.79 g. NaCl are sol. in 100 g.  $H_2O$  at room temp. (Frankforter, J. Am. Chem. Soc. 1914, 36. 1106.)

100 mol.  $H_2O$  dissolve at:

19.3° 29.7° 40.1° 54.5°  
11.04 11.06 11.15 11.35 mol. NaCl.

(Sudhaus, Miner. Jahrb. Beil. Bd. 1914, 37. 18.)

Solubility of NaCl in  $H_2O$  at  $24.5^{\circ}$  at varying pressures.

S = g. NaCl in 100 g. solvent.

P = pressure in atmospheres.

P	S	100 g. of solution contains g. NaCl
1	35.90	26.42
250	36.25	26.61
500	36.55	26.77
1000	37.02	27.02
1500	37.36	27.20

(Cohen, Inouye and Euwen, Z. phys. Ch. 1910, 75. 257.)

Sp. gr. of NaCl+Aq containing 15% NaCl is 1.109 at  $15^{\circ}$  (Francour); 1.116 at  $15^{\circ}$  (Soubeiran); 1.1107 at  $15^{\circ}$  (Coulier); 1.111 at  $15^{\circ}$  (Baudin, C. R. 68. 932).

Sp. gr. of NaCl+Aq saturated at  $15^{\circ}$  is 1.20715 (Michel and Kraft); at  $17.5^{\circ}$  is 1.2046 (Karsten); at  $8^{\circ}$  is 1.205 (Anthon).

Sp. gr. of NaCl+Aq.

% NaCl	Sp. gr.	% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1.037	15	1.112	25	1.192
10	1.074	20	1.154	26.43	1.204

(Dahlmann, J. B. 7. 321.)

Sp. gr. of NaCl+Aq at  $20^{\circ}$ .

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1.0066	15	1.1090
2	1.0133	16	1.1168
3	1.0201	17	1.1247
4	1.0270	18	1.1327
5	1.0340	19	1.1408
6	1.0411	20	1.1490
7	1.0483	21	1.1572
8	1.0556	22	1.1655
9	1.0630	23	1.1738
10	1.0705	24	1.1822
11	1.0781	25	1.1906
12	1.0857	26	1.1990
13	1.0934	27	1.2075
14	1.1012	..	...

(Schiff, A. 110. 76.)

Sp. gr. of NaCl+Aq at  $19.5^{\circ}$ .

% NaCl	Sp. gr.	% NaCl	Sp. gr.
6.402	1.0460	22.631	1.1712
12.265	1.0895	26.530	1.2036
17.533	1.1303	...	...

(Kremers, Pogg. 95. 120.)

Sp. gr. of NaCl+Aq at 15°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
1	1.00725	15	1.11146
2	1.01450	16	1.11938
3	1.02174	17	1.12730
4	1.02899	18	1.13523
5	1.03624	19	1.14315
6	1.04366	20	1.15107
7	1.05108	21	1.15931
8	1.05851	22	1.16755
9	1.06593	23	1.17580
10	1.07335	24	1.18404
11	1.08097	25	1.19228
12	1.08859	26	1.20098
13	1.09622	26.395	1.20433
14	1.10384	...	...

(Gerlach, Z. anal. 8. 279.)

Sp. gr. of NaCl+Aq at 18°.

% NaCl	Sp. gr.	% NaCl	Sp. gr.
5	1.0345	25	1.1898
10	1.0707	26	1.1982
15	1.1087	26.4	1.2014
20	1.1477	...	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of NaCl+Aq at 20°, containing  
n mols. H<sub>2</sub>O to 1 mol. NaCl.

n	Sp. gr.	n	Sp. gr.
12.5	1.15292	100	1.02069
25	1.08207	200	1.00965
50	1.04227	...	...

(Marignac, J. B. 1870. 110.)

Sp. gr. of NaCl+Aq at 0°. NaCl=g. NaCl  
to 100 g. H<sub>2</sub>O; d°=sp. gr. at 0°; d<sup>r</sup>=  
maximum sp. gr.; T=temp. of maximum.

G. NaCl	d°	d <sup>r</sup>	T
0	1.00000	1.000130	+ 4°
0.5	1.003925	1.003988	+ 3
1	1.007634	1.007666	+ 1.77
2	1.015366	1.015367	— 0.58
3	1.023530	1.023583	— 3.24
4	1.030669	1.030890	— 5.63
5	1.045975	1.046952	—11.07

(Rosetti, A. ch. (4) 17. 382.)

Sp. gr. of NaCl+Aq at 20°. x=mols. NaCl  
to 100 mols. H<sub>2</sub>O.

x	Sp. gr.	x	Sp. gr.
0.5	1.01145	4.0	1.08408
1.0	1.02255	5.0	1.10276
2.0	1.04393	...	...

(Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of NaCl+Aq at 0°. S=weight of salt  
in 100 g. of solution of the given sp. gr.;  
S<sub>1</sub>=No. mols. of salt contained in 100  
mols. of the solution.

S	S <sub>1</sub>	Sp. gr.
23.0821	8.627	1.1821
19.1932	6.769	1.1502
14.3415	4.898	1.1111
9.4120	3.097	1.0722
5.1536	1.644	1.0394

(Charpy, A. ch. (6) 29. 23.)

Sp. gr. of NaCl+Aq.

G.-equivalents NaCl per liter	t°	Sp. gr. t°/t°
0.005028	18.549	1.0002119
0.01005	18.550	1.0004258
0.02005	18.538	1.000848
0.04983	18.509	1.002101
0.09873	18.525	1.004143
0.19388	18.542	1.008093
0.28999	18.559	1.012053
0.47574	18.558	1.019627
0.49860	18.06	1.02054
4.9860	17.85	1.18783
0.00259	14.07	1.0001108
0.005178	14.076	1.0002210
0.010318	14.097	1.0004401
0.12580	14.097	1.005315
0.25019	14.076	1.010505

(Kohlrausch, W. Ann. 1894, 53. 26.)

Sp. gr. of NaCl+Aq at 18°/18°.

g.-equivalents of NaCl in 1 liter of solution	Sp. gr.
0.005	1.0002104
0.010	1.0004206
0.020	1.0008476
0.050	1.002109
0.100	1.004205

(Tammann, Z. phys. Ch. 1895, 16. 93.)



Sp. gr. of NaCl+Aq sat. 18.0°, when p = percent strength of solution; d = observed density; and w = volume conc. in grams per cc. ( $\frac{pd}{100} = w$ .)

p	d	w
25.37	1.1928	0.30263
21.25	1.1592	0.24637
17.35	1.1277	0.19503
13.25	1.0958	0.14518
9.34	1.0665	0.09960
4.810	1.0332	0.04969
2.991	1.0202	0.03052
2.593	1.0173	0.2638
1.746	1.0111	0.01765

(Barnes. J. Phys. Chem. 1898, 2. 544.)

Sp. gr. of NaCl+Aq at 20.5°.

Normality of NaCl+Aq	G. NaCl in 100 g. of solution	Sp. gr. 20.5°/4°
3.97	20.22	1.1489
2.96	15.56	1.1124
2.01	10.90	1.0775
0.97	5.49	1.0373

(Oppenheimer. Z. phys. Ch. 1898, 27. 451.)

Sp. gr. of NaCl+Aq at 15°.

Per cent NaCl	Sp. gr.
0	1.00000
5	1.03624
10	1.07335
15	1.11146
20	1.15107
25	1.19228
Sat. at 15°	1.20433

(H. C. Hahn, J. Am. Chem. Soc. 1898, 20. 622.)

Sp. gr. of NaCl+Aq at 18°/4°.

g. NaCl in 100 g. of solution	Sp. gr.
0.19560	1.0001
0.097952	0.9994
0.065410	0.99918
0.048977	0.99905

(Jahn, Z. phys. Ch. 1900, 33. 572.)

Sp. gr. 20°/4° of a normal solution of NaCl = 1.03866. (Haigh, J. Am. Chem. Soc. 1912, 34. 1151.)

Sp. gr. of sat. NaCl+Aq at t°.

t°	g. NaCl sol. in 100 g. H <sub>2</sub> O	Sp. gr.
-10°	32.90	1.200
0	35.63	1.210
10	35.69	1.205
20	35.82	1.202
30	36.03	1.198
40	36.32	1.193
50	36.67	1.189
60	37.06	1.184
70	37.51	1.178

(Tschernaj, J. Russ. Phys. Chem. Soc. 1912, 44. 1565.)

Sp. gr. of dil. NaCl+Aq at 20.004°.  
Conc. = g. equiv. NaCl per l. at 20.004°.  
Sp. gr. compared with H<sub>2</sub>O at 20.004° = 1.

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,004,2
0.0002	1.000,008,5
0.0005	1.000,021,3
0.0010	1.000,042,7
0.0020	1.000,085,1
0.0040	1.000,169,6
0.0060	1.000,211,7
0.0100	1.000,423,3

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35. 1686.)

The saturated solution boils at 109° (Kremers.)

NaCl+Aq containing 42.9 pts. NaCl to 100 pts. H<sub>2</sub>O boils at 106.8° (Griffiths); containing 41.2 pts. NaCl to 100 pts. H<sub>2</sub>O boils at 106.2° (Legrand); containing 40.38 pts. NaCl to 100 pts. H<sub>2</sub>O boils at 109.73° (Gay-Lussac); containing 38.7 pts. NaCl to 100 pts. H<sub>2</sub>O forms a crust at 108.3°; highest point observed, 108.8° (Gerlach, Z. anal. 26. 426.)

Boiling-point of NaCl+Aq.

% NaCl	B.-pt. according to	
	Bischof	G. Karsten
5	101.50°	101.10°
10	103.03	102.38
15	104.63	103.83
20	106.26	105.46
25	107.93	107.27
29.4	107.9-108.99	...

% NaCl	B.-pt. according to	
	Legrand	Gerlach
5	100.80°	100.9°
10	101.75	101.9
15	103.00	103.3
20	104.60	105.3
25	106.60	107.6

B.-pt. of NaCl+Aq containing pts. NaCl to 100 pts. H<sub>2</sub>O. G=according to Gerlach (Z. anal. 28. 438; L=according to Le-grand (A. ch. (2) 59. 431).

B.-pt.	G	L	B.-pt.	G	L
100.5°	3.4	4.4	105.5°	27.5	29.8
101	6.6	7.7	106	29.5	31.8
101.5	9.6	10.8	106.5	31.5	33.9
102	12.4	13.4	107	33.5	35.8
102.5	14.9	15.9	107.5	35.5	37.7
103	17.2	18.3	108	37.5	39.7
103.5	19.4	20.7	108.4	...	41.2
104	21.5	23.1	108.5	39.5	...
104.5	23.5	25.5	108.8	40.7	...
105	25.5	27.7	...	...	...

B.-pt. of NaCl+Aq containing g. NaCl in 100 g. H<sub>2</sub>O.

g. NaCl 7.6 11.0 14.9 16.1 18.8  
B.-pt. 102.2° 103 104.2 104.8 106.1

g. NaCl 22.3 24.0 26.0 28.7  
B.-pt. 107.1 107.7 108.7 109.5

(Richmond, Analyst, 1893, 18. 142.)

If NaCl is dissolved in 15 pts. H<sub>2</sub>O, heat is absorbed if the temp. is 15°, but much less if temp. is 86°; at 100° there is neither absorption nor evolution of heat. (Berthelot, C. R. 78. 1722.)

36 pts. NaCl mixed with 100 pts. H<sub>2</sub>O at 12.6° lower the temp. 2.5°. (Rüdorff, B. 2. 68.)

33 pts. NaCl with 100 pts. snow at -1° give a temp. of -21.3°. (Rüdorff, Pogg. 122. 337.)

The freezing-point of NaCl+Aq is lowered 0.60° for every gram NaCl up to 10 g. When more conc. the freezing-point sinks proportional to NaCl, 2H<sub>2</sub>O, 0.342° for every gram of that salt. (Rüdorff, Pogg. 118. 163.)

Insol. in conc. HCl+Aq.

Solubility of NaCl in HCl+Aq at 0°. NaCl=mols. NaCl (in milligrams) dissolved in 10 ccm. of liquid; HCl=mols. HCl (in milligrams) dissolved in 10 ccm. of liquid.

NaCl	HCl	Sum of mols.	Sp. gr.
53.5	1	54.5	1.2045
52.2	1.85	54.05	1.2025
48.5	5.1	53.6	1.196
44.0	9.275	53.275	1.185
37.95	15.05	53.00	1.1725
23.5	30.75	54.95	1.141
6.1	56.35	62.45	1.1159

(Engel, Bull. Soc. (2) 45. 654.)

Solubility in HCl+Aq at 10-10.5°.

g. per 100 cc.		G. per 100 cc.	
HCl	NaCl	HCl	NaCl
0.0	35.77	26.06	30.89
9.84	33.76	94.77	20.01
12.76	33.19	102.1	19.04
15.68	32.71	120.6	16.03
20.78	31.77	...	...

(Enklaar, R. t. c. 1901, 20. 183.)

Solubility in HCl+Aq at 30°.

Composition of the solution	
% by wt. HCl	% by wt. NaCl
0	26.47
6.93	16.16
12.50	9.35
17.35	4.52
35.60	0.11

(Schreinemakers, Z. phys. Ch. 1909, 68. 85.)

Solubility in HCl+Aq.

Conc.=concentration of HCl. g. mol. per 1,000 g. H<sub>2</sub>O.

NaCl=wt. NaCl dissolved in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0	0	357.75	6.13
	0.25	341.70	5.85
	0.50	324.45	5.56
	1.00	291.20	4.99
25	0	360.80	6.18
	0.25	344.50	5.90
	0.50	329.05	5.64
	1.00	298.10	5.10

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

Solubility in HCl+Aq at 30°.

G. mols. per l.

HCl	NaCl	Sp. gr. 30°	HCl	NaCl	Sp. gr. 30°
0.0	5.400	1.2018	3.052	2.463	1.1427
0.4575	4.932	1.1906	4.152	1.628	1.1289
0.969	4.386	1.1801	5.950	0.630	1.1188
1.786	3.589	1.1633	7.205	0.268	1.1258
2.412	2.412	1.1512			

(Masson, Chem. Soc. 1911, 99. 1132.)

## Solubility in HCl + Aq at 25°.

Millimols HCl in 10 ccm.	Millimols NaCl in 10 ccm.
...	54.56
6.07	48.50
10.32	44.67
15.90	37.82
21.17	32.97
32.83	23.43

(Herz, Z. anorg. 1912, **73**, 274.)Moderately dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  + Aq precipitate NaCl from NaCl + Aq. (Karsten.)Sol. in  $\text{H}_2\text{SO}_4$ . (Walden, Z. anorg. 1902, **29**, 384.)Solubility of NaCl in  $\text{NH}_4\text{OH}$  + Aq at 30°.

(G. in 1 l. sat. solution.)

Sp. gr.	$\text{NH}_3$	NaCl	Sp. gr.	$\text{NH}_3$	NaCl
1.1735	29.535	293.38	1.1406	72.07	283.38
1.1656	40.655	292.5	1.1395	72.715	283.06
1.160	47.26	289.7	1.1301	81.855	277.49
1.1494	60.78	286.5	1.205	97.49	270.57

(Hempel and Tedesco, Z. anorg. 1911, **24**, 2467.)Solubility of NaCl in  $\text{NH}_4\text{Cl}$  + Aq at t°.

t°	G. per 100 g. $\text{H}_2\text{O}$		Sp. gr.
	$\text{NH}_4\text{Cl}$	NaCl	
0	0	356.3	...
	146.1	286.4	1.185
15	0	357.6	1.200
	57.3	326.4	1.191
	118.9	300	1.183
	186.4	271.6	1.176
	198.8	266.8	1.175
30	0	360.3	...
	255.4	249	1.166
45	0	365	...
	322.1	233.9	...

(Fedotieff, Z. phys. Ch. 1904, **49**, 168.)See also under  $\text{NH}_4\text{Cl}$ .Solubility in NaOH + Aq at 0°.  $\text{NaCl}$  = mols. NaCl (in milligrams) in 10 ccm. solution;  $\text{Na}_2\text{O}$  = mols.  $\text{Na}_2\text{O}$  (in milligrams) in 10 ccm. solution.

NaCl	$\text{Na}_2\text{O}$	$\text{Na}_2\text{O}$ + NaCl	Sp. gr.
54.7	0	54.7	1.207
49.375	4.8	54.175	1.221
47.212	6.725	53.937	1.225
42.375	10.406	52.781	1.236
39.55	14.78	54.33	1.249
24.95	30.5	55.45	1.295
19.3	37.875	57.175	1.314
9.408	53.25	62.66	1.362

(Engel, C. R. **112**, 1130.)

## Solubility in NaOH + Aq at 20°.

G. NaOH in 1 liter	G. NaCl in 1 liter	Sp. gr.	deg. Baumé
10	306	1.200	23.5
20	308	1.210	24.0
30	306	1.215	25.5
40	302	1.225	26.4
50	297	1.230	26.9
60	286	1.235	27.4
70	277	1.240	27.9
80	269	1.245	28.4
90	261	1.250	28.8
100	253	1.250	28.8
110	244	1.252	29.0
120	236	1.252	29.0
130	229	1.260	29.7
140	221	1.265	30.2
150	213	1.270	30.6
160	205	1.275	31.1
170	197	1.275	31.1
180	189	1.280	31.5
190	181	1.285	32.0
200	173	1.290	32.4
210	165	1.295	32.8
220	159	1.295	32.8
230	152	1.300	33.3
240	146	1.303	33.5
250	139	1.305	33.7
260	134	1.310	34.2
270	129	1.315	34.6
280	124	1.320	35.0
290	118	1.325	35.4
300	112	1.330	35.8
310	107	1.333	36.0
320	101	1.335	36.2
330	96	1.340	36.6
340	90	1.345	37.0
350	85	1.350	37.4
360	80	1.355	37.8
370	76	1.360	38.2
380	71	1.365	38.6
390	66	1.370	39.0
400	61	1.375	39.4
410	56	1.380	40.0
420	52	1.385	40.2
430	48	1.390	40.6

Solubility in NaOH + Aq at 20°.—*Continued.*

G. NaOH in 1 liter	G. NaCl in 1 liter	Sp. gr.	deg. Baumé
440	45	1.395	41.0
450	42	1.400	41.5
460	39	1.405	41.9
470	37	1.410	42.0
480	34	1.415	42.3
490	32	1.420	42.6
500	30	1.425	43.0
510	28	1.430	43.5
520	27	1.435	43.7
530	27	1.440	44.0
540	26	1.445	44.3
550	26	1.450	44.6
560	25	1.450	44.6
570	24	1.455	45.0
580	23	1.460	45.5
590	23	1.465	45.9
600	22	1.470	46.2
610	21	1.475	46.5
620	20	1.480	46.8
630	19	1.485	47.0
640	18	1.490	47.5

(Winteler, Z. Elektrochem, 1900, 7. 360.)

Solubility in Na<sub>2</sub>O + Aq at 30°.

Composition of the solution		Solid phase
% by wt. Na <sub>2</sub> O	% by wt. NaCl	
0	26.47	NaCl
4.47	21.49	"
12.22	13.62	"
24.48	4.36	"
29.31	2.40	"
37.85	1.12	"
41.42	0.97	NaCl + NaOH, H <sub>2</sub> O
42	0	NaOH, H <sub>2</sub> O

(Schreinemakers, Z. phys. Ch. 1909, 68. 85.)

The presence of other salts increases the solubility of NaCl in H<sub>2</sub>O.

Sol. in sat. NH<sub>4</sub>Cl + Aq with pptn. of NH<sub>4</sub>Cl. When the reaction is complete, the solution has sp. gr. 1.1788, and contains 32.62% mixed salts; or 100 pts. H<sub>2</sub>O dissolve 48.42 pts. mixed salts, viz., 26.36 pts. NaCl and 22.06 pts. NH<sub>4</sub>Cl. (Karsten.) (See under NH<sub>4</sub>Cl.)

Sol. in sat. BaCl<sub>2</sub> + Aq with pptn. of BaCl<sub>2</sub> until a state of equilibrium is reached, when 100 pts. H<sub>2</sub>O at 17° dissolve 38.6 pts. of mixed salts, of which 4.1 pts. are BaCl<sub>2</sub>. (Karsten.) (See under BaCl<sub>2</sub>.)

Insol. in sat. CaCl<sub>2</sub> + Aq. (Vauquelin, Ann. de Chim. 13. 95.)

Much more sol. in hot than in cold H<sub>2</sub>O containing MgCl<sub>2</sub> or CaCl<sub>2</sub>; but NaCl is pptd. from sat. NaCl + Aq when that solution is mixed with MgCl<sub>2</sub> or CaCl<sub>2</sub> + Aq. (Fuchs and G. Reichenbach, 1826.) (See under MgCl<sub>2</sub>.)

Less sol. in conc. CaCl<sub>2</sub> + Aq than in H<sub>2</sub>O. (Hermann.)

Solubility of NaCl + CaCl<sub>2</sub> in H<sub>2</sub>O at 25°.G. per 100 g. H<sub>2</sub>O.

NaCl	CaCl <sub>2</sub>	Sp. gr. 25°/25°	Solid phase
0	84	....	CaCl <sub>2</sub> , 6H <sub>2</sub> O
1.846	78.49	1.4441	" + NaCl
1.637	58.48	1.3651	NaCl
1.799	53.47	1.3463	"
7.77	36.80	1.2831	"
10.70	30.08	1.2653	"
18.85	19.53	1.2367	"
32.48	3.92	1.2080	"
35.80	0	1.2030	"

(Cameron, Bell and Robinson, J. phys. Chem. 1907, 11. 396.)

Solubility of NaCl in NaHCO<sub>3</sub> sat. with CO<sub>2</sub> at t°.

t°	G. per 1000 g. H <sub>2</sub> O	
	NaHCO <sub>3</sub>	NaCl
0	6.0	356.3
"	7.7	350.1
15	0.0	357.6
"	10.0	354.6
30	0.0	360.3
"	13.9	358.1
45	0.0	356.0
"	0.23	361.5

(Fedotieff, Z. phys. Ch. 1904, 49. 170.)

Sol. in sat. KClO<sub>3</sub> + Aq; the solution can then dissolve more KClO<sub>3</sub>. (Margueritte, C. R. 38. 305.)

In solution containing Na, K, Cl and NO<sub>3</sub> ions, the solubility—relations between the four salts NaCl, KCl, NaNO<sub>3</sub> and KNO<sub>3</sub> have been studied. (Uyeda, Z. anorg. 1911, 71. 2.)

Sol. in sat. NH<sub>4</sub>NO<sub>3</sub> + Aq, without causing pptn. (Karsten.)

Sol. in sat. NH<sub>4</sub>NO<sub>3</sub> + Aq, from which solution it is not pptd. by salts which would cause its pptn. in aqueous solution. (Margueritte, C. R. 38. 307.)

Sol. in sat. Ba(NO<sub>3</sub>)<sub>2</sub> + Aq without causing pptn.

Insol. in Ca(NO<sub>3</sub>)<sub>2</sub> + Aq.

Sol. in Mg(NO<sub>3</sub>)<sub>2</sub> + Aq with pptn. of small portion of Mg(NO<sub>3</sub>)<sub>2</sub>.

Sol. in sat. KNO<sub>3</sub> + Aq, the mixed solution having the power to dissolve more KNO<sub>3</sub>, and the solubility of the KNO<sub>3</sub> apparently increasing in the same ratio as the amount of NaCl present. (Fourcroy and Vauquelin, Ann. de Chim. 11. 130.)

Sol. in sat. KNO<sub>3</sub> + Aq; the solution thus

obtained at 18.13° contains 40.34% of the mixed salts, or 100 pts. H<sub>2</sub>O dissolve 67.72 pts. of the mixed salts, viz., 38.25 pts. NaCl and 29.45 pts. KNO<sub>3</sub>. (Karsten.)

Solubility of NaCl in KNO<sub>3</sub>+Aq at 25°. KNO<sub>3</sub>=g. KNO<sub>3</sub> in 100 cc. of solution. NaCl=g. mol. per l.

KNO <sub>3</sub>	NaCl	KNO <sub>3</sub>	NaCl
0	5.44	12	5.28
4	5.52	16	5.21
8	5.45	20	5.15

(Ritzel, Z. Krist. 1911, 49. 152.)  
(See also under KNO<sub>3</sub>.)

Solubility of NaCl in NaNO<sub>3</sub>+Aq at 15.5°.

Sp. gr.	g. per 100 cc. sat. solution		
	NaNO <sub>3</sub>	NaCl	H <sub>2</sub> O
1.2025	0	31.78	88.47
1.2305	7.53	27.89	87.63
1.2580	13.24	26.31	86.25
1.2810	21.58	23.98	82.66
1.3090	28.18	22.30	80.42
1.3345	33.80	20.40	79.25
1.3465	37.88*	19.40*	77.37
1.3465	37.64*	19.67*	77.34

\*Solutions sat. with both salts.  
(Bodländer, Z. phys. Ch. 1891, 1. 361.)

Sol. in sat. NaNO<sub>3</sub>+Aq with pptn. of NaNO<sub>3</sub>.

Solubility of NaCl in NaNO<sub>3</sub>+Aq.

Conc.=concentration of NaNO<sub>3</sub> in g. mol. per 1,000 g. H<sub>2</sub>O.

NaCl=g. NaCl dissolved in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0	0	359.65	6.16
	0.25	355.90	6.09
	0.50	351.20	6.02
	1	342.15	5.86
25	0	362.95	6.20
	0.25	356.65	6.11
	0.50	352.30	6.03
	1	343.65	5.88
	2	325.50	5.58

(Armstrong and Eyre, Proc. R. Soc. 1910, A. 84. 127.)

(See also under NaNO<sub>3</sub>.)

Sol. in sat. KCl+Aq with elevation of temp. (Vauquelin.)

100 g. H<sub>2</sub>O sat. with KCl dissolve 0.494 gram-equivalent NaCl at 25°. (Fuler, Z. phys. Ch. 1904, 49. 315.)

Solubility in KCl+Aq at t°.

t°	Sat. solution contains	
	% NaCl	% KCl
-20	21.3	5.7
-10	21.3	6.7
0	21.3	7.7
+10	21.3	8.6
20	21.3	9.6
30	21.3	10.6
40	21.3	11.5
50	21.3	12.5
60	21.3	13.5
70	21.3	14.4
80	20.7	15.8
90	19.9	17.8
100	18.8	19.8
110	17.2	22.4
120	16.5	24.1
130	16.4	25.1
140	16.4	26.1
150	16.4	27.1
160	16.4	28.0
170	16.4	29.0
180	16.4	30.0

(Étard, A. ch. 1894, (7) 3. 277.)

(See under KCl.)

100 pts. NaCl+NaI+Aq sat. at 18-19° contain 62.33 pts. of the two salts. (v. Hauer.)

Sol. in sat. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+Aq with no pptn. (Vauquelin.)

Sol. in sat. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq with pptn. of considerable amt. of (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq. (Vauquelin.)

Sol. in sat. CuSO<sub>4</sub>+Aq.

100 pts. H<sub>2</sub>O dissolve 36.71 pts. NaCl and 7.19 pts. K<sub>2</sub>SO<sub>4</sub> at 15°, and solution has sp. gr. 1.24. (Page and Keightley.)

NaCl is sol. in K<sub>2</sub>SO<sub>4</sub>+Aq, and *vice versa*, without separation of a salt.

100 pts. H<sub>2</sub>O dissolve 7.03 pts. K<sub>2</sub>SO<sub>4</sub> and 37.60 pts. NaCl, when warmed and cooled to 14°. (Rüdorff.)

Solubility of NaCl and K<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O at t°.

100 pts. H<sub>2</sub>O contain pts. NaCl, K<sub>2</sub>SO<sub>4</sub>, and KCl.

t°	Pts. NaCl	Pts. K <sub>2</sub> SO <sub>4</sub>	Pts. KCl
10	33.43	8.10	3.18
20	34.01	8.90	3.06
30	34.56	9.56	2.95
40	35.16	10.38	2.81
50	35.77	11.07	2.84
60	36.40	11.93	2.72
70	36.64	12.82	3.20
80	36.04	12.26	5.06
90	35.86	12.42	6.98
100	35.63	12.56	8.79

(Precht and Wittgen, B. 15. 1666.)

Sol. in cold sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at first without pptn., afterwards  $\text{Na}_2\text{SO}_4$  separates out. (Karsten.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 7.45 g.  $\text{Na}_2\text{SO}_4$  in 100 g. of the solution.

t°	g. NaCl in 100 g. of the solution
14.80	23.30
17.90	23.33
24.85	23.45
25.60	23.485
27.75	23.525
32.18	23.55
34.28	23.68

(Marie and Marquis, C. R. 1903, 136. 684.)

See also under  $\text{Na}_2\text{SO}_4$ .

Sol. in sat.  $\text{ZnSO}_4 + \text{Aq}$  with separation of  $\text{Na}_2\text{SO}_4$ ,  $\text{ZnSO}_4$ . (Karsten.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

12.2 pts.  $\text{NaCl}$  are sol. in 1 pt. hydrazine at 12.5–13°. (de Bruyn, R. t. c. 1899, 18. 297.)

100 g. hydroxylamine dissolve 14.7 g.  $\text{NaCl}$  at 17.5°. (de Bruyn, Z. phys. Ch. 1892, 10. 782.)

100 g. 95% formic acid dissolve 5.8 g. at 19.7°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Solubility in alcohol.

100 pts. alcohol of 0.900 sp. gr. dissolve 5.8 pts.  $\text{NaCl}$ ; of 0.872 sp. gr. dissolve 3.67 pts.  $\text{NaCl}$ ; of 0.834 sp. gr. dissolve 0.6 pt.  $\text{NaCl}$ . (Kirwan.)

100 pts. alcohol containing given % by weight of absolute alcohol dissolve pts.  $\text{NaCl}$  at 25°.

% alcohol	Pts. NaCl	% alcohol	Pts. NaCl	% alcohol	Pts. NaCl
0.0	35.70	33.4	16.08	66.9	5.95
8.4	30.49	41.8	13.28	75.2	3.75
16.7	24.84	50.2	11.28	83.6	1.59
25.1	19.30	58.5	7.96	..	..

(Kopp, A. 40. 206.)

100 pts. alcohol of 75% by weight dissolve at:

14°	15.2°	38°	71.5°
0.661	0.700	0.736	1.033 pts. $\text{NaCl}$ .

100 pts. alcohol of 95.5% by weight dissolve at:

15°	77.2°
0.174	0.171 pts. $\text{NaCl}$ .

(Wagner, A. 64. 293.)

100 pts. alcohol containing % alcohol by weight dissolve pts.  $\text{NaCl}$  at 15°, or 100 pts. solution contain %  $\text{NaCl}$ .

10	20	30	40	% alcohol,
28.53	22.55	17.51	13.25	pts. $\text{NaCl}$ ,
22.2	18.4	14.9	11.7	% $\text{NaCl}$ ,

50	60	80	% alcohol,
9.77	5.93	1.22	pts. $\text{NaCl}$ ,
8.9	5.6	1.2	% $\text{NaCl}$ .

(Schiff, A. 118. 365.)

Solubility of  $\text{NaCl}$  in alcohol increases with the temperature.

100 pts. (by weight) of alcohol of 0.9282 sp. gr. (50.5% by weight) dissolve at:

4°	10°	13°	23°	32°
10.9	11.1	11.43	11.9	12.3

pts.  $\text{NaCl}$ ,

33°	44°	51°	60°
-----	-----	-----	-----

12.5	13.1	13.8	14.1
------	------	------	------

pts.  $\text{NaCl}$ .

(Gerardin, A. ch. (4) 5. 146.)

Solubility in alcohol at 13°.

Sp. gr.	100 ccm. contain in g.		
	Alcohol	Water	Salt
1.2030	0	88.70	31.60
1.1348	11.81	78.41	23.26
1.1144	15.99	74.64	20.81
1.0970	19.39	71.45	18.86
1.0698	24.95	65.80	16.23
1.0295	32.33	57.96	12.66
0.9880	40.33	49.34	9.13
0.9445	49.28	38.54	5.93
0.9075	57.91	29.37	3.47
0.8700	63.86	21.62	1.52
0.8400	72.26	11.24	0.50

(Bodländer, Z. phys. Ch. 7. 317.)

Solubility in ethyl alcohol +  $\text{Aq}$  at 30°.

wt. % alcohol	g. $\text{NaCl}$ per 100 g.		wt. % alcohol	g. $\text{NaCl}$ per 100 g.	
	solution	$\text{H}_2\text{O}$		solution	$\text{H}_2\text{O}$
0	26.50	36.05	50	9.34	20.60
5	24.59	34.29	60	6.36	16.96
10	22.56	32.57	70	3.36	12.75
20	19.05	29.40	80	1.56	7.95
30	15.67	26.53	90	0.43	4.30
40	12.45	23.70	..	...	...

(Taylor, J. phys. Ch. 1897, 1. 723.)

Solubility in ethyl alcohol +  $\text{Aq}$  at 40°.

wt. % alcohol	g. $\text{NaCl}$ per 100 g.		wt. % alcohol	g. $\text{NaCl} + 100$ g.	
	solution	$\text{H}_2\text{O}$		solution	$\text{H}_2\text{O}$
0	26.68	36.38	50	9.67	21.42
5	24.79	34.69	60	6.65	17.82
10	22.90	33.00	70	3.87	13.10
20	19.46	30.20	80	1.69	8.68
30	16.02	27.25	90	0.50	5.10
40	12.75	24.37	..	..	..

(Taylor, J. c.)

## Solubility of NaCl in ethyl alcohol + Aq at 28°.

$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\% \text{H}_2\text{O}$	$\frac{\%}{\text{NaCl}}$	$\frac{\%}{\text{C}_2\text{H}_5\text{OH}}$	$\% \text{H}_2\text{O}$	$\frac{\%}{\text{NaCl}}$
0	73.53	26.47	45.35	45.35	9.3
3.8	71.6	24.6	56.2	37.5	6.3
7.7	69.7	22.6	67.4	28.9	3.7
16.1	64.6	19.3	78.8	19.7	1.5
25.3	58.9	15.8	89.6	10	0.4
35.0	52.5	12.5			

(Fontein, Z. phys. Ch. 1904, 73. 212.)

## Solubility of NaCl in ethyl alcohol + Aq at 25°.

Conc. = concentration of alcohol in g. mol. per 1,000 g. H<sub>2</sub>O.NaCl = g. in 1,000 g. H<sub>2</sub>O.

Conc.	NaCl	Molecular solubility
0	359.65	6.16
0.25	355.15	6.08
0.50	349.65	5.98
1	337.80	5.79
3	301.60	5.16

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

100 pts. absolute methyl alcohol dissolve 1.41 pts. at 18.5°; 100 pts. absolute ethyl alcohol dissolve 0.065 pt. at 18.5°. (de Bruyn, Z. phys. Ch. 10. 782.)

100 pts. wood-spirit of 40% (by weight) dissolve 13.0 pts. NaCl. (Schiff, A. 118. 365.)

100 g. NaCl + CH<sub>3</sub>OH contain 0.1 g. NaCl at the critical temp. (Centnerszwer, Z. phys. Ch. 1910, 72. 437.)

## Solubility of NaCl in methyl alcohol + Aq. at 25°.

Conc. = concentration of alcohol in g. mol. per 1,000 g. H<sub>2</sub>O.NaCl = g. in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0°	0	357.75	6.13
	0.25	355.20	6.08
	0.50	353.10	6.05
	1	347.45	5.95
25°	0	362.95	6.20
	0.25	359.40	6.14
	0.50	357.60	6.11
	1	353.20	6.04
	3	336.25	5.75

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

Traces dissolve in propyl alcohol. (Schlamp Z. phys. Ch. 1894, 14. 276.)

## Solubility of NaCl in propyl alcohol + Aq. at 25°.

Conc. = concentration of alcohol in g. mol. per 1,000 g. H<sub>2</sub>O.NaCl = g. NaCl in 1,000 g. H<sub>2</sub>O.

t°	Conc.	NaCl	Molecular solubility
0	0	357.75	6.13
	0.25	351.20	6.01
	0.50	345.55	5.91
25	0	362.95	6.20
	0.25	355.75	6.10
	0.50	350.20	6.00

(Armstrong and Eyre, Proc. R. Soc. 1910, A. 84. 127.)

## Solubility of NaCl in propyl alcohol + Aq at 23-25°.

$\frac{\%}{\text{NaCl}}$	$\frac{\%}{\text{C}_3\text{H}_7\text{OH}}$	$\frac{\%}{\text{H}_2\text{O}}$	$\frac{\%}{\text{NaCl}}$	$\frac{\%}{\text{C}_3\text{H}_7\text{OH}}$	$\frac{\%}{\text{H}_2\text{O}}$
0.55	87.7	11.75	14.38	5.39	80.23
2.23	51.57	46.20	15.42	5.11	79.47
3.55	18.99	77.46	16.38	4.47	79.14
3.90	14.78	81.32	18.08	3.83	78.09
5.27	12.77	81.96	20.12	3.27	76.61
8.04	9.49	82.47	22.35	2.64	75.01
10.49	7.79	81.72	24.50	2.13	75.37
12.20	6.57	81.23	24.90	2.3	72.80

(Frankforter and Frary, J. phys. Ch. 1913, 17. 402.)

100 g. sat. solution of NaCl in 99.6% propyl alcohol contain 0.04 g. NaCl at 25°. (Frankforter and Frary.)

Insol. in fusel oil. (Gooch, Am. Ch. J. 9. 53.)

## Solubility of NaCl in amyl alcohol + Aq. Liquid phases conjugated at 28°.

Upper layer			Lower layer		
NaCl	amyl alcohol	H <sub>2</sub> O	NaCl	amyl alcohol	H <sub>2</sub> O
0.05	95.45	4.5	26.36	0.22	73.42
"	94.1	5.9	19	0.4	80.4
"	92.9	7.1	12.7	0.8	86.5
"	91.6	8.4	6.2	1.5	92.3
0	90.2	9.8	0	2.3	97.7

(Fontein, Z. phys. Ch. 1910, 73. 226.)

At room temp. 1 pt. by weight is sol. in:

75 pts. methyl alcohol D<sub>15</sub> 0.7990.

566 " ethyl " D<sub>15</sub> 0.8100.

3000 " propyl " D<sub>15</sub> 0.8160.

(Rohland, Z. anorg. 1898, 18. 325.)

100 g. methyl alcohol dissolve 1.31 g. NaCl at 25°.

100 g. ethyl alcohol dissolve 0.065 g. NaCl at 25°.

100 g. propyl alcohol dissolve 0.012 g. NaCl at 25°.

100 g. isoamyl alcohol dissolve 0.002 g. NaCl at 25°.

(Turner and Bissett, Chem. Soc. 1913, 108. 1909.)

Solubility of NaCl in ethyl+amyl alcohol at 28°.

Upper layer			Lower layer		
% NaCl	% amyl alcohol	% ethyl alcohol	% NaCl	% amyl alcohol	% ethyl alcohol
0.05	95.45	0	26.35	0.22	0
0.10	86.6	9.5	25.30	0.25	1.9
0.25	75.4	19.1	24.02	0.3	9.5
0.58	59.9	30.9	22.64	0.4	6.9
1.23	47.0	38.7	21.19	0.5	10.3
2.81	31.6	44.8	19.26	1.3	15.2
6.56	17.7	41.5	15.81	3.69	22.1

Critical solution: amyl alcohol, 10%; ethyl alcohol, 32.5%; NaCl, 11%; H<sub>2</sub>O, 46.5%.

(Fontein, Z. phys. Ch. 1910, 73. 244.)

Ether ppts. NaCl from NaCl+Aq. (Gmelin.)

Very sl. sol. in a mixture of equal pts. of absolute alcohol and ether. (Berzelius.)

500 mg. NaCl treated with above mixture yielded only 0.5 mg. to the liquid. (Lawrence Smith, Am. J. Sci. (2) 16. 57.)

100 pts. of a mixture of 1 pt. 96% alcohol and 1 pt. 98% ether dissolve 0.11 pt. NaCl. (Mayer, A. 98. 205.)

Insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184; Eidmann, C. C. 1899, II. 1014.)

Solubility in acetone+Aq at 20°.

A = cem. acetone in 100 cem. of the solvent.

NaCl = millimols NaCl in 100 cem. of the solution.

A	NaCl
0	537.9
10	464.6
20	394.8
30	330.1
32 to 87 } 2 phases	lower layer 308.5
88	upper layer 7.7
89	7.3
90	5.6
100	4.3
	...

(Hers and Knoch, Z. anorg. 1904, 41. 318.)

Solubility in acetone+Aq at 20°.

% NaCl	% H <sub>2</sub> O	% acetone
25.9	73.06	1.04
24.19	71.18	4.03
25.06	72.00	2.94
20.85	66.78	12.37
20.17	66.01	13.82
18.32	63.16	18.52
20.44	66.19	13.37
17.89	62.21	19.90
0.32	13.92	85.76
0.19	10.82	88.99
0.15	9.62	90.23
0.12	8.94	90.94

(Frankforter and Cohen, J. Am. Chem. Soc. 1914, 36. 1127.)

Solubility in glycol at 14.8° = 31.7%. (de Coninck, Belg. Acad. Bull. 1906. 275.)

Sol. in glycerine. (Pelouse.)

Solubility of NaCl in glycerine+Aq at 25°. G = g. glycerine in 100 g. glycerine+Aq. NaCl = millimols NaCl in 100 cc. of the solution.

G	NaCl	Sp. gr.
0	545.6	1.1960
13.28	501.1	1.2048
25.98	448.4	1.2133
45.36	370.2	1.2283
54.23	333.9	1.2381
83.84	220.8	1.2696
100	167.1	1.2964

(Hers and Knoch, Z. anorg. 1905, 45. 267.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

Solubility of NaCl in solutions of HgCl<sub>2</sub> in ethyl acetate.

100 mols. ethyl acetate dissolve			
Mols. HgCl <sub>2</sub>	Mols. NaCl	Mols. HgCl <sub>2</sub>	Mols. NaCl
40.0	20.0	18.0	5.1
38.1	19.6	16.4	4.3
36.0	19.2	14.1	3.8
34.9	18.5	13.2	2.9
34.8	18.3	12.4	2.3
32.1	13.8	12.0	1.6
28.0	9.1	12.2	1.3
22.8	7.0	12.9	0.8
22.9	7.0	...	...

(Linebarger, Am. Ch. J. 1894, 16. 215.)



## Solubility of NaCl in urea + Aq at 25°.

% urea	% NaCl	% urea	% NaCl
0	31.80	18	27.65
5	30.63	23	27.24
9.6	29.05	28	26.56
13	28.46	..	....

(Ritzel, Z. Kryst. Min. 1911, 49. 152.)

## Solubility of NaCl in urea + Aq at (?)°.

g = g. urea in 100 cc. of solution.

sol. = increase of solubility of NaCl in g. per 100 cc. of the solution.

g.	sol.	g.	sol.
5	0.044	30	0.709
10	0.124	35	0.910
15	0.234	40	1.134
20	0.372	45	1.370
25	0.529	50	1.602

(Fastert, N. Jahrb. Min. Beil. Bd. 1912, 23. 286.)

## Solubility of NaCl in formamide + Aq at 25°.

% HCONH <sub>2</sub>	% NaCl	% HCONH <sub>2</sub>	% NaCl
0	31.80	11	29.11
2.3	30.98	15	28.52
5.3	30.86	18.8	27.76
8	30.40	...	....

(Ritzel, Z. Kryst. Min. 1911, 49. 152.)

Insol. in anhydrous and in 97% pyridine. Very sl. sol. in 95% pyridine + Aq. Sl. sol. in 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

Insol. in oil of turpentine. (T. S. Hunt, Am. J. Sci. (2) 19. 417.)

100 g. H<sub>2</sub>O dissolve 236.3 g. sugar + 42.3 g. NaCl at 31.25°, or 100 g. sat. aq. solution contain 62.17 g. sugar + 11.13 g. NaCl. (Köhler, Z. Ver. Zuckerind, 1897, 47. 447.)

## Solubility of NaCl in glucose + Aq at 25°.

Conc. = concentration of glucose + Aq in g. mol. per 1,000 g. H<sub>2</sub>O.

Sol. = Solubility in 1,000 g. H<sub>2</sub>O.

Conc.	Sol.	Molecular solubility
0	361.40	6.18
0.25	364.15	6.22
0.50	364.30	6.23
1.0	369.90	6.32

(Armstrong and Eyre, Proc. R. Soc. 1910, (A) 84. 127.)

## Min. Halite.

+ 2H<sub>2</sub>O. Efflorescent below 0°; sl. deliquescent at temps. above 0°. (Fuchs, 1826.)

The solubility in H<sub>2</sub>O at -12.25° corresponds to 32.9 pts. of NaCl per 100 pts. H<sub>2</sub>O. (Matignon, C. R. 1909, 143. 551.)

Sodium stannic chloride, 2NaCl, SnCl<sub>4</sub> + 6H<sub>2</sub>O.

See Chlorostannate, sodium.

Sodium thallic chloride, 3NaCl, TlCl<sub>3</sub> + 12H<sub>2</sub>O.

Very sol. in H<sub>2</sub>O. (Pratt, Am. J. Sci. 1895, (3) 49. 404.)

Sodium uranium chloride, 2NaCl, UCl<sub>4</sub>.

Non volatile and not hygroscopic. (Moissan, C. R. 1896, 123. 1089.)

Sl. in H<sub>2</sub>O. (Colani, A. ch. 1907, (8) 12. 59.)

Sodium uranyl chloride, Na<sub>2</sub>(UO<sub>2</sub>)Cl<sub>4</sub>.

As K salt. (Aloy, Bull. Soc. 1899, (3) 21. 264.)

Sodium zinc chloride, 2NaCl, ZnCl<sub>2</sub> + 3H<sub>2</sub>O.

Deliquescent. Easily sol. in H<sub>2</sub>O. (Schindler, Mag. Pharm. 36. 48.)

Sodium zirconium chloride, 2NaCl, ZrCl<sub>4</sub>.

(Paykull.)

Sodium chloriodide, NaCl<sub>2</sub>I + 2H<sub>2</sub>O.

Easily decomp. by alcohol or ether. (Wells and Wheeler, Sill. Am. J. 143. 42.)

Sodium fluoride, NaF.

Very sl. sol. in cold, and not more abundantly in boiling H<sub>2</sub>O. (Rose.)

100 pts. H<sub>2</sub>O dissolve 4.78 pts. at 16°. (Berzelius.)

100 pts. H<sub>2</sub>O dissolve 4 pts. at 15°. (Fremy, A. ch. (3) 47. 32.)

Sp. gr. of aqueous solutions containing in 100 pts. H<sub>2</sub>O:

1.1081	2.2162	3.3243 pts. NaF.
1.0110	1.0221	1.0333

Sat. solution has sp. gr. 1.0486. (Gerlach, Z. anal. 27. 277.)

Sp. gr. of solution sat. at 18° = 1.044, containing 4.3% NaF. (Mylius and Funk, B. 1897, 30. 1718.)

## Solubility of NaF in HF + Aq at 21°.

g. per 1000 g. H <sub>2</sub> O		g. per 1000 g. H <sub>2</sub> O	
HF	NaF	HF	NaF
0.0	41.7	83.8	22.9
10.0	41.4	129.7	23.8
45.8	22.5	596.4	48.8
56.5	22.7	777.4	81.7

(Ditte, C. R. 1896, 123. 1282.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905, 46. 2.)

Sl. sol. in conc. KC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Stromeyer.)

Almost insol. in alcohol. (Berzelius, Pogg. 1. 13.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Sodium hydrogen fluoride, NaHF<sub>2</sub>.**

Rather difficultly sol. in cold, more easily in hot H<sub>2</sub>O. (Berzelius, Pogg. 1. 13.)

**Sodium tantalum fluoride.**

See Fluotantalate, sodium.

**Sodium tin (stannous) fluoride, 2NaF, 3SnF<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Wagner, B. 19. 896.)

**Sodium tin (stannic) fluoride.**

See Fluostannate, sodium.

**Sodium tantalum fluoride.**

See Fluotantalate, sodium.

**Sodium tellurium fluoride, NaF, TeF<sub>4</sub>.**

Decomp. by H<sub>2</sub>O. (Berzelius.)

**Sodium titanium fluoride.**

See Fluotitanate, sodium.

**Sodium tungstyl fluoride.**

See Fluoxytungstate, sodium.

**Sodium uranium fluoride, NaF, UF<sub>4</sub> (?).**

Somewhat soluble in H<sub>2</sub>O. (Bolton.)

**Sodium uranyl fluoride.**

See Fluoxyuranate, sodium.

**Sodium vanadium sesquifluoride.**

See Fluovanadate, sodium.

**Sodium zinc fluoride, NaF, ZnF<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (R. Wagner.)

**Sodium zirconium fluoride, 5NaF, 2ZrF<sub>4</sub>.**

See Fluozirconate, sodium.

**Sodium fluoride vanadium pentoxide.**

See Fluoxyvanadate, sodium.

**Sodium hydrazide, NH<sub>2</sub>, NHNa.**

Decomp. by H<sub>2</sub>O with explosive violence.

Decomp. by alcohol. (Schlenk, B. 1915, 48. 670.)

**Sodium hydride, NaH.**

Decomp. by H<sub>2</sub>O and by acids.

Sol. in fused Na or Na amalgam. Insol. in liquid NH<sub>3</sub>. Insol. in CS<sub>2</sub>, CCl<sub>4</sub>, C<sub>6</sub>H<sub>6</sub> and terebenthene. (Moissan, C. R. 1902, 134. 73.)

Na<sub>2</sub>H<sub>4</sub>. Decomp. violently by H<sub>2</sub>O.

**Sodium hydrosulphide, NaSH.**

Deliquescent. Sol. in H<sub>2</sub>O and alcohol. +3H<sub>2</sub>O. Difficultly sol. in H<sub>2</sub>O. (Damoiseau, C. C. 1885. 36.)

**Sodium hydroxide, NaOH.**

Very deliquescent. 100 pts. NaOH under a bell jar with H<sub>2</sub>O at 16–20° absorb 552 pts. in 56 days. (Mulder.)

Very sol. in H<sub>2</sub>O with evolution of much heat. Sol. in 0.47 pt. H<sub>2</sub>O. (Bineau, C. R. 41. 509.)

**Solubility of NaOH in H<sub>2</sub>O.**

t°	g. per 100 g.		Solid phase
	Solution	H <sub>2</sub> O	
— 7.8	8.0	8.7	Ice
— 20	16.0	19.1	"
— 28	19.0	23.5	Ice + NaOH.7H <sub>2</sub> O
— 24	22.2	28.5	NaOH.7H <sub>2</sub> O + NaOH.5H <sub>2</sub> O
— 17.7	24.5	32.5	NaOH.5H <sub>2</sub> O + NaOH.4H <sub>2</sub> O
0	29.6	42.0	NaOH.4H <sub>2</sub> O
+ 5	32.2	47.5	NaOH.4H <sub>2</sub> O + NaOH.3½H <sub>2</sub> O
10	34.0	51.5	NaOH.3½H <sub>2</sub> O
15.5	38.9	63.53	" f. pt.
5	45.5	83.5	NaOH.3½H <sub>2</sub> O + NaOH.2H <sub>2</sub> O
12	50.7	103.0	NaOH.2H <sub>2</sub> O + NaOH.H <sub>2</sub> O
20	52.2	109	NaOH.H <sub>2</sub> O
30	54.3	119	"
40	56.3	129	"
50	59.2	145	"
60	63.5	174	"
64.3	69.0	222.3	" f. pt.
61.8	74.2	288	NaOH.H <sub>2</sub> O + NaOH
80	75.8	313	NaOH (?)
110	78.5	365	"
192	83.9	521	"

(Pickering, Chem. Soc. 1903, 63. 890; Mylius and Funk, W. A. B. 1900, 3. 450. Calc. by Seidell, Solubilities, 2d Edition, p. 653.)

100 g. sat. NaOH + Aq at 15° contain 46.86 g. NaOH. (de Forcrand, C. R. 149. 1344.)

**Sp. gr. and b-pt of NaOH + Aq.**

% Na <sub>2</sub> O	Sp. gr.	B-pt.	% Na <sub>2</sub> O	Sp. gr.	B-pt.
4.7	1.06	100.56°	31.0	1.44	120.00°
9.0	1.12	101.11	34.0	1.47	123.89
13.0	1.18	102.78	36.8	1.50	129.44
16.0	1.23	104.44	41.2	1.56	137.78
19.0	1.29	106.66	46.6	1.63	148.89
23.0	1.32	108.89	53.8	1.72	204.44
26.0	1.36	112.78	63.6	1.85	315.56
29.0	1.40	116.66	77.8	2.00	red heat.

(Dalton.)

**Sp. gr. of NaOH + Aq at 15°.**

% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.
0.302	1.0040	10.879	1.1630	21.154	1.3053
0.601	1.0061	11.484	1.1734	21.758	1.3125
1.209	1.0163	12.088	1.1841	21.894	1.3143
1.813	1.0246	12.692	1.1948	22.363	1.3198
2.418	1.0330	13.297	1.2058	22.967	1.3273
3.022	1.0414	13.901	1.2178	23.572	1.3349
3.626	1.0500	14.506	1.2280	24.176	1.3426
4.231	1.0587	15.110	1.2392	24.780	1.3505
4.835	1.0675	15.714	1.2453	25.385	1.3586
5.440	1.0764	16.319	1.2515	25.989	1.3668
6.044	1.0855	16.923	1.2578	26.594	1.3751
6.648	1.0948	17.528	1.2642	27.200	1.3836
7.253	1.1042	18.132	1.2708	27.802	1.3923
7.857	1.1137	18.730	1.2775	28.407	1.4011
8.462	1.1233	19.341	1.2843	29.011	1.4101
9.066	1.1330	19.954	1.2912	29.616	1.4193
9.670	1.1428	20.550	1.2982	30.220	1.4285
10.275	1.1528				

(Tünnerman, N. J. Pharm. 18. 2.)

Sp. gr. of NaOH+Aq.

% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.
2.07	1.02	14.73	1.16	28.16	1.30
4.02	1.04	16.73	1.18	29.96	1.32
5.89	1.06	18.71	1.20	31.67	1.34
7.69	1.08	20.66	1.22	32.40	1.35
9.43	1.10	22.58	1.24	33.08	1.36
11.10	1.12	24.47	1.26	34.41	1.38
12.81	1.14	26.33	1.28	...	...

(Richter.)

Sp. gr. of NaOH+Aq at 15°.

%	Sp. gr. if % is Na <sub>2</sub> O	Sp. gr. if % is NaOH	%	Sp. gr. if % is Na <sub>2</sub> O	Sp. gr. if % is NaOH
1	1.015	1.012	32	1.450	1.351
2	1.020	1.023	33	1.462	1.363
3	1.043	1.035	34	1.475	1.374
4	1.058	1.046	35	1.488	1.384
5	1.074	1.059	36	1.500	1.395
6	1.089	1.070	37	1.515	1.405
7	1.104	1.081	38	1.530	1.415
8	1.119	1.092	39	1.543	1.426
9	1.132	1.103	40	1.558	1.437
10	1.145	1.115	41	1.570	1.447
11	1.160	1.126	42	1.583	1.456
12	1.175	1.137	43	1.597	1.468
13	1.190	1.148	44	1.610	1.478
14	1.203	1.159	45	1.623	1.488
15	1.219	1.170	46	1.637	1.499
16	1.233	1.181	47	1.650	1.508
17	1.245	1.192	48	1.663	1.519
18	1.258	1.202	49	1.678	1.529
19	1.270	1.213	50	1.690	1.540
20	1.285	1.225	51	1.705	1.550
21	1.300	1.236	52	1.719	1.560
22	1.315	1.247	53	1.730	1.570
23	1.329	1.258	54	1.745	1.580
24	1.341	1.269	55	1.760	1.591
25	1.355	1.279	56	1.770	1.601
26	1.369	1.290	57	1.785	1.611
27	1.381	1.300	58	1.800	1.622
28	1.395	1.310	59	1.815	1.633
29	1.410	1.321	60	1.830	1.643
30	1.422	1.332	70	...	1.748
31	1.438	1.343	...	...	...

(Gerlach, Z. anal. 8. 279, calculated from Schiff, A. 107. 300.)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
0.61	1.0070	4.0	1.0435
0.9	1.0105	4.32	1.0473
1.0	1.0107	4.64	1.0511
1.2	1.0141	4.96	1.0549
1.6	1.0177	5.29	1.0588
2.0	1.0213	5.58	1.0627
2.36	1.0249	5.87	1.0667
2.71	1.0286	6.21	1.0706
3.0	1.0318	6.55	1.0746
3.35	1.0360	6.76	1.0787
3.67	1.0397	7.31	1.0827

Sp. gr. of NaOH+Aq at 15°—Continued.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
7.66	1.0868	24.81	1.2748
8.0	1.0909	25.3	1.2800
8.34	1.0951	25.8	1.2857
8.68	1.0992	26.31	1.2905
9.0	1.1030	26.83	1.2973
9.42	1.1077	27.31	1.3032
9.74	1.1120	27.8	1.3091
10.0	1.1158	28.31	1.3151
10.5	1.1195	28.83	1.3211
10.97	1.1250	29.38	1.3272
11.42	1.1294	30.0	1.3339
11.84	1.1339	30.57	1.3395
12.24	1.1383	31.22	1.3458
12.64	1.1423	31.85	1.3521
13.0	1.1474	32.47	1.3585
13.55	1.1520	33.0	1.3642
13.86	1.1566	33.69	1.3714
14.5	1.1631	34.38	1.3780
14.75	1.1662	35.0	1.3858
15.0	1.1697	35.65	1.3913
15.5	1.1755	36.25	1.3981
15.91	1.1803	36.86	1.4049
16.38	1.1852	37.47	1.4118
16.77	1.1901	38.13	1.4187
17.22	1.1950	38.8	1.4267
17.67	1.2000	39.39	1.4328
17.12	1.2050	40.0	1.4410
18.58	1.2101	40.75	1.4472
19.0	1.2148	41.41	1.4545
19.58	1.2202	42.12	1.4619
20.0	1.2250	42.83	1.4694
20.59	1.2308	43.66	1.4769
21.0	1.2361	44.38	1.4845
21.42	1.2414	45.27	1.4922
22.0	1.2462	46.15	1.5000
22.64	1.2522	46.87	1.5079
23.15	1.2576	47.60	1.5158
23.67	1.2632	48.81	1.5238
24.24	1.2687	49.02	1.531

Hager, Comm. 1883.)

The sp. gr. increases or diminishes for each degree as follows:

% NaOH	Corr.
40-50	0.00045
30-39	0.0004
20-29	0.0003
10-19	0.0002

Hager, Comm. 1883.)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.
2.5	1.0280	20	1.2262
5	1.0568	25	1.2823
10	1.1131	30	1.3374
15	1.1790	...	...

(Kohlrausch, W. Ann. 1879.)

Sp. gr. of NaOH+Aq at 20° containing 2 mols. NaOH to 100 mols. H<sub>2</sub>O = 1.04712. (Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of NaOH+Aq at 15°.

% Na <sub>2</sub> O	Sp. gr.	% Na <sub>2</sub> O	Sp. gr.
5	1.069	25	1.353
10	1.139	30	1.426
15	1.210	35	1.500
20	1.281	..	...

(Hager, Adjumenta Varia, Leipsic, 1876.)

Sp. gr. of NaOH+Aq at 15°.

% NaOH	Sp. gr.	% NaOH	Sp. gr.	% NaOH	Sp. gr.
0	0.999180	17	1.188707	34	1.373453
1	1.010611	18	1.199783	35	1.383815
2	1.021920	19	1.210861	36	1.394092
3	1.033109	20	1.221933	37	1.404279
4	1.044317	21	1.233062	38	1.414363
5	1.055463	22	1.244119	39	1.424353
6	1.066602	23	1.255134	40	1.434299
7	1.077733	24	1.266092	41	1.444161
8	1.088856	25	1.277063	42	1.453929
9	1.099969	26	1.287990	43	1.463623
10	1.111069	27	1.298877	44	1.473249
11	1.122165	28	1.309708	45	1.482850
12	1.133250	29	1.320496	46	1.492406
13	1.144353	30	1.331213	47	1.501927
14	1.155450	31	1.341879	48	1.511412
15	1.166538	32	1.352472	49	1.520868
16	1.177619	33	1.362991	50	1.530282

(Pickering, Phil. Mag. 1894, (5) 37. 373.)

Sp. gr. of a N solution of NaOH+Aq at 18°/18° = 1.0418. (Loomis, W. Ann. 1896, 60. 550.)

Sp. gr. of NaOH+Aq.  
 % NaOH                      8.73                      3.67                      3.82  
 Sp. gr. 20°/20°            1.0968            1.0416            1.0464  
 (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 272.)

Sp. gr. of NaOH+Aq at t°. H<sub>2</sub>O at 4° = 1.  
 The solutions contained a small amount of Na<sub>2</sub>CO<sub>3</sub>.

t°	% NaOH	% Na <sub>2</sub> CO <sub>3</sub>	Sp. gr.
60	22.57	0.61	1.2312
	20.04	0.48	1.2026
	17.04	0.35	1.1692
	14.16	0.38	1.1374
	10.92	0.36	1.1020
80	22.81	0.55	1.2207
	14.01	0.42	1.1232

(Wegscheider and Walter, M. 1905, 26. 691.)

Sat. NaOH+Aq boils at 215.5°. (Griffiths.)

Sat. NaOH+Aq boils at 310°. (Gerlach, Z. anal. 26. 427.)

NaOH+Aq of 1.500 sp. gr. contains 36.8% NaOH and boils at 130°.

B.-pt. of NaOH+Aq containing pts. NaOH to 100 pts. H<sub>2</sub>O.

B.-pt.	Pts. NaOH	B.-pt.	Pts. NaOH
105°	17	210°	425.5
110	30	215	475.5
115	41	220	526.3
120	51	225	583.3
125	60.1	230	645.2
130	70.1	235	714.3
135	81.1	240	800
140	93.5	245	888.8
145	106.5	250	1000
150	120.4	255	1142.8
155	134.5	260	1333.3
160	150.8	265	1534
165	168.8	270	1739.1
170	187	275	2000
175	208.3	280	2353
180	230	285	2857
185	254.5	290	3571.4
190	281.7	300	4651.1
195	312.3	305	6451.6
200	345	310	10526.3
205	380.9	314	22222.2

(Gerlach, Z. anal. 26. 463.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Sp. gr. of Na<sub>2</sub>CO<sub>3</sub>+NaOH+Aq at 11.5°. H<sub>2</sub>O at 4° = 1.

% Na <sub>2</sub> CO <sub>3</sub>	% NaOH	Sp. gr.
3.845	14.10	1.196
3.171	13.63	1.182
2.204	12.51	1.164
1.642	10.17	1.136
0.2686	16.64	1.186

(Wegscheider and Walter, M. 1905, 26. 693.)

Sp. gr. of Na<sub>2</sub>CO<sub>3</sub>+NaOH+Aq at t°. H<sub>2</sub>O at 4° = 1.

t°	% Na <sub>2</sub> CO <sub>3</sub>	% NaOH	Sp. gr.
60°	15.38	10.63	1.2621
	13.79	9.52	1.2302
	12.10	8.29	1.1952
	9.965	6.86	1.1594
	9.47	6.70	1.1521
	7.69	5.22	1.1158
80°	15.26	11.14	1.2510
	9.48	6.93	1.1417

(Wegscheider and Walter, M. 1905, 26. 692.)

Solubility of NaOH + Na<sub>2</sub>SbS<sub>4</sub> at 30°.

% NaOH	% NaSbS <sub>4</sub>	Solid phase
0	27.1	Na <sub>2</sub> SbS <sub>4</sub> · 9H <sub>2</sub> O
9.9	13.	"
24.8	5.9	"
32.9	10.5	"
42.6	16.4	"
47.2	17.7	" + NaOH, H <sub>2</sub> O
49.5	9.1	NaOH, H <sub>2</sub> O
54.3	0	"

(Donk, Chem. Weekbl. 1908, 5. 529, 629, 767.)

Easily sol. in alcohol or wood spirit; sol. in fusel-oil. Sol. in an aqueous solution of mannite. (Favre, A. ch. (3) 11. 76.)

Easily sol. in glycerine.

Sol. to a certain extent in ether.

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate (Naumann, B. 1904, 37. 3602); benzonitrile. (Naumann, B. 1914, 47. 1370.)

+H<sub>2</sub>O. 100 g. solution in H<sub>2</sub>O sat. at 25° contain 42 g. Na<sub>2</sub>O. (Schreinemakers, Arch. Néer. Sc. 1910, (2) 15. 81.)

Mpt. 64.3°. (See above.)

+1/2 H<sub>2</sub>O. (Cripps, Pharm. J. Trans. (3) 14. 833.)

+2H<sub>2</sub>O. See above.

+3/2 H<sub>2</sub>O. Deliquescent. Sol. in H<sub>2</sub>O with absorption of much heat. Melts at 6°. (Hermes.)

Mpt. 15.5°. (See above.)

+4, 5 and 7H<sub>2</sub>O. (See above.)

The composition of the hydrates formed by NaOH at different dilutions is calculated from determinations of the lowering of the fr-pt. produced by NaOH and of the conductivity and sp. gr. of NaOH + Aq. (Jones, Am. Ch. J. 1905, 34. 336.)

Sodium perhydroxide, NaO<sub>2</sub>H.

"Natrlyl hydroxide."

Decomp. by H<sub>2</sub>O. Sol. in cold alcoholic acetic acid. (Tafel, B. 1894, 27. 2300.)

Sodium iodide, NaI, and +2H<sub>2</sub>O.

Solubility of NaI and of NaI + 2H<sub>2</sub>O in H<sub>2</sub>O differ. Below 65°, NaI + 2H<sub>2</sub>O usually separates out, and above that temp. NaI separates.

Solubility of NaI in 100 pts. H<sub>2</sub>C at t°.

t°	Pts. NaI	t°	Pts. NaI	t°	Pts. NaI
71.3	294.4	92.4	300.2	124.7	317.5
74.1	295.3	97.1	300.3	132.5	317.3
81.6	296.8	101.7	302.5	138.1	319.2
86.4	298.3	110.7	306.2	...	...

Solubility is represented by a straight line of the formula  $S = 264.19 + 0.3978t$ .

Solubility of NaI + 2H<sub>2</sub>O in 100 pts. at t°.

t°	Pts. NaI	t°	Pts. NaI	t°	Pts. NaI
-17	149.4	15	173.7	45	215.6
-15	150.3	20	178.7	50	227.8
-5	155.4	25	184.2	55	241.2
0	158.7	30	190.3	60	256.8
5	163.6	35	197.0	65	278.4
10	168.6	40	205.1	...	...

(Coppet, A. ch. (5) 50. 424.)

If solubility  $S$  = pts. NaI in 100 pts. solution,  $S = 61.3 + 0.1712t$  from 0° to 80°;  $S = 75 + 0.0258t$  from 80° to 160°. (Étard, C. R. 98. 1432.)

NaI + 2H<sub>2</sub>O is sol. in 0.55 pt. H<sub>2</sub>O at 15°. (Eder, Dingl. 221. 89.)

100 pts. NaI + Aq at 18–19° contain 62.98 pts. NaI. (v. Hauer, J. pr. 98. 137.)

100 pts. H<sub>2</sub>O dissolve at:

0°	20°	40°	60°
158.7	178.6	208.4	256.4 pts. NaI,
80°	100°	120°	140°
303	312.5	322.5	333.3 pts. NaI.

(Kremers, Pogg. 97. 14.)

Transition pt. for NaI + 2H<sub>2</sub>O to NaI is 64.3°, and sat. solution containing 74.4% NaI. (Panfiloff, J. Russ. Phys. Chem. Soc. 1893, 25. 162.)

100 g. H<sub>2</sub>O dissolve 172.4 g. NaI at 15°, and sp. gr. of sat. solution = 1.8937. (Greenish, Pharm. J. 1900, 65. 190.)

100 g. solution of NaI + 2H<sub>2</sub>O sat. at 30° contains 65.5 g. anhyd. NaI. (Cocheret, Dissert. 1910.)

Sp. gr. of NaI + Aq at 19.5° containing:

5	10	15	20	25	30 % NaI,
1.040	1.062	1.128	1.179	1.234	1.294

35	40	45	50	55	60 % NaI.
1.360	1.432	1.510	1.60	1.70	1.81

(Gerlach, Z. anal. 8. 285.)

Sat. solution boils at 141°.

Sol. in liquid SO<sub>2</sub>. (Walden, B. 1899, 32. 2864); POCl<sub>3</sub>. (Walden, Z. anorg. 1900, 25. 212.)

Very easily sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

Sol. in 12.0 pts. absolute alcohol; in 360 pts. ether. (Eder, Dingl. 221. 89.)

Sol. in 3 pts. 90% alcohol. (Hager.)

100 pts. absolute methyl alcohol dissolve 77.7 pts. NaI at 22.5°; ethyl alcohol, 43.1 pts. (de Bruyn, Z. phys. Ch. 10. 783.)

Very sol. in abs. methyl alcohol and is not pptd. therefrom on the addition of a large volume of abs. ether, while wet ether produces immediate separation. (Loeb, J. Am. Chem. Soc. 1905, 27. 1020.)

Solubility of NaI in ethyl alcohol.  
(g. NaI in 100 g. alcohol.)

t°	NaI	t°	NaI
10	43.77	200	42.3
30	44.25	220	38.5
50	44.50	230	36.2
80	45.0	240	32.7
100	45.1	250	26.2
120	45.2	255	21.0
160	45.0	260	10.8
180	44.3	261.5*	8.6

\*Critical temp. of solution.

(Tyrer, Chem. Soc. 1910, 97. 626.)

100 g. sat. solution of NaI in ethyl alcohol at 30° contains 30.9 g. (Cocheret, Dissert, 1910.)

Solubility in ethyl alcohol + Aq at 30°.

% NaI	% alcohol	Solid phase
65.52	0	NaI, 2H <sub>2</sub> O
64	3.40	"
54.2	18.5	"
54	18.8	"
48.8	28.5	"
42.35	41.7	"
38.5	53.2	"
37.91	54.7	"
37.49	55.37	NaI, 2H <sub>2</sub> O + NaI
35.65	59.24	NaI
33.24	61.78	"
30.90	68.70	"

(Cocheret, Dissert. 1911.)

At room temp. 1 pt. by weight is sol in:

- 1.2 pts. methyl alcohol D<sup>18</sup> 0.7990.  
1.7 " ethyl " D<sup>18</sup> 0.8100.  
3.8 " propyl " D<sup>18</sup> 0.8160.

(Rohland, Z. anorg. 1898, 18. 325.)

100 g. methyl alcohol dissolve 90.35 g. NaI at 25°.

100 g. ethyl alcohol dissolve 46.02 g. NaI at 25°.

100 g. propyl alcohol dissolve 28.22 g. NaI at 25°.

100 g. isoamyl alcohol dissolve 16.30 g. NaI at 25°.

(Turner and Bissett, Chem. Soc. 1913, 103. 1909.)

Solubility in methyl alcohol + ethyl alcohol at 25°.

P = % methyl alcohol in the solvent.

G = g. NaI in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution at 25°.

P	G	S 25°/4°
0.00	3.515	1.0806
4.37	3.768	1.1029
10.40	3.971	1.1123
41.02	4.598	1.1742
80.69	5.744	1.2741
84.77	5.892	1.2886
91.25	6.110	1.3056
100.00	6.322	1.3250

(Herz and Kuhn, Z. anorg. 1908, 60. 154.)

Solubility in mixtures of methyl and propyl alcohol at 25°.

P = % propyl alcohol in the solvent.

G = g. NaI in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	6.322	1.3250
11.11	5.845	1.2853
23.8	5.464	1.2528
65.2	4.071	1.138
91.8	2.914	1.0420
93.75	2.649	1.0178
100.00	2.411	0.9968

(Herz and Kuhn, Z. anorg. 1908, 60. 156.)

Solubility in mixtures of propyl and ethyl alcohol at 25°.

P = % propyl alcohol in the solvent.

G = g. NaI in 10 ccm. of the solution.

S = Sp. gr. of the sat. solution.

P	G	S 25°/4°
0	3.515	1.0806
8.1	3.460	1.0732
17.85	3.405	1.0720
56.6	2.841	1.0276
88.6	2.613	1.0130
91.2	2.588	1.0104
95.2	2.474	1.0020
100	2.411	0.9968

(Herz and Kuhn, Z. anorg. 1908, 60. 159.)

Sol. in normal propyl alcohol. (Loeb, J. Am. Chem. Soc. 1905, 27. 1020.)

28.74 g. are sol. in 100 g. propyl alcohol. (Schlamp, Z. phys. Ch. 1894, 14. 276.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Sol. in ethyl acetate. (Casasaca, C. R. 30. 821.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Solubility in organic solvents at t°.

C = pts. by wt. of NaI in 100 ccm. of the sat. solution.

L = no. of liters which at the saturation temp. hold in solution 1 mol. NaI.

Solvent	t°	C	L
Furfuroil	25	25.10	0.597
Acetonitrile	25	18.43	0.813
"	0	22.09	0.679
Propionitrile	25	6.230	2.406
"	0	9.091	1.649
Nitromethane	25	0.478	31.36
"	0	0.339	44.27

(Walden, Z. phys. Ch. 1906, 55. 718.)

Very sol. in acetone. (Walden.)  
+5H<sub>2</sub>O. Transition point of NaI+5H<sub>2</sub>O to NaI+2H<sub>2</sub>O is -13.5°, and sat. solution contains 60.2% NaI. (Panfiloff, J. Russ. Phys. Chem. Soc. 1893, 25. 162.)

Sodium tin (stannous) iodide, NaI, SnI<sub>2</sub>.

Very sol. in H<sub>2</sub>O. When treated with little H<sub>2</sub>O, NaI is dissolved out, but a larger amt. of H<sub>2</sub>O dissolves it completely. (Boullay, A. ch. (2) 34. 375.)

Sodium zinc iodide, 2NaI, ZnI<sub>2</sub>+3H<sub>2</sub>O.

Deliquescent.

NaZnI<sub>2</sub>+2H<sub>2</sub>O. Very hygroscopic. (Ephraim, Z. anorg. 1910, 67. 383.)

Sodium nitride,

Decomp. by heat. (Frans Fisher, B. 1910, 43. 1468.)

Sodium suboxide, Na<sub>2</sub>O.

Decomp. by H<sub>2</sub>O. (de Forcrand, C. R. 1898, 127. 365.)

Sodium oxide, Na<sub>2</sub>O.

Very deliquescent, and sol. in H<sub>2</sub>O with evolution of heat.

See Sodium hydroxide.

Sodium peroxide, Na<sub>2</sub>O<sub>2</sub>.

Deliquescent, and very sol. in H<sub>2</sub>O with partial decomp.

Solution decomp. on boiling.

Cryst. with 2H<sub>2</sub>O, and 8H<sub>2</sub>O. (Fairley, Chem. Soc. 1877. 125.)

Forms hydrate Na<sub>2</sub>O<sub>2</sub>(OH)<sub>2</sub>+4H<sub>2</sub>O.

Easily sol. in H<sub>2</sub>O or dil. acids without decomp. (Schöne, A. 193. 241.)

Sodium peroxide carbonate, Na<sub>2</sub>CO<sub>4</sub>.

Easily decomp. (Woffenstein, B. 1908, 41. 285.)

Sodium peroxide dicarbonate, Na<sub>2</sub>C<sub>2</sub>O<sub>4</sub>.

Easily decomp. (Woffenstein, B. 1908, 41. 287.)

Sodium trioxide, NaO<sub>3</sub>.

Sol. in H<sub>2</sub>O forming a solution of Na<sub>2</sub>O<sub>2</sub>. (Joannis, C. R. 1893, 116. 1371.)

Sodium trioxide carbonate, Na<sub>2</sub>CO<sub>3</sub>.

(Woffenstein, B. 1908, 41. 296.)

Sodium trioxide dicarbonate, NaHCO<sub>4</sub>.

Two isomeric modifications. (Woffenstein, B. 1908, 41. 390.)

Sodium trioxide hydrate, NaO.OH.

See Sodium perhydroxide.

Isomeric with Tafel's sodyl hydroxide. O:Na.OH. (B. 27, 2297.)

Insol. in alcohol.

Very unstable. (Woffenstein, B. 1908, 41. 290.)

Sodium phosphide, NaP<sub>3</sub>.

Easily decomp. by H<sub>2</sub>O. (Hugot, C. R. 1895, 121. 208.)

Sodium hydrogen phosphide, NaH<sub>2</sub>P.

Decomp. by H<sub>2</sub>O. (Joannis, C. R. 1894, 119. 558.)

Na<sub>2</sub>H<sub>2</sub>P<sub>2</sub>. Decomp. by acids and H<sub>2</sub>O. (Hugot, C. R., 1898, 126. 1721.)

Sodium selenide, Na<sub>2</sub>Se.

Very deliquescent. Decomp. by H<sub>2</sub>O. (Uelsmann, A. 116. 127.)

Insol. in liquid NH<sub>3</sub>; sol. in air free H<sub>2</sub>O to a colorless liquid. (Hugot, C. R. 1899, 129. 299.)

Cryst. with 16H<sub>2</sub>O, 9H<sub>2</sub>O, and 1/2 H<sub>2</sub>O. (Fabre, C. R. 102. 613.)

+10H<sub>2</sub>O. Very sol. in H<sub>2</sub>O; very unstable in the air. (Clever, Z. anorg. 1895, 10. 145.)

Sodium diselenide, Na<sub>2</sub>Se<sub>2</sub>.

(Jackson, B. 7. 1277.)

Sodium triselenide, Na<sub>2</sub>Se<sub>3</sub>.

Sol. in H<sub>2</sub>O. (Mathewson, J. Am. Chem. Soc. 1907, 29. 873.)

Sodium hexaselenide, Na<sub>2</sub>Se<sub>6</sub>.

Sol. in H<sub>2</sub>O. (Mathewson, J. Am. Chem. Soc. 1907, 29. 873.)

Sodium monosulphide, Na<sub>2</sub>S.

Sol. in H<sub>2</sub>O. Much less sol. in alcohol than in H<sub>2</sub>O. Insol. in ether. (Roussin.)

+5H<sub>2</sub>O. Tr. pt. from Na<sub>2</sub>S+5½H<sub>2</sub>O, 94°.

+5½H<sub>2</sub>O.

The sat. solution contains:—

28.48%	anhydrous salt at	50°
29.27	"	" 55°
29.92	"	" 60°
31.38	"	" 70°
33.95	"	" 80°
37.20	"	" 90°

Labile from 48.9–91.5°; stabile from 91.5–96°.

(Parravano and Fornaini, C. C. 1906, I. 5.)

+6H<sub>2</sub>O. Less efflorescent than with 9H<sub>2</sub>O. Sol. in H<sub>2</sub>O and alcohol.

The sat. solution contains:—

26.7 %	anhydrous salt at	50°
28.1	"	" 60°
30.22	"	" 70°
32.95	"	" 80°
36.42	"	" 90°

Tr. pt. to Na<sub>2</sub>S+5½H<sub>2</sub>O, 91.5°.

(Parravano and Fornaini.)

+9H<sub>2</sub>O. Efflorescent. Much less sol. in alcohol than H<sub>2</sub>O. When dissolved in H<sub>2</sub>O, temp. sinks from +22 to –6.1°. (Finger, Pogg. 128. 635.)

The sat. solution contains:—

9.34%	anhydrous Na <sub>2</sub> S at	–10°
13.36	"	" +10°
14.36	"	" 15°
15.30	"	" 18°
16.2	"	" 22°
17.73	"	" 28°
19.09	"	" 32°
20.98	"	" 37°
24.19	"	" 45°

Tr. pt. to Na<sub>2</sub>S+5½H<sub>2</sub>O, 48.9°.

(Parravano and Fornaini.)

**Sodium disulphide, Na<sub>2</sub>S<sub>2</sub>.**

Sol. in H<sub>2</sub>O and alcohol.

+5H<sub>2</sub>O. Not efflorescent.

**Sodium trisulphide, Na<sub>2</sub>S<sub>3</sub>.**

Sol. in H<sub>2</sub>O with decomp.

Cryst. with 3H<sub>2</sub>O from an alcoholic solution. (Böttger, A. 223. 355.)

**Sodium tetrasulphide, Na<sub>2</sub>S<sub>4</sub>+6H<sub>2</sub>O.**

Very deliquescent, and sol. in H<sub>2</sub>O. Difficultly sol. in absolute alcohol. Insol. in ether. (Schöne.)

+8H<sub>2</sub>O. Efflorescent. (Böttger.)

**Sodium pentasulphide, Na<sub>2</sub>S<sub>5</sub>+6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Schöne.)

Sol. in alcohol.

+8H<sub>2</sub>O. (Böttger.)

Solution is easily decomp. by warming. (Jones, Chem. Soc. 37. 461.)

**Sodium tellurium sulphide.**

See Sulphotellurate, sodium.

**Sodium stannic sulphide.**

See Sulphostannate, sodium.

**Sodium yttrium sulphide, Na<sub>2</sub>S, Y<sub>2</sub>S<sub>3</sub>.**

Decomp. by dil. acids, even by HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq. (Duboin, C. R. 107. 243.)

**Sodium zinc sulphide, Na<sub>2</sub>S, 3ZnS.**

Not so stable as the corresponding K salt. (Schneider, J. pr. (2) 8. 29.)

**Sodium sulphoselenide, Na<sub>2</sub>SSe<sub>2</sub>+5H<sub>2</sub>O.**

Hydroscopic, and decomp. in the air. (Messinger, B. 1897, 30. 806.)

**Sodium telluride, Na<sub>2</sub>Te.**

Sol. in H<sub>2</sub>O. (Demarçay, Bull. Soc. (2) 40. 99.)

**Sodium tritelluride, Na<sub>2</sub>Te<sub>3</sub>.**

Sol. in H<sub>2</sub>O.

Sol. in liquid NH<sub>3</sub>. (Hugot, C. C. 1899, II. 580.)

**Stannic acid, H<sub>2</sub>SnO<sub>4</sub>.**

Insol. in H<sub>2</sub>O. Sol. in HCl, and H<sub>2</sub>SO<sub>4</sub>+Aq, even when dil. (Fremy.) Easily sol. in acids, from which solution it may be pptd. by dilution or boiling. While moist it is sol. in HNO<sub>3</sub>+Aq, but gradually separates on standing, and coagulates at once when heated to 50°. If NH<sub>4</sub>NO<sub>3</sub> be added to the solution, it remains clear at ord. temp. (Berzelius.)

Easily sol. in HNO<sub>3</sub>+Aq, when previously treated with NH<sub>4</sub>OH+Aq. (Thénard.)

Easily sol. in KOH+Aq, but addition of large excess ppts. K<sub>2</sub>SnO<sub>3</sub>, insol. in KOH+Aq.

Easily sol. in NaOH+Aq, and not pptd. by an excess of that reagent. (Barfoed, J. B. 1867. 267.)

Sl. sol. in NH<sub>4</sub>OH+Aq or (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>+Aq. Completely sol. in K<sub>2</sub>CO<sub>3</sub>+Aq, but not in Na<sub>2</sub>CO<sub>3</sub>+Aq.

Insol. in alkali hydrogen carbonates or NH<sub>4</sub>Cl+Aq.

Sol. in alkali sulphides+Aq. (Berzelius.)

Sol. in triethyltoluanyl ammonium hydrate+Aq.

Not pptd. by NH<sub>4</sub>OH+Aq in presence of Na citrate+Aq.

SnO<sub>2</sub>, 2H<sub>2</sub>O. (Weber, Pogg. 122. 358.)

"*α-Orthostannic acid*." Easily sol. in HCl+Aq. (Neumann, M. 12. 515.)

H<sub>2</sub>SnO<sub>4</sub> (?)

*Metastannic acid.* Insol. in H<sub>2</sub>O, HNO<sub>3</sub>, or H<sub>2</sub>SO<sub>4</sub>+Aq. Insol. in HCl+Aq, but converted thereby into metastannic chloride, which dissolves after excess of HCl has been removed. (Fresenius.) Insol. in HCl+Aq of sp. gr. 1.1. (Barfoed.) Sol. in large amount



of conc.  $\text{HCl} + \text{Aq.}$  (Allen, Chem. Soc. (2) 10. 274.)

In contact with  $\text{HCl} + \text{Aq.}$  metastannic acid is converted into stannic acid. (Barfoed.)

Insol. in  $\text{HNO}_3 + \text{Aq.}$  even after treatment with  $\text{NH}_4\text{OH} + \text{Aq.}$

Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

Sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq.}$  with formation of metastannates, which are insol. in dil.  $\text{NaOH} + \text{Aq.}$  but sol. in  $\text{H}_2\text{O}$  or  $\text{KOH} + \text{Aq.}$ , therefore  $\text{KOH} + \text{Aq.}$  dissolves metastannic acid, while  $\text{NaOH} + \text{Aq.}$  does not, but if the clear solution in  $\text{KOH} + \text{Aq.}$  is treated with a large excess of that reagent, a further pptn. occurs. (Barfoed, J. pr. 101. 368.)

Insol. in  $\text{K}_2\text{CO}_3 + \text{Aq.}$  (Rose); alkali carbonates +  $\text{Aq.}$  (Fremy.)

Insol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  even after long boiling.

Sol. in  $\text{Fe}(\text{NO}_3)_3 + \text{Aq.}$  containing  $\text{HNO}_3$ . (Lepèz and Storch, W. A. B. 98, 2b. 270.)

Also in  $\text{Cr}(\text{NO}_3)_3 + \text{Aq.}$  but not in  $\text{Ce}(\text{NO}_3)_3$ ,  $\text{Al}(\text{NO}_3)_3$ ,  $\text{Co}(\text{NO}_3)_2 + \text{Aq.}$ , etc. (L. and S.)

A colloidal metastannic acid sol. in  $\text{H}_2\text{O}$  can be obtained. (Lepèz and Storch.)

According to Weber (Pogg. 123. 358), stannic and metastannic acids are only different hydrates of same oxide, and it is not a case of allotropic modification.

*Colloidal.*  $\text{H}_2\text{SnO}_3$  in colloidal state can be obtained in aqueous solution containing 5.164 g.  $\text{SnO}_2$  in a litre. This solution is coagulated by  $\text{HNO}_3 + \text{Aq.}$  only when in great excess; easily by dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  but not by conc.  $\text{HCl} + \text{Aq.}$   $\text{NH}_4\text{OH} + \text{Aq.}$  in large excess causes coagulation; also  $\text{NH}_4\text{Cl}$ ,  $\text{NaOH}$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ , etc. (Schneider, Z. anorg. 5. 83.)

**Parastannic acid**,  $\text{H}_2\text{Sn}_2\text{O}_{11} + 3\text{H}_2\text{O}$ .

(Engel, C. R. 1897, 125. 711.)

### Stannates.

Stannates of alkali metals are sol. in  $\text{H}_2\text{O}$ ; others are insol. All metastannates, excepting  $\text{Na}$ ,  $\text{K}$ , and  $\text{NH}_4$  salts, are insol. in  $\text{H}_2\text{O}$ . (Fremy, A. ch. (3) 12. 474.)

**Ammonium stannate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{SnO}_2$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Berzelius.)

+  $x\text{H}_2\text{O}$ . (Moberg, 1838.)

**Ammonium cupric stannate**,  $(\text{NH}_4)_2\text{O}$ ,  $\text{CuSnO}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 96. 701.)

**Barium stannate**,  $\text{BaSnO}_3 + 6\text{H}_2\text{O}$ .

Ppt. Sol. in  $\text{HCl} + \text{Aq.}$  (Moberg.)

$\text{Ba}_3\text{SnO}_4 + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 95. 641.)

**Calcium stannate**,  $\text{CaSnO}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Moberg.)

+  $5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 96. 701.)

$2\text{CaO}$ ,  $\text{SnO}_2$ . (Zulkowaki, Chem. Ind. 1901, 24. 422.)

**Cobaltous stannate**,  $\text{CoSnO}_3 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte.)

**Cupric stannate**,  $\text{CuSnO}_3 + 3\text{H}_2\text{O}$ .

(Moberg.)

+  $4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Ditte.)

**Cuprous stannous stannate**,  $\text{Cu}_2\text{O}$ ,  $3\text{SnO}$ ,  $\text{SnO}_2 + 5\text{H}_2\text{O}$ .

Slowly decomp. by dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$ ; completely decomp. by conc. acids. (Lensen, J. pr. 79. 90.)

**Gold (aurous) stannate.**

See Gold purple.

**Lead stannate**,  $\text{RbSn}(\text{OH})_3$ .

Ppt. (Bellucci, Chem. Soc. 1905, 88. (2) 40.)

**Lithium stannate hexatungstate**,  $2\text{Li}_2\text{O}$ ,  $\text{SnO}_2$ ,  $6\text{WO}_3 = \text{Li}_2\text{SnO}_3$ ,  $\text{Li}_2\text{W}_6\text{O}_{19}$ .

Insol. in  $\text{H}_2\text{O}$ . (Knorre, J. pr. (2) 27. 49.)

**Magnesium stannate.**

Ppt. (Moberg.)

**Manganous stannate.**

Ppt. (Moberg.)

**Mercurous stannate**,  $\text{Hg}_2\text{SnO}_3 + 5\text{H}_2\text{O}$ .

Ppt.

**Mercuric stannate**,  $\text{HgSnO}_3 + 6\text{H}_2\text{O}$ .

Ppt. (Moberg, J. pr. 23. 231.)

**Nickel stannate**,  $\text{NiSnO}_3 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 96. 701.)

**Platinous sodium stannous stannate**,  $2\text{PtO}$ ,  $\text{Na}_2\text{O}$ ,  $\text{SnO}$ ,  $\text{SnO}_2(?)$ .

(Schneider, Pogg. 136. 105.)

**Platinous stannous stannate**,  $\text{PtO}$ ,  $2\text{SnO}$ ,  $\text{SnO}_2$ .

Decomp. by conc. alkalies. (Schneider, Pogg. 136. 105.)

**Potassium stannate**,  $\text{K}_2\text{SnO}_3 + 3\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 106.6 pts. at  $10^\circ$ , solution has sp. gr. = 1.618; 100 pts. dissolve 110.5 pts. at  $20^\circ$ , solution has sp. gr. = 1.627. (Ordway, Sill. Am. J. (2) 40. 173.)

Very sl. sol. in conc. KOH + Aq.  
 Insol. in KCl + Aq. (Fremy.)  
 Insol. in alcohol.  
 Pptd. from aqueous solution by the addition of any soluble salt, especially those of K, Na, and  $\text{NH}_4$  (Fremy); by  $\text{NH}_4\text{Cl}$ , but not by KCl or NaCl (Ordway).  
 Insol. in acetone. (Naumann, B. 1904, 37. 329.)

**Potassium metastannate**,  $\text{K}_2\text{O}$ ,  $10\text{SnO}_2$ .

$\text{K}_2\text{O}$ ,  $7\text{SnO}_2 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Solution gelatinises on heating. (Rose.)  
 $\text{K}_2\text{O}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but loses its solubility by drying. (Fremy, A. ch. (3) 12. 475.)

$\text{K}_2\text{O}$ ,  $5\text{SnO}_2 + 4\text{H}_2\text{O}$ . Completely sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Fremy, A. ch. (3) 23. 396.)

$\text{K}_2\text{O}$ ,  $3\text{SnO}_2 + 3\text{H}_2\text{O}$ . Deliquescent. (Fremy.)

**Silver stannate**,  $\text{Ag}_3\text{SnO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Unacted upon by  $\text{NH}_4\text{OH}$  or HCl + Aq. (Ditte.)

**Silver (argentous) stannous stannate** (?),  $\text{Ag}_2\text{O}$ ,  $\text{SnO}$ ,  $3\text{SnO}_2 + 3\text{H}_2\text{O}$  (?).

Cold dil.  $\text{HNO}_3$  + Aq slowly dissolves all Ag, hot  $\text{HNO}_3$  + Aq rapidly.

Easily sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . (Schulze, J. B. 1857. 257.)

**Sodium stannate**,  $\text{Na}_2\text{SnO}_3 + 3\text{H}_2\text{O}$ .

More easily sol. in cold than in hot  $\text{H}_2\text{O}$ . (Fremy.)

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $20^\circ$  and  $100^\circ$  (Magnac.)

100 pts.  $\text{H}_2\text{O}$  dissolve 67.4 pts. at  $0^\circ$ , 61.3 pts. at  $20^\circ$ , and solutions have sp. gr. = 1.472 and 1.438 at  $15.5^\circ$ . (Ordway, Sill. Am. J. (2) 40. 173.)

Pptd. from  $\text{Na}_2\text{SnO}_3$  + Aq by salts of K, Na, and  $\text{NH}_4$ .

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+  $4\text{H}_2\text{O}$ . (Prandtl, B. 1907, 40. 2129.)

+  $8\text{H}_2\text{O}$ . (Haefely, J. B. 1857. 650.)

+  $9\text{H}_2\text{O}$ . (Jones, C. C. 1865. 607.)

+  $10\text{H}_2\text{O}$ . Very efflorescent. (Scheurer-Kestner, Bull. Soc. (2) 8. 389.)

**Sodium metastannate**,  $\text{Na}_2\text{O}$ ,  $9\text{SnO}_2 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in NaOH + Aq or alcohol. (Barfoed, J. B. 1867. 267.)

$\text{Na}_2\text{O}$ ,  $5\text{SnO}_2$ . Very difficultly sol. in  $\text{H}_2\text{O}$ . (Fremy, A. ch. (3) 23. 399.)

Insol. in KOH + Aq.

+  $8\text{H}_2\text{O}$ . (Haefely, Chem. Gaz. 1855. 59.)

**Sodium stannate vanadate**,

$\text{Na}_2\text{SnO}_3$ ,  $3\text{Na}_2\text{VO}_4 + 32\text{H}_2\text{O}$ .

$\text{Na}_2\text{SnO}_3$ ,  $4\text{Na}_2\text{VO}_4 + 48\text{H}_2\text{O}$ .

$\text{Na}_2\text{SnO}_3$ ,  $5\text{Na}_2\text{VO}_4 + 64\text{H}_2\text{O}$ .

$\text{Na}_2\text{SnO}_3$ ,  $6\text{Na}_2\text{VO}_4 + 80\text{H}_2\text{O}$ . (Prandtl, B. 1907, 40. 2128.)

**Strontium stannate**,  $3\text{SrO}$ ,  $2\text{SnO}_2 + 10\text{H}_2\text{O}$ .

Ppt. Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte, C. R. 95. 641.)

$\text{SrSn}(\text{OH})_6$ . (Belluci, Chem. Soc. 1905, 88 (2) 40.)

**Tin (stannous) stannate**,  $\text{SnO}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{HNO}_3$  + Aq into metastannic acid. (Schiff, A. 120. 53.)

Sol. in HCl + Aq, and in KOH + Aq.

**Tin (stannous) metastannate**,  $\text{SnO}$ ,  $7\text{SnO}_2$ .

$\text{SnO}$ ,  $6\text{SnO}_2 + 9\text{H}_2\text{O}$ . Sol. in KOH + Aq or in HCl + Aq. (Fremy.)  
 +  $4\text{H}_2\text{O}$ . (Schiff.)

**Zinc stannate**,  $\text{ZnSnO}_3 + 2\text{H}_2\text{O}$ .

Ppt. (Moberg, 1838.)

$3\text{ZnO}$ ,  $2\text{SnO}_2 + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Ditte.)

**Perstannic acid**,  $\text{H}_2\text{Sn}_2\text{O}_7$ .

See Perstannic acid.

**Stannophosphomolybdic acid**.

**Ammonium stannophosphomolybdate**,

$3(\text{NH}_4)_2\text{O}$ ,  $4\text{SnO}_2$ ,  $3\text{P}_2\text{O}_5$ ,  $16\text{MoO}_3 + 28\text{H}_2\text{O}$ .

Quite insol. even in boiling  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 382.)

**Stannophosphotungstic acid**.

**Ammonium stannophosphotungstate**,

$2(\text{NH}_4)_2\text{O}$ ,  $2\text{SnO}_2$ ,  $\text{P}_2\text{O}_5$ ,  $22\text{WO}_3 + 16\text{H}_2\text{O}$ .

Precipitate. Sl. sol. in boiling  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 319.)

**Stannosulphuric acid**.

See Sulphate, stannic.

**Stibine**.

See Hydrogen antimonide.

**Strontium, Sr.**

Decomp. by  $\text{H}_2\text{O}$  with violence. Dil.  $\text{H}_2\text{SO}_4$ , and HCl + Aq decomp. and dissolve; cold  $\text{H}_2\text{SO}_4$  attacks slowly. Fuming  $\text{HNO}_3$  has scarcely any action even when boiling. (Frans, J. pr. 107. 253.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

Sol. in excess of liquid  $\text{NH}_3$  at  $-60^\circ$  forming  $\text{Sr}(\text{NH}_3)_6$ . (Roederer, C. R. 1905, 140. 1252.)

**Strontium amalgam**,  $\text{SrHg}_{12}$ .

Stable below  $30^\circ$ . Above  $30^\circ$  the composition of the amalgam varies. Can be cryst. from Hg at any temp. below  $30^\circ$ . (Kerp, Z. anorg. 1900, 25. 68.)

**Strontium amide**,  $\text{Sr}(\text{NH}_2)_2$ .

(Roederer, Bull. Soc. 1906, (3) 35. 715.)

**Strontium arsenide,  $\text{Sr}_3\text{As}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Lebeau, C. R. 1899, 129. 47.)

**Strontium azoimide,  $\text{SrN}_4$ .**

Hydroscopic.

45.83 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ .

0.095 " " " " 100 " abs. alcohol at  $16^\circ$ .

Insol. in pure ether. (Curtius, J. pr. 1898, (2) 58. 287.)

**Strontium boride,  $\text{SrB}_3$ .**

Sol. in fused oxidising agents; not decomp. by  $\text{H}_2\text{O}$ ; insol. in aq. acids; sl. sol. in conc.  $\text{H}_2\text{SO}_4$ ; sol. in dil. and conc.  $\text{HNO}_3$ . (Moissan, C. R. 1897, 125. 633.)

**Strontium bromide,  $\text{SrBr}_2$ , and  $+6\text{H}_2\text{O}$ .**

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$   $20^\circ$   $38^\circ$   $59^\circ$   $83^\circ$   $110^\circ$   
87.7 99 112 133 182 250 pts.  $\text{SrBr}_2$ .

(Kremers, Pogg. 103. 65.)

Sat.  $\text{SrBr}_2 + \text{Aq}$  contains at:

$-11^\circ$   $-1^\circ$   $+7^\circ$   $18^\circ$   
43.1 46.85 48.2 51.7%  $\text{SrBr}_2$ ,  
 $20^\circ$   $93^\circ$   $97^\circ$   $107^\circ$   
51.8 68.5 68.7 69.8%  $\text{SrBr}_2$ .

(Étard, A. ch. 1894, (7) 2. 540.)

Sp. gr. of  $\text{SrBr}_2 + 19.5^\circ$  containing:

5 10 15 20 25 %  $\text{SrBr}_2$   
1.046 1.094 1.146 1.204 1.266  
30 35 40 45 50 %  $\text{SrBr}_2$   
1.332 1.41 1.492 1.59 1.694

(Kremers, Pogg. 99. 444; calculated by Gerlach, Z. anal. 8. 235.)

Somewhat sol. in absolute alcohol. (Löwig.)  
Solubility of anhydrous  $\text{SrBr}_2$  in alcohol is practically constant between  $0^\circ$  and  $40^\circ$ ; 100 ccm. of abs. alcohol dissolving about 64.5 g. of the anhydrous salt and forming a solution having a sp. gr. = 1.210 at  $0^\circ$ . (Fonsses-Diacon, Chem. Soc. 1895, 68 (2) 223.)

Much more sol. than  $\text{BaBr}_2$  in boiling amyl alcohol.

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Strontium stannic bromide.**

See Bromostannate, strontium.

**Strontium bromide ammonia,  $2\text{SrBr}_2 \cdot \text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 55. 238.)

**Strontium bromide hydrazine,  $\text{SrBr}_2 \cdot 3\text{N}_2\text{H}_4$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Franzen, Z. anorg. 1908, 60. 290.)

**Strontium bromofluoride,  $\text{SrF}_2 \cdot \text{SrBr}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Defacqs, A. ch. 1904, (8) 1. 356.)

**Strontium carbide,  $\text{SrC}_2$ .**

Easily decomp. by  $\text{H}_2\text{O}$  and dil. acids. (Moissan, Bull. Soc. 1894, (3) 11. 1006.)

**Strontium carbonyl,  $\text{Sr}(\text{CO})_2$ .**

(Roederer, Bull. Soc. 1906, (3) 85. 725.)

**Strontium chloride,  $\text{SrCl}_2$ , and  $+6\text{H}_2\text{O}$ .**

Deliquescent in moist air.

Sol. in 1.5 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and 0.8 pt. at boiling (Dumas); in 1.998 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach).  
1 pt. anhydrous  $\text{SrCl}_2$  is sol. in 2.27 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ ; in 1.88 pts. at  $20^\circ$ ; in 1.54 pts. at  $40^\circ$ ; in 1.18 pts. at  $60^\circ$ ; in 1.08 pts. at  $80^\circ$ ; in 0.98 pt. at  $100^\circ$ . (Kremers, Pogg. 103. 66.)

100 pts.  $\text{H}_2\text{O}$  dissolve 106.2 pts.  $\text{SrCl}_2 + 6\text{H}_2\text{O}$  at  $0^\circ$ , and 205.8 pts. at  $40^\circ$ . (Tilden, Chem. Soc. 45. 409.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$

$t^\circ$	Pts. $\text{SrCl}_2$	$t^\circ$	Pts. $\text{SrCl}_2$	$t^\circ$	Pts. $\text{SrCl}_2$
0	44.2	41	67.4	81	92.7
1	44.5	42	68.2	82	93.1
2	44.8	43	68.9	83	93.4
3	45.2	44	69.7	84	93.7
4	45.6	45	70.4	85	94.1
5	46.0	46	71.2	86	94.5
6	46.5	47	72.0	87	94.9
7	46.9	48	72.8	88	95.4
8	47.4	49	73.6	89	95.8
9	47.8	50	74.4	90	96.2
10	48.3	51	75.3	91	96.7
11	48.8	52	76.1	92	97.2
12	49.4	53	77.0	93	97.9
13	49.9	54	77.9	94	98.2
14	50.4	55	78.7	95	98.8
15	51.0	56	79.6	96	99.4
16	51.5	57	80.4	97	100.0
17	52.1	58	81.3	98	100.6
18	52.7	59	82.2	99	101.3
19	53.3	60	83.1	100	101.9
20	53.9	61	84.0	101	102.6
21	54.5	62	84.9	102	103.3
22	55.1	63	85.8	103	104.0
23	55.7	64	86.6	104	104.7
24	56.3	65	87.5	105	105.4
25	56.9	66	88.4	106	106.1
26	57.5	66.5	88.8	107	106.9
27	58.1	67	88.9	108	107.6
28	58.7	68	89.1	109	108.4
29	59.3	69	89.3	110	109.1
30	60.0	70	89.6	111	109.9
31	60.6	71	89.8	112	110.7
32	61.3	72	90.1	113	111.4
33	61.9	73	90.3	114	112.2
34	62.5	74	90.6	115	113.0
35	63.2	75	90.9	116	113.8
36	63.9	76	91.2	117	114.6
37	64.6	77	91.5	118	115.5
38	65.3	78	91.8	118.8	116.4
39	66.0	79	92.1	...	...
40	66.7	80	92.4	...	...

(Mulder, Scheik. Verhandel. 1864. 118.)

100 pts.  $H_2O$  dissolve 52.4 pts.  $SrCl_2$  at  $18^\circ$ . (Gerardin.)

Sat.  $SrCl_2$ +Aq contains %  $SrCl_2$  at  $t^\circ$ .

$t^\circ$	% $SrCl_2$	$t^\circ$	% $SrCl_2$
-17	26.5	75	46.5
-11	28.6	80	47.1
-5	29.3	92	47.5
-1	30.8	98	49.6
+2	31.3	104	50.7
7	31.7	105	50.7
18	33.7	118	52.0
21.5	34.7	132	52.5
35	37.8	144	54.7
44.5	39.8	153	55.7
54	42.8	175	60.5
55	43.8	215	64.1
59	47.7	222	65.4
64	46.4	250	67.3
70	46.1	...	...

(Étard, A. ch. 1894, (7) 2. 535.)

$SrCl_2$ +Aq sat. at  $8^\circ$  has sp. gr. = 1.379. (Anthon, A. 24. 211.)

Sp. gr. of  $SrCl_2$ +Aq.

Pts. $SrCl_2$ to 100 pts. $H_2O$	Sp. gr.	Pts. $SrCl_2$ to 100 pts. $H_2O$	Sp. gr.
9.81	1.0823	41.04	1.3114
20.12	1.1632	51.69	1.3816
30.57	1.2401	...	...

(Kremers, Pogg. 99. 444.)

Sp. gr. of  $SrCl_2$ +Aq at  $15^\circ$ .

% $SrCl_2$	Sp. gr.	% $SrCl_2$	Sp. gr.
5	1.0453	25	1.2580
10	1.0929	30	1.3220
15	1.1439	33	1.3633
20	1.1989	...	...

(Gerlach, Z. anal. 8. 283.)

Sp. gr. of  $SrCl_2$ +Aq at  $24.7^\circ$ . a=no. of molecules in grms. dissolved in 1,000 g.  $H_2O$ ; b=sp. gr. when a= $SrCl_2$ + $6H_2O$ ,  $\frac{1}{2}$  mol.  $SrCl_2$ + $6H_2O$ =133.5 g.; c=sp. gr. when a= $SrCl_2$ ,  $\frac{1}{2}$  mol.=79.5 g.

a	b	c	a	b	c
1	1.063	1.067	7	1.304	1.401
2	1.118	1.130	8	1.330	...
3	1.166	1.190	9	1.354	...
4	1.207	1.247	10	1.376	...
5	1.243	1.301	11	1.396	...
6	1.275	1.352	...	...	...

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $SrCl_2$ +Aq at  $18^\circ$ .

% $SrCl_2$	Sp. gr.	% $SrCl_2$	Sp. gr.
5	1.0443	20	1.2023
10	1.0932	22	1.2259
15	1.1456	...	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $SrCl_2$ +Aq at  $0^\circ$ . S=pts.  $SrCl_2$  in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
31.8193	1.3609	18.2629	1.1915
27.7170	1.3086	12.9997	1.1284
23.2300	1.2515	6.7243	1.0637

(Charpy, A. ch. (6) 29. 24.)

Sat.  $SrCl_2$ +Aq boils at  $114^\circ$  (Kremers);  $118.8^\circ$  (Mulder);  $117.45^\circ$ , and contains 117.5 pts.  $SrCl_2$  to 100 pts.  $H_2O$  (Legrand); forms a crust at  $115.5^\circ$ , and contains 120.7 pts.  $SrCl_2$  to 100 pts.  $H_2O$ ; highest temp. observed,  $119^\circ$ . (Gerlach, Z. anal. 26. 436.)

B.-pt. of  $SrCl_2$ +Aq containing pts.  $SrCl_2$  to 100 pts.  $H_2O$ . G=according to Gerlach (Z. anal. 26. 442); L=according to Legrand (A. ch. (2) 59. 436.)

B.-pt.	G	L	B.-pt.	G	L
101°	11	16.7	110°	71.4	68.9
102	20.5	25.2	111	76.5	74.1
103	28.9	32.1	112	81.6	79.6
104	36.2	37.9	113	87	85.3
105	43.2	43.4	114	93.1	91.2
106	49.6	48.8	115	99.5	97.5
107	55.4	54.0	116	105.9	104.0
108	60.8	59.0	117	112.3	110.9
109	66.2	63.9	117.5	...	...

Melts in its crystal  $H_2O$  at  $112^\circ$ . (Tilden, Chem. Soc. 45. 409.)

Sp. gr. of  $SrCl_2$ +Aq at  $25^\circ$ .

Concentration of $SrCl_2$ +Aq.	Sp. gr.
1-normal	1.0676
$\frac{1}{2}$ -normal	1.0336
$\frac{1}{3}$ -normal	1.0171
$\frac{1}{4}$ -normal	1.0084

(Wagner, Z. phys. Ch. 1890, 5. 40.)

$SrCl_2$ +Aq containing 3.24%  $SrCl_2$  has sp. gr.  $20^\circ/20^\circ$ =1.0284.

$SrCl_2$ +Aq containing 7.08%  $SrCl_2$  has sp. gr.  $20^\circ/20^\circ$ =1.0638.

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 279.)

Sp. gr. of  $\text{SrCl}_2 + \text{Aq}$  at  $20^\circ$ .

g. mols. $\text{SrCl}_2$ per l.	Sp. gr.
0.01	1.0012284
0.02937	1.0038396
0.03987	1.0053832
0.05017	1.007028
0.07077	1.009560
0.10	1.013205
0.25	1.034433
0.50	1.068379
0.75	1.101760
1.00	1.135423

(Jones and Pearce, Am. Ch. J. 1907, 33. 697.)

Conc.  $\text{HCl} + \text{Aq}$  ppts. part of the  $\text{SrCl}_2$  from  $\text{SrCl}_2 + \text{Aq}$ . (Hope.)

Solubility of  $\text{SrCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .  $\text{SrCl}_2 = \frac{1}{2}$  mols.  $\text{SrCl}_2$  (in milligrammes) dissolved in 10 ccm. of liquid;  $\text{HCl} =$  mols.  $\text{HCl}$  (in milligrammes) dissolved in 10 ccm. of liquid.

$\text{SrCl}_2$	$\text{HCl}$	Sum of mols.	Sp. gr.
55	0	55.0	1.334
48.2	6.1	54.3	1.3045
41.25	12.75	54.00	1.2695
30.6	23.3	53.9	1.220

(Engel, Bull. Soc. (2) 45. 655.)

Solubility of  $\text{SrCl}_2$  in  $\text{HCl} + \text{Aq}$  at  $0^\circ$ .

Mg. mols. per 10 cc. solution		Sp. gr. of solution	G. per 100 cc. solution	
$\frac{\text{SrCl}_2}{2}$	$\text{HCl}$		$\text{SrCl}_2$	$\text{HCl}$
51.6	0	1.334	40.9	0.0
44.8	6.1	1.304	35.5	2.22
37.85	12.75	1.269	30.0	4.65
27.2	23.3	1.220	21.56	8.49
22.0	28.38	1.201	17.44	10.35
14.0	37.25	1.167	11.09	13.58
4.25	52.75	1.133	3.37	19.23

(Engel, A. ch. 1888, (6) 13. 376.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)Sol. in 6 pts. alcohol of 0.833 sp. gr. at  $15^\circ$ . (Vauquelin.)Sol. in 24 pts. absolute alcohol at  $15^\circ$ , and in 19 pts. at boiling. (Bucholz.) Sol. in 2.5 pts. of boiling alcohol.

Anhydrous  $\text{SrCl}_2$  is sol. in 111.6–116.4 pts. alcohol of 99.3% at  $14.5^\circ$ , and in 26.2 pts. of the same alcohol at boiling. (Fresenius, A. 59. 127.)

100 pts. alcohol of given sp. gr. at  $0^\circ$  dissolve pts.  $\text{SrCl}_2$  at  $18^\circ$ .

0.990	0.985	0.973	0.966	0.953 sp. gr.
49.81	47.0	39.6	35.9	30.4 pts. $\text{SrCl}_2$ ,
0.939	0.909	0.846	0.832 sp. gr.	
26.8	19.2	4.9	3.2 pts. $\text{SrCl}_2$ .	

Insol. in absolute alcohol. (Gerardin, A. ch. (4) 5. 156.)

100 pts. absolute methyl alcohol dissolve 63.3 pts.  $\text{SrCl}_2 + 6\text{H}_2\text{O}$  at  $6^\circ$ ; ethyl alcohol, 3.8 pts. (de Bruyn, Z. phys. Ch. 10. 787.)

Sl. sol. in boiling amyl alcohol. (Browning, Sill. Am. J. 144. 459.)

100 g. 95% formic acid dissolve 23.8 g.  $\text{SrCl}_2$  at room temp. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Absolutely insol. in acetic ether. (Cann, C. R. 102. 363.)

Very al. sol. in acetone. (Krug and M'Elroy.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Sl. sol. in anhydrous pyridine. Sol. in 97%, 95% and 93% pyridine + Aq. (Kahlenberg, J. Am. Chem. Soc. 1908, 30. 1107.)

+  $2\text{H}_2\text{O}$ . Tr. pt. from +  $6\text{H}_2\text{O}$  is  $61.5^\circ$ . (Richards and Churchill, Z. phys. Ch. 1899, 28. 313.)+  $6\text{H}_2\text{O}$ . See above.Strontium thallic chloride,  $\text{SrCl}_3$ ,  $2\text{TiCl}_3 + 6\text{H}_2\text{O}$ .

(Gewecke, A. 1909, 366. 223.)

Strontium tin (stannous) chloride,  $\text{SrCl}_2$ ,  $\text{SnCl}_2 + 4\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Poggiale, C. R. 20. 1183.)

Strontium tin (stannic) chloride.

See Chlorostannate, strontium.

Strontium uranium chloride,  $\text{SrCl}_2$ ,  $\text{UCl}_4$ .Decomp. by  $\text{H}_2\text{O}$ . (Aloy, Bull. Soc. 1899, (3) 21. 265.)Strontium zinc chloride,  $\text{SrZnCl}_4 + 4\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ . (Ephraim, Z. anorg. 1910, 67. 380.)Strontium chloride ammonia,  $\text{SrCl}_2$ ,  $8\text{NH}_3$ .Decomp. by  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 155.)Strontium chloride hydrazine,  $\text{SrCl}_2$ ,  $2\text{N}_2\text{H}_4 + \text{H}_2\text{O}$ .

Hydroscopic. (Fransen, Z. anorg. 1908, 60. 289.)

Strontium chloride hydroxylamine,  $2\text{SrCl}_2$ ,  $5\text{NH}_2\text{OH} + 2\text{H}_2\text{O}$ .

As Ca comp. (Antonow, J. Russ. Phys. Chem. Soc. 1905, 37. 482.)

Strontium hydrogen chloride hydroxylamine,  $2\text{SrCl}_2$ ,  $3\text{HCl}$ ,  $9\text{NH}_2\text{OH} + \text{H}_2\text{O}$ .

(Antonow, J. Russ. Phys. Chem. Soc. 1905, 37. 482.)

Strontium chlorofluoride,  $\text{SrF}_2$ ,  $\text{SrCl}_2$ .Decomp. by  $\text{H}_2\text{O}$ , by very dil.  $\text{HCl}$ ,  $\text{HNO}_3$  or acetic acid, by hot dil. or conc.  $\text{H}_2\text{SO}_4$ .

Sol. in conc. HCl or HNO<sub>3</sub>. Insol. in, and not decomp. by cold or boiling alcohol. (Defacqz, A. ch. 1904, (8) 1. 355.)

**Strontium fluoride, SrF<sub>2</sub>.**

Somewhat sol. in H<sub>2</sub>O. (Fr. Röder.)  
1 l. H<sub>2</sub>O dissolves 113.5 mg. SrF<sub>2</sub> at 0.26°;  
117.3 mg. at 17.4°; 119.3 mg. at 27.4°.  
(Kohlrausch, Z. phys. Ch. 1908, 64. 168.)  
Insol in HF+Aq. (Berzelius.)  
Boiling HCl+Aq dissolves; sl. attacked by boiling HNO<sub>3</sub>+Aq; decomp. by hot H<sub>2</sub>SO<sub>4</sub>. (Poulenc, C. R. 116. 987.)

**Strontium stannic fluoride.**

See Fluostannate, strontium.

**Strontium titanium fluoride.**

See Fluotitanate, strontium.

**Strontium fluoiodide, SrF<sub>2</sub>, SrI<sub>2</sub>.**

Decomp. by cold H<sub>2</sub>O, more rapidly by hot H<sub>2</sub>O. Decomp. by dil. HCl, dil. HNO<sub>3</sub>, dil. H<sub>2</sub>SO<sub>4</sub>, or conc. H<sub>2</sub>SO<sub>4</sub>, also by alcohol and by ether, if not absolute. (Defacqz, A. ch. 1904, (8) 1. 358.)

**Strontium hydride, SrH.**

Decomp. by H<sub>2</sub>O or HCl+Aq. (Winkler, B. 24. 1976.)

SrH<sub>2</sub>. Decomp. by H<sub>2</sub>O. (Gautier, C. R. 1902, 134. 100.)

**Strontium hydroselenide.**

Sol. in H<sub>2</sub>O.

**Strontium hydrosulphide, SrS<sub>2</sub>H<sub>2</sub>.**

Sol. in H<sub>2</sub>O; decomp. by boiling.

**Strontium hydroxide, SrO<sub>2</sub>H<sub>2</sub>, and +8H<sub>2</sub>O.**

Deliquescent.

Sol. in 50 pts. cold, and 2.4 pts. boiling H<sub>2</sub>O (Buchs); in 50 pts. H<sub>2</sub>O at 15.56° (Dalton); in 51.4 pts. H<sub>2</sub>O at 15.56°, and 2 pts. at 100° (Hope); in 52 pts. H<sub>2</sub>O at 18°, and 2.4 pts. at 100° (Berzelius); in 48 pts. H<sub>2</sub>O at 18.75° (Abt).  
100 pts. H<sub>2</sub>O at 20° dissolve 1.49 pts. SrO. (Bineau, C. R. 41. 509.)

100 pts. aqueous solution of SrO<sub>2</sub>H<sub>2</sub> contain pts. SrO and pts. SrO<sub>2</sub>H<sub>2</sub>+8H<sub>2</sub>O at t°.

t°	Pts. SrO	Pts. SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O	t°	Pts. SrO	Pts. SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O
0	0.35	0.90	55	2.54	6.52
5	0.41	1.05	60	3.03	7.77
10	0.48	1.23	65	3.62	9.29
15	0.57	1.46	70	4.35	11.16
20	0.68	1.74	75	5.30	13.60
25	0.82	2.10	80	6.56	16.83
30	1.00	2.57	85	9.00	23.09
35	1.22	3.13	90	12.00	30.78
40	1.48	3.80	95	15.15	38.86
45	1.78	4.57	100	18.60	47.71
50	2.13	5.46	...	...	...

(Scheibler, J. pharm. Chim. 1883, (5) 8. 540.)

Sol. in cold NH<sub>4</sub>Cl+Aq. (Rose.)

**Solubility in Sr(NO<sub>3</sub>)<sub>2</sub>+Aq at 25°.**

Sp. gr. 25°/25°	G. SrO as Sr(OH) <sub>2</sub> in 100 g. H <sub>2</sub> O	G. Sr(NO <sub>3</sub> ) <sub>2</sub> in 100 g. H <sub>2</sub> O
1.481	0.0	79.27
*1.506	1.76	81.06
1.490	1.71	74.27
1.450	1.55	66.88
1.419	1.51	63.71
1.403	1.47	60.37
1.381	1.41	56.30
1.359	1.34	52.90
1.327	1.27	46.97
1.317	1.20	44.03
1.291	1.14	40.83
1.267	1.11	37.81
1.239	1.03	32.41
1.217	1.01	28.80
1.206	0.96	26.58
1.178	0.95	23.83
1.148	0.91	17.96
1.126	0.87	16.21
1.108	0.84	12.78
1.079	0.81	8.96
1.059	0.79	6.29
1.033	0.78	4.45

\*Solution is sat. with respect to both substances.

(Parsons and Perkins, J. Am. Chem. Soc. 1910, 32. 1388.)

Sol. in methyl alcohol. At room temp. 1 l. contains 31.5 g. SrO. (Neuberg and Revald; Biochem. Z. 1908, 9. 540.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Sol. in an aqueous solution of cane sugar. (Hunton, Phil. Mag. (3) 11. 156.)

**Solubility in H<sub>2</sub>O containing 10 g. sugar at t°.**

t°	g. SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O	t°	g. SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O
3	3.10	24	4.79
15	3.79	40	9.70

(Sidersky, C. C. 1886. 57.)

+8H<sub>2</sub>O. 0.0835 mol. is sol. in 1 l. H<sub>2</sub>O at 25°. (Rothmund, Z. phys. Ch. 1909, 69. 539.)

**Solubility in organic compds.+Aq at 25°.**

Solvent	Mol. SrO <sub>2</sub> H <sub>2</sub> +8H <sub>2</sub> O sol. in 1 litre
water	0.0835
0.5-N methyl alcohol	0.0820
" ethyl alcohol	0.0744
" propyl alcohol	0.0708
" tert. amyl alcohol	0.0630
" acetone	0.0692
" ether	0.0645

Solubility in organic compds. + Aq at 25°.—  
*Continued.*

Solvent	Mol. $\text{SrO}_2\text{H}_2 + 8\text{H}_2\text{O}$ sol. id 1 litre
0.5-N glycol	0.9922
" glycerine	0.1094
" mannitol	0.1996
" urea	0.0820
" ammonia	0.0785
" diethyl amine	0.0586
" pyridine	0.0694

(Rothmund, Z. phys. Ch. 1909, **69**, 539.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)

*See also* Strontium oxide.

Strontium iodide,  $\text{SrI}_2$ , and +6, or  $7\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0° 20° 40° 70° 100°

164 179 196 250 370 pts.  $\text{SrI}_2$ .

(Kremers, Pogg. **103**, 65.)

Sat. aq. solution contains at:

—20° —10° —3° +7° 11° 18° 38°

60.0 60.3 62.2 63.0 63.4 63.5 64.8%  $\text{SrI}_2$ ,

52° 63° 77° 81° 97° 105° 120 175°

66.0 68.5 70.5 74.0 79.2 79.4 80.8 85.6%  $\text{SrI}_2$ .

(Étard, A. ch. 1894, (7) **2**, 543.)

Sp. gr. of  $\text{SrI}_2$  + Aq at 19.5° containing:

5 10 20 30 %  $\text{SrI}_2$ ,  
1.045 1.091 1.200 1.330

40 50 60 65 %  $\text{SrI}_2$ .

1.491 1.695 1.955 2.150

(Kremers, Pogg. **103**, 67; calculated by  
Gerlach, Z. anal. **8**, 285.)

Sat. solution in abs. ethyl alcohol contains  
at:

—20° +4° 39° 82°  
2.6 3.1 4.3 4.7%  $\text{SrI}_2$ .

(Étard, A. ch. 1894, (7) **2**, 565.)

Strontium periodide,  $\text{SrI}_2 + 15\text{H}_2\text{O}$ .

(Mosnier, A. ch. 1897, (7) **12**, 399.)

$\text{SrI}_2$ . (Hers and Bulla, Z. anorg. 1911, **71**, 255.)

Strontium stannous iodide.

Very sol. in  $\text{H}_2\text{O}$ . (Boullay.)

Strontium zinc iodide,  $\text{SrZnI}_4 + 9\text{H}_2\text{O}$ .

Hydroscopic. (Ephraim, Z. anorg. 1910, **67**, 385.)

Strontium nitride,  $\text{Sr}_3\text{N}_2$ .

Decomp.  $\text{H}_2\text{O}$  violently, but not alcohol.  
(Maquenne, A. ch. (6) **29**, 225.)

Strontium oxide,  $\text{SrO}$ .

Decomp. by  $\text{H}_2\text{O}$  to  $\text{SrO}_2\text{H}_2$ , which see.

Sol. in 160 pts.  $\text{H}_2\text{O}$  at 15.56° (Dalton); in 50 pts. at 100° (Dalton); in 130 pts. at 20° (Bineau); in 40 pts. cold, and 20 pts. hot  $\text{H}_2\text{O}$  (Dumas).

Very sl. sol. in alcohol. Insol. in ether.

1 l. methyl alcohol dissolves 11.2 g.  $\text{SrO}$ .  
(Neuberg and Rewald, Biochem. Z. 1908, **9**, 540.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329; Eidmann, C. C. **1899**, II. 1014.)

Sol. in cane sugar + Aq.

Solubility in  $\text{H}_2\text{O}$  containing 10 g. sugar at t°.

t°	g. $\text{SrO}$	t°	g. $\text{SrO}$
8	1.21	24	1.87
15	1.48	40	3.55

(Sidersky, C. C. **1896**, 57.)

*See also* Strontium hydroxide.

Strontium peroxide,  $\text{SrO}_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in acids and  $\text{NH}_4\text{Cl}$  + Aq. Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Conroy, Chem. Soc. (2) **11**, 812.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329; Eidmann, C. C. **1899**, II. 1014.)

Strontium oxybromide,  $\text{SrBr}_2$ ,  $\text{SrO} + 9\text{H}_2\text{O}$ .

Not hygroscopic; sol. in  $\text{H}_2\text{O}$ . (Tassilly, C. R. 1895, **120**, 1339.)

Strontium oxychloride,  $\text{SrCl}_2$ ,  $\text{SrO} + 9\text{H}_2\text{O}$ .

Very easily decomp. by  $\text{H}_2\text{O}$  and alcohol.  
(André, A. ch. (6) **3**, 76.)

Strontium oxyiodide,  $2\text{SrI}_2$ ,  $5\text{SrO} + 30\text{H}_2\text{O}$ .

Not hygroscopic; sol. in  $\text{H}_2\text{O}$ . (Tassilly, C. R. 1895, **120**, 1339.)

Strontium oxysulphide,  $\text{Sr}_2\text{OS}_4 + 12\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Insol. in alcohol, ether, and  $\text{CS}_2$ . (Schöne.)

Mixture of  $\text{SrS}_2\text{O}_6$  and  $\text{SrS}_2$ . (Geuther, A. **224**, 178.)

Strontium phosphide,  $\text{Sr}_3\text{P}_2$ .

*Crystallized.* Sol. in dil. acids; insol. in conc. acids; decomp. by  $\text{H}_2\text{O}$ . Insol. in organic solvents at ord. temp. (Jaboin, C. R. 1899, **129**, 764.)

Strontium selenide,  $\text{SrSe}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Fabre, C. R. **102**, 1469.)

Strontium silicide,  $\text{SrSi}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bradley, C. N. 1900, **82**, 150.)

**Strontium sulphide, SrS.**

Sol. in  $H_2O$  with decomp. into  $SrO_2H_2$  and  $SrS_2H_2$ .

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Strontium tetrasulphide, SrS<sub>4</sub>.**

Very deliquescent, and sol. in  $H_2O$  and alcohol. Aqueous solution decomp. on air. Cryst. with 2, or 6  $H_2O$ . (Schöne, Pogg. 117. 58.)

**Strontium pentasulphide, SrS<sub>5</sub>.**

Known only in solution.

**Strontium stannic sulphide.**

See Sulphostannate, strontium.

**Sulphaluminate acid.****Silver sulphaluminate, 4Ag<sub>2</sub>S, 5Al<sub>2</sub>S<sub>3</sub>.**

(Cambi, Real. Ac. Einc. 1912, (5) 21, II. 837.)

**Sulphamic acid, HOSO<sub>2</sub>NH<sub>2</sub>.**

See Amidosulphonic acid.

**Ammonium sulphamate, 2NH<sub>3</sub>, SO<sub>2</sub>.**

(Woronin.)

Is ammonium imidosulphonate, which see. (Berglund.)

**Ammonium sulphamate, acid, 3NH<sub>3</sub>, 2SO<sub>2</sub>.**

(Woronin.)

Is basic ammonium imidosulphonate, which see. (Berglund.)

**Barium sulphamate, basic, 2BaO, 3SO<sub>2</sub>, 2NH<sub>3</sub>.**

Somewhat sol. in  $H_2O$ , easily in  $HCl + Aq$ . (Jacquelin, A. ch. (3) 8. 304.)

$BaS_2O_6(NH_3)_2$ . Sl. sol. in  $H_2O$ . Decomp. by heating with  $H_2O$ . (Woronin, J. B. 1860. 80.)

Is barium imidosulphonate. (Berglund.)

**Sulphamide, SO<sub>2</sub>(NH<sub>2</sub>)<sub>2</sub>.**

Very sol. in  $H_2O$ . (Regnault, A. ch. 69. 170; Mente, A. 243. 267.)

Insol. in alcohol, ether, etc. (Traube, B. 26. 607.)

Very sol. in  $H_2O$ .

Sl. sol. in abs. alcohol.

Sl. sol. in dry ether. (Divers and Ogawa, Chem. Soc. 1902, 81. 504.)

Very sol. in liquid  $NH_3$ . (Franklin and Stafford, Am. Ch. J. 1902, 28. 95.)

Sol. in alcohol; very sol. in  $H_2O$ . (Hantzsch, B. 1901, 34. 436.)

**Silver sulphamide, SO<sub>2</sub>(NHAg)<sub>2</sub>.**

Sl. sol. in cold  $H_2O$ . Sol. in  $HNO_3$ , and  $(NH_4)_2CO_3 + Aq$ . (Traube, B. 26. 607.)

$3NH_3$ , 2SO<sub>2</sub>. (Jacquelin.)

Is basic ammonium imidosulphonate, which see. (Berglund.)

**Sulphamidic acid.**

(Fremy.)

See Imidosulphonic acid.

**Sulphaminoplatinous acid.****Ammonium tetrasulphaminoplatinite,**

$[Pt(SO_2NH_2)_4](NH_4)_2 + 6H_2O$ .

Sl. sol. in cold  $H_2O$ . (Ramberg, B. 1912, 45. 1512.)

**Potassium —,  $[Pt(SO_2NH_2)_4]K_2 + 2H_2O$ .**

Very al. sol. in cold  $H_2O$ . (Ramberg.)

**Sodium —.**

Easily sol. in cold  $H_2O$ . (Ramberg.)

**Sulphammonic, and Metasulphammonic acids.**

(Fremy.)

See Nitrilosulphonic acid.

**Monosulphammonic acid.**

(Claus.)

See Amidosulphonic acid.

**Disulphammonic acid.**

(Claus.)

See Imidosulphonic acid.

**Trisulphammonic acid.**

(Claus.)

See Nitrilosulphonic acid.

**Tetrasulphammonic acid.**

(Claus.)

Does not exist. See Nitrilosulphonic acid.

**Sulphammonium, S(NH<sub>2</sub>)<sub>2</sub>, 2NH<sub>3</sub>.**

Sol. in liquid  $NH_3$ .

Sol. in abs. alcohol and anhydrous ether. (Moissan, C. R. 1901, 132. 517.)

**Sulphantimonic acid.****Sulphantimonates.**

The alkali sulphantimonates are sol. in  $H_2O$ , but the solutions decomp. on the air; most of the other sulphantimonates are insol. in  $H_2O$ ; all sulphantimonates are insol. in alcohol. (Rammelsberg.)



**Ammonium sulphantimonate,  $(\text{NH}_4)_3\text{SbS}_4$ .**

Sol. in  $\text{H}_2\text{O}$ .  
Sol. in dil. acids with decomp. (Stanek,  
Z. anorg. 1898, 17. 122.)  
+4 $\text{H}_2\text{O}$ . (Stanek.)

Solubility of  $(\text{NH}_4)_3\text{SbS}_4 + 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $(\text{NH}_4)_3\text{SbS}_4$	Solid phase
- 1.9	9.9	Ice
- 5	20.0	"
- 8	30.2	"
-13.5	41.6	Ice + $(\text{NH}_4)_3\text{SbS}_4 \cdot 4\text{H}_2\text{O}$
0	41.6	$(\text{NH}_4)_3\text{SbS}_4 \cdot 4\text{H}_2\text{O}$
+20	47.7	"
30	54.5	"

(Donk, Chem. Weekbl. 1908, 5. 529.)

Solubility of  $(\text{NH}_4)_3\text{SbS}_4$  in alcohol at  $10^\circ$ .

Solid phase,  $(\text{NH}_4)_3\text{SbS}_4 + 4\text{H}_2\text{O}$ .

% $\text{C}_2\text{H}_5\text{OH}$	% $(\text{NH}_4)_3\text{SbS}_4$	% $\text{C}_2\text{H}_5\text{OH}$	% $(\text{NH}_4)_3\text{SbS}_4$
0	43.2	43.1	8.7
5.1	35.9	53.1	4.1
19.1	23.1	93.3	0

(Donk, l. c.)

**Antimonyl sulphantimonate,  $(\text{SbO})_2\text{SbS}_4$ .**

Sol. in  $\text{HCl}$ . (Rammelsberg, Pogg. 1841,  
52. 236.)

**Barium sulphantimonate,  $\text{Ba}_3(\text{SbS}_4)_2 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

**Barium potassium sulphantimonate,**

$\text{KBaSbS}_4 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

Decomp. by acids. (Glatzel, Z. anorg.  
1911, 72. 100.)

**Bismuth sulphantimonate.**

Ppt.

**Cadmium sulphantimonate.**

Ppt. (Rammelsberg, Pogg. 52. 236.)

**Calcium sulphantimonate,  $\text{Ca}_3(\text{SbS}_4)_2$ .**

Partially sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

**Cobaltous sulphantimonate,  $\text{Co}_2(\text{SbS}_4)_2$ .**

Ppt. Decomp. by  $\text{HCl} + \text{Aq}$ . (Rammels-  
berg, Pogg. 52. 236.)

**Cupric sulphantimonate,  $\text{Cu}_2(\text{SbS}_4)_2$ .**

Ppt. (Rammelsberg, Pogg. 52. 226.)

**Iron (ferrous) sulphantimonate.**

Ppt.

**Iron (ferric) sulphantimonate,  $\text{Fe}_2(\text{SbS}_4)_2$ .**

(Rammelsberg, Pogg. 52. 234.)

**Lead sulphantimonate,  $\text{Pb}_2(\text{SbS}_4)_2$ .**

Ppt. Decomp. by  $\text{KOH} + \text{Aq}$ . (Rammels-  
berg, Pogg. 52. 223.)

**Lithium sulphantimonate,  $\text{Li}_3\text{SbS}_4 + 8\frac{1}{2}\text{H}_2\text{O}$ .**

100 g. sat. solution in  $\text{H}_2\text{O}$  contain 50.8 g.  
anhyd.  $\text{Li}_3\text{SbS}_4$ .

Solubility in alcohol at  $30^\circ$ .

% alcohol	% $\text{Li}_3\text{SbS}_4$	Solid phase
0	50.8	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O}$
13.3	46.3	"
51.9	30.7	"
54.8	29.9	"
58.4	30.8	$\text{Li}_3\text{SbS}_4 \cdot 8\frac{1}{2}\text{H}_2\text{O} + \text{Li}_3\text{SbS}_4$
58.6	32.3	"
65.26	29.31	$\text{Li}_3\text{SbS}_4$
74.3	24.1	"
79.5	20.5	"

(Schreinemakers and Jacobs, Ch. Weekbl.  
1910, 72. 213.)

+9 $\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Brinkmann,  
Dissert. 1891.)

+10 $\text{H}_2\text{O}$ . Solubility of  $\text{Li}_3\text{SbS}_4 + 10\text{H}_2\text{O}$  in  
 $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Li}_3\text{SbS}_4$	Solid phase
- 1.7	7.1	Ice
- 3.2	12.8	"
- 5.1	17.5	"
-10.8	23.2	"
-15.9	28.5	"
-26.2	35.3	"
-42	40.4	Ice + $\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
0	45.5	$\text{Li}_3\text{SbS}_4 \cdot 10\text{H}_2\text{O}$
+10	46.9	"
30	50.1	"
50	51.3	"

(Donk, Chem. Weekbl. 1908, 5. 629.)

At  $10^\circ$ , 100 g. sat.  $\text{Li}_3\text{SbS}_4 + 10\text{H}_2\text{O}$  in 10.7  
% alcohol contain 41.8 g.  $\text{Li}_3\text{SbS}_4$ ; 26.2%  
alcohol, 36.5 g.  $\text{Li}_3\text{SbS}_4$ . (Donk, l. c.)

**Magnesium sulphantimonate,  $\text{Mg}_2(\text{SbO}_4)_2$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . Decomp. by  
alcohol.

**Mercurous sulphantimonate,  $(\text{Hg}_2)_2(\text{SbS}_4)_2$ .**

Ppt.

**Mercuric sulphantimonate,  $\text{Hg}_2(\text{SbS}_4)_2$ .**

Ppt. (Rammelsberg, Pogg. 52. 229.)

**Mercuric sulphantimonate chloride,**  
 $\text{Hg}_2(\text{SbS}_4)_2 \cdot 3\text{HgCl}_2 \cdot 3\text{HgO}$ .

Insol. in acids, except aqua regia. (Rammelsberg.)

**Nickel sulphantimonate,**  $\text{Ni}_2(\text{SbS}_4)_2$ .

Ppt. Decomp. by hot  $\text{HCl} + \text{Aq}$ . (Rammelsberg, Pogg. 52. 226.)

**Potassium sulphantimonate,**  $\text{K}_2\text{SbS}_4$ .

Sol. in  $\text{H}_2\text{O}$ .

Solubility of  $\text{K}_2\text{SbS}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{K}_2\text{SbS}_4$	Solid phase
- 1.3	9.5	Ice
- 2.6	17.1	
- 4	24.2	
- 7.2	35.4	
- 10.6	42.9	
- 13.5	48.8	"
- 18.5	52.6	
- 28.8	59.6	"
- 34	62	
- 10	65.5	$\text{Ice} + \text{K}_2\text{SbS}_4 \cdot 6\text{H}_2\text{O}$
- 4.5	69.1	
0	75.4	$\text{K}_2\text{SbS}_4 \cdot 5\text{H}_2\text{O}$
+ 10	76.2	
30	77.1	"
50	77.7	
80	79.2	

(Donk, Chem. Weekbl. 1908, 5. 529, 629, 767.)

Solubility of  $\text{K}_2\text{SbS}_4$  in  $\text{KOH} + \text{Aq}$  at  $25^\circ$ .

% $\text{K}_2\text{SbS}_4$	% $\text{KOH}$	Solid phase
75	0	$\text{K}_2\text{SbS}_4 \cdot 5\text{H}_2\text{O}$
68.4	3.4	
56.8	11.0	$\text{K}_2\text{SbS}_4 \cdot 3\text{H}_2\text{O}$
50.9	16.1	
37.7	25.5	"
19.8	40.5	
11.5	46.9	$\text{K}_2\text{SbS}_4$
9.4	49.9	
00.0	56.3	$\text{K}_2\text{SbS}_4 + \text{KOH} \cdot 2\text{H}_2\text{O}$

(Donk.)

Solubility of  $\text{K}_2\text{SbS}_4$  in alcohol +  $\text{Aq}$  at  $10^\circ$ .

% $\text{C}_2\text{H}_5\text{OH}$	% $\text{K}_2\text{SbS}_4$	Solid phase
94	0	$\text{K}_2\text{SbS}_4 \cdot 5\text{H}_2\text{O}$
90.5	0	
0.8	69.2	"
0	76.1	

\* Two liquid layers are formed.

Composition of the liquid layers.

Alcohol layer		$\text{H}_2\text{O}$ layer	
% $\text{C}_2\text{H}_5\text{OH}$	% $\text{K}_2\text{SbS}_4$	% alcohol	% $\text{K}_2\text{SbS}_4$
85	0	1.1	67.4
54.7	2.2	3.4	49.0
46.9	4.2	3.8	45.6
16	27.4	...	...
....	....	31.1	12.7

(Donk, l. c.)

+  $4\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ ; more sol. than the Na salt.

+ 3, 5, and  $6\text{H}_2\text{O}$ . See Donk above.

$2\text{K}_2\text{S} \cdot \text{Sb}_2\text{S}_3$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 168.)

$\text{K}_2\text{S} \cdot 2\text{Sb}_2\text{S}_3 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Ditte.)

$\text{K}_2\text{S} \cdot \text{Sb}_2\text{S}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Ditte.)

$\text{K}_2\text{S} \cdot 2\text{Sb}_2\text{S}_3$ . (Ditte.)

**Silver sulphantimonate,**  $\text{Ag}_2\text{SbS}_4$ .

Insol. in  $\text{H}_2\text{O}$  or acids. Decomp. by  $\text{KOH} + \text{Aq}$ . (Rammelsberg, Pogg. 52. 218.)

**Sodium sulphantimonate,**  $\text{Na}_2\text{SbS}_4 + 9\text{H}_2\text{O}$ .

(Schlippe's salt.) Sol. in 2.9 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . Aqueous solution is precipitated by alcohol. (Rammelsberg.)

Sol. in 3 pts. cold  $\text{H}_2\text{O}$ . (van den Corput.)

Sol. in 4 pts. cold  $\text{H}_2\text{O}$ . (Duffos.)

Sol. in 1 pt. boiling  $\text{H}_2\text{O}$ . (Duffos.)

Solubility of  $\text{Na}_2\text{SbS}_4 + 9\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{Na}_2\text{SbS}_4$	Solid phase
- 0.1	0.5	Ice
- 0.65	4	
- 0.9	5.7	
- 1.26	7.8	
- 1.45	9.2	
- 1.75	11.2	"
0	11.3	
15	19.3	$\text{Na}_2\text{SbS}_4 \cdot 9\text{H}_2\text{O}$
30	27.1	
38	32	"
49.6	38.9	
59.6	45	"
69.6	50.7	
79.5	57.1	"

(Donk, Chem. Weekbl. 1908, 5. 529, 629, 767.)

Solubility of  $\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$ .

$\text{Na}_3\text{SbS}_4$	$\text{Na}_2\text{S}_2\text{O}_3$	Solid phase
$t^\circ = 10^\circ$		
11.8	0	$\text{Na}_3\text{SbS}_4, 9\text{H}_2\text{O}$
4.4	4.9	"
0.8	14.6	"
0.1	27.3	"
0.0	33.6	$\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
$t^\circ = 30^\circ$		
19.9	7.7	$\text{Na}_3\text{SbS}_4, 9\text{H}_2\text{O}$
12.5	16.4	"
4.2	37.7	"
1	43.8	"
1	47	"
1	47.8	$\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
0	45.8	$\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$

(Donk, l. c.)

Solubility of  $\text{Na}_3\text{SbS}_4$  in alcohol + Aq at  $t^\circ$ .Solid phase,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$ .

$t = 0^\circ$		$t = 30^\circ$		$t^\circ = 65^\circ$	
% $\text{C}_2\text{H}_5\text{OH}$	% $\text{Na}_3\text{SbS}_4$	% $\text{C}_2\text{H}_5\text{OH}$	% $\text{Na}_3\text{SbS}_4$	% $\text{C}_2\text{H}_5\text{OH}$	% $\text{Na}_3\text{SbS}_4$
0	11.8	5.	19.3	0	47.9
3.7	8.2	10.3	14.6	4.7	39.3
12.7	3.2	24.8	6.4	8	36.5
29.	0.9	46	1.2	* 54.1	4.1
60.8	0	76.2	0	81.	0

\* Two layers are formed.

## Composition of above layers.

Alcohol layer		$\text{H}_2\text{O}$ layer	
% alcohol	% $\text{Na}_3\text{SbS}_4$	% alcohol	% $\text{Na}_3\text{SbS}_4$
54.1	4.1	8.0	36.5
40.4	10.2	14.3	27.8
33.5	14.1	18.8	24.1
....	....	27.2	18.0

(Donk, l. c.)

Solubility of  $\text{Na}_3\text{SbS}_4$  in methyl alcohol at  $t^\circ$ .Solid phase,  $\text{Na}_3\text{SbS}_4 + 9\text{H}_2\text{O}$ .

$t = 0^\circ$		$t = 30^\circ$	
% $\text{CH}_3\text{OH}$	% $\text{Na}_3\text{SbS}_4$	% $\text{CH}_3\text{OH}$	% $\text{Na}_3\text{SbS}_4$
3.4	8.6	0	27.1
15.5	2.8	18.1	12.8
23.1	2.1	33.1	5.8
50.3	0.3	65.7	0.1
57	0.1	84.2	0.1
81.7	0.05	91.2	1.2
92	0.2	94.	3.9
95.9	2.0	....	....

(Donk, l. c.)

## Sodium sulphantimonate thiosulphate,

 $\text{Na}_3\text{SbS}_4, 2\text{Na}_2\text{S}_2\text{O}_3 + 20\text{H}_2\text{O}$ .Efflorescent, and decomp. by  $\text{H}_2\text{O}$ . (Unger, Arch. Pharm. (2) 147. 193.)No double salt exists. See Donk,  $\text{Na}_3\text{SbS}_4 + \text{Na}_2\text{S}_2\text{O}_3$  under  $\text{Na}_3\text{SbS}_4$ .

## Strontium sulphantimonate.

Sol. in  $\text{H}_2\text{O}$ ; pptd. by alcohol.

## Uranium sulphantimonate.

Ppt.

Zinc sulphantimonate,  $\text{Zn}_2(\text{SbS}_4)_2$ .Ppt. Sol. in hot  $\text{Na}_3\text{SbS}_4 + \text{Aq}$ ; insol. in  $\text{ZnSO}_4 + \text{Aq}$ . Partially sol. in  $\text{KOH} + \text{Aq}$ ; sol. in hot  $\text{HCl} + \text{Aq}$ . (Rammelsberg, Pogg. 52. 233.)

## Sulphantimonous acid.

Ammonium metasulphantimonite,  $\text{NH}_4\text{SbS}_3$ .Insol. in  $\text{H}_2\text{O}$ . (Rouget, C. R. 1898, 126. 1145.)+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. in the air. (Stanek, Z. anorg. 1898, 17. 119.)

## Ammonium orthosulphantimonite,

 $(\text{NH}_4)_2\text{Sb}_2\text{S}_5$ .Easily decomp. Stable only in presence of  $(\text{NH}_4)_2\text{S}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol, by which it is pptd. from aqueous solution. (Pouget, A. ch. 1899, (7) 18. 536.)

## Ammonium parasulphantimonite,

 $(\text{NH}_4)_2\text{Sb}_2\text{S}_7$ .

Stable in the air.

Insol. in  $\text{H}_2\text{O}$ .

Decomp. by acids. (Stanek, Z. anorg. 1898, 17. 120.)

Stable; cryst. from hot solutions. (Pouget C. R. 1898, 126. 1145.)

**Ammonium silver orthosulphantimonite,**  
 $\text{NH}_4\text{Ag}_2\text{Sb}_2\text{S}_5$ .Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 551.)**Barium metasulphantimonite,**  $\text{BaSb}_2\text{S}_4$   
 $+4\frac{1}{2}\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 541.)**Barium orthosulphantimonite,**  $\text{Ba}_2\text{Sb}_2\text{S}_5$   
 $+8\text{H}_2\text{O}$ .Decomp. in the air and by  $\text{H}_2\text{O}$ . Somewhat sol. in  $\text{BaS}+\text{Aq}$ . (Pouget, C. R. 1898, 126. 1792.)**Barium pyrosulphantimonite,**  $\text{Ba}_2\text{Sb}_2\text{S}_5$   
 $+8\text{H}_2\text{O}$ .Decomp. by  $\text{H}_2\text{O}$ .Nearly insol. in  $\text{BaS}+\text{Aq}$ . (Rouget.)**Barium sulphantimonite,**  $\text{Ba}_2\text{Sb}_2\text{S}_5+10\text{H}_2\text{O}$ .

Pptd. from aq. solution of ortho and pyrobarium salts. (Pouget.)

 $\text{Ba}_2\text{Sb}_2\text{S}_{11}+16\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 538.)**Calcium sulphantimonite basic,**  $\text{Ca}(\text{OH})\text{Sb}_2\text{S}_5$ .Insol. in  $\text{H}_2\text{O}$ .Sol. in conc.  $\text{HCl}$ . (Pouget, A. ch. 1899, (7) 18. 544.)**Calcium pyrosulphoantimonite,**  $\text{Ca}_2\text{Sb}_2\text{S}_5$   
 $+15\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  without decomp. (Pouget, C. R. 1898, 126. 1793.)**Cobaltous orthosulphantimonite,**  $\text{Co}_2\text{Sb}_2\text{S}_5$ .

Ppt. (Pouget, A. ch. 1899, (7) 18. 554.)

**Cuprous metasulphantimonite,**  $\text{CuSbS}_3$ .Sol. in mixture of  $\text{HNO}_3$  and tartaric acid with separation of  $\text{S}$ .Insol. in  $\text{NH}_4\text{OH}+\text{Aq}$ . Decomp. by hot  $\text{KOH}$  and alkali sulphides  $+\text{Aq}$ . (Sommerlad, Z. anorg. 1898, 18. 430.)Min. *Wolfsberite*. Sol. in  $\text{HNO}_3+\text{Aq}$  with separation of  $\text{S}$  and  $\text{Sb}_2\text{O}_3$ .**Cuprous orthosulphantimonite,**  $\text{Cu}_2\text{Sb}_2\text{S}_5$ .

(Sommerlad, Z. anorg. 1898, 18. 432.)

Ppt. Insol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 556.)**Cuprous sulphantimonite,**  $\text{Cu}_2\text{Sb}_2\text{S}_7$ .Min. *Guejarite*.**Cupric orthosulphantimonite,**  $\text{Cu}_2\text{Sb}_2\text{S}_5$ .

Ppt. (Pouget, A. ch. 1899, (7) 18. 557.)

**Cuprous lead sulphantimonite,**  $\text{Cu}_2\text{Sb}_2\text{S}_5$ ,  
 $2\text{Pb}_2\text{Sb}_2\text{S}_5$ .Min. *Bourmonite*. Decomp. by  $\text{HNO}_3+\text{Aq}$ , and aqua regia.**Cuprous potassium orthosulphantimonite,**  
 $\text{Cu}_2\text{KSbS}_5$ .Ppt.; easily decomp. by  $\text{H}_2\text{O}$ . (Pouget, C. R. 1899, 126. 104.) $+3\text{H}_2\text{O}$ . Ppt., decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 556.)**Iron (ferrous) orthosulphantimonite,**  
 $\text{Fe}_2(\text{Sb}_2\text{S}_5)_2$ .

Ppt. (Pouget, A. ch. 1899, (7) 18. 554.)

Min. *Berthierite*. Sl. sol. in  $\text{HCl}+\text{Aq}$ ; easily sol. in aqua regia.**Lead orthosulphantimonite,**  $\text{Pb}_2(\text{Sb}_2\text{S}_5)_2$ .Ppt. Very sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 553.)Min. *Boulangerite*. Completely sol. in hot  $\text{HCl}+\text{Aq}$ ; decomp. by  $\text{HNO}_3+\text{Aq}$ .**Lead sulphantimonite.**Sol. in boiling conc.  $\text{HNO}_3+\text{Aq}$ . (Fournet.) $\text{Pb}(\text{SbS}_2)_2$ . Min. *Zinckenite*. Decomp. by hot  $\text{HCl}+\text{Aq}$ . $4\text{PbS}$ ,  $\text{Sb}_2\text{S}_5$ . Min. *Plagionite*. $2\text{PbS}$ ,  $\text{Sb}_2\text{S}_5$ . Min. *Jamesonite*. Decomp. by hot  $\text{HCl}+\text{Aq}$ . $4\text{PbS}$ ,  $\text{Sb}_2\text{S}_5$ . Min. *Meneghinite*. $5\text{PbS}$ ,  $\text{Sb}_2\text{S}_5$ . Min. *Geokronite*. $6\text{PbS}$ ,  $\text{Sb}_2\text{S}_5$ . Min. *Kibrickenite* (?).**Lead potassium orthosulphantimonite,**  
 $\text{PbKSbS}_5$ .Very sl. sol. in  $\text{H}_2\text{O}$ .Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 554.)**Lead silver sulphantimonite,**  $(\text{Ag}, \text{Pb})_2\text{Sb}_2\text{S}_{11}$ .Min. *Freieslebenite*.**Lithium orthosulphantimonite,**  $\text{Li}_2\text{Sb}_2\text{S}_5$   
 $+3\text{H}_2\text{O}$ .

Very deliquescent.

Very sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 530.)**Lithium parasulphantimonite,**  
 $\text{Li}_2\text{Sb}_2\text{S}_7+3\text{H}_2\text{O}$ .

Ppt. (Pouget, A. ch. 1899, (7) 18. 531.)

**Lithium silver orthosulphantimonite,**  
 $\text{LiAg}_2\text{Sb}_2\text{S}_5$ .Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 551.)**Manganous orthosulphantimonite,**  $\text{Mn}_2\text{Sb}_2\text{S}_5$ .Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 553.)**Manganous potassium orthosulphantimonite,**  
 $\text{MnKSbS}_5$ .Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 553.)

**Nickel orthosulphantimonite,  $\text{Ni}_3\text{Sb}_2\text{S}_6$ .**

Ppt. (Pouget, A. ch. 1899, (7) 18. 554.)

**Potassium metasulphantimonite,  $\text{KSbS}_3$ .**

Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 513.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but decomp. quickly.

Sol. in  $\text{H}_2\text{O}$ . (Stanek, Z. anorg. 1898, 17. 119.)**Potassium orthosulphantimonite,  $\text{K}_2\text{Sb}_2\text{S}_7$ .**

Very deliquescent.

Very sol. in  $\text{H}_2\text{O}$ .

Decomp. by acids. (Pouget, A. ch. 1899, (7) 18. 518.)

**Potassium sulphantimonite,  $\text{K}_2\text{Sb}_2\text{S}_7 + 3\text{H}_2\text{O}$ .**Sl. sol. in  $\text{H}_2\text{O}$  and not decomp. thereby. (Pouget, A. ch. 1899, (7) 18. 522.)

Decomp. in the air.

Sol. in  $\text{K}_2\text{S} + \text{Aq}$ . (Stanek, Z. anorg. 1898, 17. 120.) $2\text{K}_2\text{S}, \text{Sb}_2\text{S}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 103. 68.)

$x\text{K}_2\text{S}, y\text{Sb}_2\text{S}_3$ . Deliquescent. When  $\text{K}_2\text{S}$  is in excess, sol. in  $\text{H}_2\text{O}$ ; when  $\text{Sb}_2\text{S}_3$  is in excess, partially sol. Aqueous solution is decomp. by all acids, even  $\text{CO}_2$ , and by  $\text{K}_2\text{CO}_3$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ ,  $\text{KHCO}_3$ ,  $\text{NH}_4\text{HCO}_3 + \text{Aq}$ . Insol. in absolute alcohol. (Kohl.)

**Potassium hydrogen sulphantimonite,  $\text{KHSb}_2\text{S}_7$ .**

(Pouget, A. ch. 1899, (7) 18. 522.)

**Potassium silver orthosulphantimonite,  $\text{Ag}_3\text{KSb}_2\text{S}_7$ .**Decomp. by boiling  $\text{H}_2\text{O}$ . (Pouget, C. R. 1897, 124. 1519.)**Potassium zinc orthosulphantimonite,  $\text{KZnSb}_2\text{S}_7$ .**Decomp. by  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 552.)**Silver orthosulphantimonite,  $\text{Ag}_3\text{Sb}_2\text{S}_7$ .**Ppt. Sl. sol. in  $\text{H}_2\text{O}$ . (Pouget, A. ch. 1899, (7) 18. 547.)

Min. *Pyrrargyrite*. Sol. in  $\text{HNO}_3 + \text{Aq}$  with residue of S and  $\text{Sb}_2\text{O}_3$ .  $\text{KOH} + \text{Aq}$  dissolves out  $\text{Sb}_2\text{S}_3$ .

**Silver sulphantimonite.** $\text{AgSbS}_3$ . Min. *Miargyrite*. $5\text{Ag}_2\text{S}, \text{Sb}_2\text{S}_3$ . Min. *Stephanite*. Easily decomp. by warm  $\text{HNO}_3 + \text{Aq}$ . $12\text{Ag}_2\text{S}, \text{Sb}_2\text{S}_3$ . Min. *Polyargyrite*.**Silver sodium orthosulphantimonite,  $\text{Ag}_3\text{NaSb}_2\text{S}_7$ .**Decomp. by  $\text{H}_2\text{O}$ . Pouget, A. ch. 1899, (7) 18. 551.)**Sodium metasulphantimonite,  $\text{NaSbS}_3$ .**

Deliquescent. Decomp. by hot  $\text{H}_2\text{O}$ . When  $\text{Na}_2\text{S}$  is in excess, sol. in  $\text{H}_2\text{O}$ , but partially sol. if  $\text{Sb}_2\text{S}_3$  is in excess. (Unger, Arch. Pharm. (2) 148. 1.)

Ppt. Insol. in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1145.)**Sodium orthosulphantimonite,  $\text{Na}_2\text{Sb}_2\text{S}_7 + 9\text{H}_2\text{O}$ .**Decomp. in solution in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1144.)**Sodium sulphantimonite,  $\text{Na}_2\text{Sb}_2\text{S}_7 + 2\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1145.)

$\text{Na}_2\text{Sb}_2\text{S}_7$ . (Pouget, C. R. 1898, 126. 1144.)  
 $4\text{Na}_2\text{S}, 3\text{Sb}_2\text{S}_3 + 3\text{H}_2\text{O}$ . Permanent; sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (Kohl.)

**Strontium orthosulphantimonite,  $\text{Sr}_2\text{Sb}_2\text{S}_7 + 10\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Pouget, C. R. 1898, 126. 1793.)**Strontium pyrosulphantimonite,  $\text{Sr}_2\text{Sb}_2\text{S}_8 + 15\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  without essential decomp. (Pouget, C. R. 1898, 126. 1793.)**Zinc orthosulphantimonite,  $\text{Zn}_2\text{Sb}_2\text{S}_7$ .**

Ppt. (Pouget, A. ch. 1899, (7) 18. 552.)

**Orthosulpharsenic acid,  $\text{H}_2\text{AsS}_4$ .**

Ppt. Loses  $\text{H}_2\text{S}$  by prolonged boiling with  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 145.)

See also Sulphoxyarsenic acid:

**Ammonium sulpharsenate,  $(\text{NH}_4)_2\text{As}_2\text{S}_7$ .**Known only in solution in  $\text{H}_2\text{O}$ . Decomp. on boiling into— $\text{NH}_4\text{AsS}_4$ . Sol. in alcohol. $(\text{NH}_4)_2\text{AsS}_4$ . Sol. in  $\text{H}_2\text{O}$ . Precipitated by alcohol. $(\text{NH}_4)_2\text{S}, 12\text{As}_2\text{S}_3$ . Ppt. Insol. in  $\text{H}_2\text{O}$ .**Ammonium magnesium sulpharsenate,  $(\text{NH}_4)_2\text{S}, \text{MgS}, \text{As}_2\text{S}_3$ .****Ammonium sodium sulpharsenate,  $(\text{NH}_4)_2\text{AsS}_4, \text{Na}_2\text{AsS}_4$ .**Much more sol. in  $\text{H}_2\text{O}$  than  $\text{Na}_2\text{AsS}_4$ ; sl. sol. in cold, more sol. in hot alcohol. (Berzelius.)**Barium sulpharsenate,  $\text{Ba}(\text{AsS}_4)_2$ .**Sol. in  $\text{H}_2\text{O}$  and alcohol. Decomp. by evaporation. $\text{Ba}_2\text{As}_2\text{S}_7$ . Sol. in  $\text{H}_2\text{O}$  in all proportions with decomp. Decomp. by alcohol. $\text{Ba}_3(\text{AsS}_4)_2$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. $\text{BaS}, 3\text{As}_2\text{S}_3$ . Ppt. Insol. in  $\text{H}_2\text{O}$ .

**Barium potassium sulpharsenate,**  
 $\text{KBaAsS}_4 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

Decomp. by acids with separation of  $\text{As}_2\text{S}_3$ .  
 (Glatzel, Z. anorg. 1911, 71. 209.)

**Barium sulpharsenate sulpharsenite,**  
 $\text{Ba}_3(\text{AsS}_4)_2, \text{Ba}_2\text{As}_2\text{S}_7 + 4\text{H}_2\text{O}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .  
 (Nilson.)

**Bismuth sulpharsenate,  $2\text{Bi}_2\text{S}_3, 3\text{As}_2\text{S}_5$ .**

Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ .

$\text{Bi}_2\text{S}_3, 3\text{As}_2\text{S}_5$ . As above. (Berzelius.)

**Cadmium sulpharsenate.**

Ppt. (Berzelius, Pogg. 7. 88.)

**Calcium sulpharsenate,  $\text{Ca}_2\text{As}_2\text{S}_7$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol.

$\text{Ca}_2(\text{AsS}_4)_2$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol.

+  $10\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 169.)

$5\text{CaS}, 2\text{As}_2\text{S}_5 + 6\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ .  
 (Nilson, J. pr. (2) 14. 163.)

**Cerous sulpharsenate,  $\text{Ce}_2\text{As}_2\text{S}_7$ .**

Ppt.

$\text{Ce}_2(\text{AsS}_4)_2$ . Ppt.

$\text{Ce}_2(\text{As}_2\text{S}_7)_2$ . Ppt.

**Cobaltous sulpharsenate,  $\text{Co}_2\text{As}_2\text{S}_7$ .**

Ppt. Sol. in excess of sodium sulpharsenate +  $\text{Aq}$ .

**Cuprous sulpharsenate,  $\text{Cu}_2\text{AsS}_4$ .**

Ppt. (Preis, A. 257. 201.)

Min. *Enargite*. *Clarite*. Not wholly decomp. by  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{HCl} + \text{Aq}$  with residue of  $\text{As}_2\text{O}_3$ . Not attacked by  $\text{KOH} + \text{Aq}$ .

**Cupric sulpharsenate,  $\text{Cu}_2\text{As}_2\text{S}_7$ .**

Ppt. Sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ . Decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Berzelius.)

$\text{Cu}_2(\text{AsS}_4)_2$ . Ppt. (Preis, A. 257. 201.)

**Glucinum sulpharsenate.**

Sl. sol. in  $\text{H}_2\text{O}$ .

**Gold sulpharsenate,  $\text{AuAsS}_4$ .**

Sol. in pure  $\text{H}_2\text{O}$ . Insol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ .  
 $2\text{Au}_2\text{S}_3, 3\text{As}_2\text{S}_5$ . Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Iron (ferrous) sulpharsenate,  $\text{Fe}_2\text{As}_2\text{S}_7$ .**

Ppt. Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ . (Berzelius.)

**Iron (ferric) sulpharsenate,  $\text{Fe}_3(\text{As}_2\text{S}_7)_2$ .**

Ppt. Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ . (Berzelius.)

**Lead sulpharsenate,  $\text{Pb}_2\text{As}_2\text{S}_7$ .**

Ppt. (Berzelius.)

$\text{Pb}_2(\text{AsS}_4)_2$ . Ppt.

**Lithium sulpharsenate,  $\text{Li}_2\text{AsS}_4$ .**

Easily sol. in hot, less sol. in cold  $\text{H}_2\text{O}$ . Insol. in alcohol.

$\text{Li}_2\text{As}_2\text{S}_7$ . Completely sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol.

$\text{LiAsS}_4$ . Known only in acid solution.

**Magnesium sulpharsenate,  $\text{Mg}_2\text{As}_2\text{S}_7$ .**

Sol. in all proportions of  $\text{H}_2\text{O}$ , and in alcohol.

$\text{Mg}_2(\text{AsS}_4)_2$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. alcohol.

$3\text{MgS}, \text{As}_2\text{S}_5$ . Nearly insol. in  $\text{H}_2\text{O}$ .

$5\text{MgS}, 2\text{As}_2\text{S}_5 + 15\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Nilson.)

**Manganous sulpharsenate,  $\text{Mn}_2\text{As}_2\text{S}_7$ .**

Sl. sol. in  $\text{H}_2\text{O}$ .

$\text{Mn}_2(\text{AsS}_4)_2$ . Permanent. Sl. sol. in  $\text{H}_2\text{O}$ .

$6\text{MnS}, \text{As}_2\text{S}_5$ . Sl. sol. in  $\text{H}_2\text{O}$ .

**Mercurous sulpharsenate,  $(\text{Hg}_2)_2\text{As}_2\text{S}_7$ .**

Ppt.

**Mercuric sulpharsenate,  $\text{Hg}_2\text{As}_2\text{S}_7$ .**

Ppt. (Berzelius, Pogg. 7. 29.)

$\text{Hg}_2(\text{AsS}_4)_2$ . Ppt. (Preis, A. 257. 200.)

**Nickel sulpharsenate,  $\text{Ni}_2(\text{AsS}_4)_2$ .**

Ppt. Not decomp. by  $\text{HCl} + \text{Aq}$ . Sol. in  $\text{Na}_2\text{AsS}_4 + \text{Aq}$ . (Berzelius.)

$2\text{NiS}, \text{As}_2\text{S}_5$ . As above.

**Potassium sulpharsenate,  $\text{KAsS}_4$ .**

Known only in alcoholic solution.

$\text{K}_2\text{As}_2\text{S}_7$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $\text{K}_2\text{AsS}_4$ .

$\text{K}_2\text{AsS}_4$ . Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol.

+  $\text{H}_2\text{O}$ . Very deliquescent. (Nilson, J. pr. (2) 14. 159.)

**Potassium sodium sulpharsenate.**

Sol. in  $\text{H}_2\text{O}$ .

**Silver sulpharsenate,  $\text{Ag}_2\text{AsS}_4$ .**

Ppt. (Berzelius, Pogg. 7. 29.)

$\text{Ag}_2\text{As}_2\text{S}_7$ . Ppt.

**Sodium sulpharsenate,  $\text{NaAsS}_4$ .**

Known only in alcoholic solution.

$\text{Na}_2\text{As}_2\text{S}_7$ . Sol. in  $\text{H}_2\text{O}$ . Alcohol ppts.  $\text{Na}_2\text{AsS}_4$  from  $\text{H}_2\text{O}$  solution.

$\text{Na}_2\text{AsS}_4 + 7\frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol.

+  $8\text{H}_2\text{O}$ . Insol. in alcohol; very sol. in  $\text{H}_2\text{O}$ . (McCay, Z. anal. 1895, 34. 726.)

+  $9\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 160.)

$\text{Na}_2\text{S}, 12\text{As}_2\text{S}_5$  (?). Insol. in  $\text{H}_2\text{O}$ .

**Sodium zinc sulpharsenate,  $\text{NaZnAsS}_4 + 4\text{H}_2\text{O}$ .**

Sol. in hot  $\text{H}_2\text{O}$  with decomp. (Preis, A. 257. 202.)

**Strontium sulpharsenate,  $\text{Sr}_2(\text{As}_2\text{S}_4)_2$ .**Easily sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. $\text{Sr}_2\text{As}_2\text{S}_7$ . Easily sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $\text{Sr}_2(\text{As}_2\text{S}_4)_2$ .**Strontium sulpharsenate sulpharsenite,** $\text{Sr}_2(\text{As}_2\text{S}_4)_2, \text{Sr}_2\text{As}_2\text{S}_6 + 4\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 162.)**Thalious sulpharsenate,  $\text{Tl}_2\text{As}_2\text{S}_4$ .**Not decomp. by  $\text{H}_2\text{O}$ . Decomp. by dil. acids. Insol. in dil. alkali sulphides. Partially decomp. by boiling with a conc. solution of sodium sulphide. (Hawley, J. Am. Chem. Soc. 1907, 29. 1013.)**Tin (stannous) sulpharsenate.**

Ppt.

**Tin (stannic) sulpharsenate.**

Ppt.

**Uranic sulpharsenate,  $2\text{U}_2\text{S}_3, \text{As}_2\text{S}_4$ .**Ppt. Sol. in  $\text{Na}_2\text{As}_2\text{S}_4 + \text{Aq}$ .**Zinc sulpharsenate,  $\text{Zn}_2(\text{As}_2\text{S}_4)_2$ .**

Ppt. (Berzelius.)

 $2\text{ZnS}, \text{As}_2\text{S}_4$ . Ppt. (Berzelius.) $\text{ZnS}, \text{As}_2\text{S}_4$ . (Wöhler.)**Disulpharsenic acid.**

See Disulphoxyarsenic acid.

**Sulpharseniosulphomolybdic acid.****Ammonium sulpharseniosulphomolybdate,** $(\text{NH}_4)_2\text{As}_2\text{S}_7(\text{MoS}_3)_2 + 5\text{H}_2\text{O}$ .

Very unstable.

Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland, Z. anorg. 1897, 15. 49.)**Barium —,  $\text{Ba}_2\text{As}_2\text{S}_7(\text{MoS}_3)_2 + 14\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland.)**Potassium —,  $\text{KAsS}_2(\text{MoS}_3) + 4\text{H}_2\text{O}$ .**

(Weinland.)

 $\text{K}_4\text{As}_2\text{S}_7(\text{MoS}_3)_2 + 8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. by mineral acids. Insol. in alcohol. (Weinland.)**Sodium —,  $\text{NaAsS}_2(\text{MoS}_3) + 6\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{NaOH}$  and  $\text{NH}_3 + \text{Aq}$ . (Weinland.) $\text{Na}_4\text{As}_2\text{S}_7(\text{MoS}_3)_2 + 14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Decomp. by mineral acids. (Weinland.)**Sulpharseniosulphoxymolybdic acid.****Barium sulpharseniosulphoxymolybdate,** $\text{Ba}_2\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_3\text{O}_4) + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1897, 15. 60.)**Magnesium sulpharseniosulphoxymolybdate,** $\text{Mg}_2\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_3\text{O}_4) + 16\text{H}_2\text{O}$ .Very sol. in  $\text{H}_2\text{O}$ . (Weinland.)**Potassium —,  $\text{KAsS}_2(\text{MoSO}_3) + 2\frac{1}{2}\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  with decomp. (Weinland.) $\text{K}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_3\text{O}_4) + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Weinland.) $+ 10\text{H}_2\text{O}$ . (Weinland.)**Sodium —,  $\text{NaAsS}_2(\text{MoSO}_3) + 5\text{H}_2\text{O}$ .**Sl. sol. in cold, very sol. in hot  $\text{H}_2\text{O}$ . (Weinland.) $\text{Na}_4\text{As}_2\text{S}_7(\text{Mo}_2\text{S}_3\text{O}_4) + 15\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Weinland.)**Sulpharsenious acid.****Ammonium sulpharsenite,  $\text{NH}_4\text{As}_2\text{S}_5 + 2\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . Ppt. Sol. in  $\text{KOH}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . Sl. attacked by boiling  $\text{HCl} + \text{Aq}$ . (Nilson, J. pr. (2) 14. 42.) $(\text{NH}_4)_2\text{As}_2\text{S}_5 = 2(\text{NH}_4)_2\text{S}, \text{As}_2\text{S}_5$ . Sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $(\text{NH}_4)_2\text{As}_2\text{S}_5$ . $(\text{NH}_4)_2\text{As}_2\text{S}_5 = 3(\text{NH}_4)_2\text{S}, \text{As}_2\text{S}_5$ . Decomp. on air; sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. $(\text{NH}_4)_2\text{As}_2\text{S}_{10}$ . Sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 160.)**Barium sulpharsenite,  $\text{Ba}_2\text{As}_2\text{S}_5$ .**Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol. $+ 5\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 46.) $+ 15\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Nilson.)  $\text{Ba}_2(\text{As}_2\text{S}_5)_2$ . Sl. sol. in  $\text{H}_2\text{O}$ . Precipitated by alcohol. $+ 14\text{H}_2\text{O}$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Nilson.) $\text{Ba}_2(\text{As}_2\text{S}_5)_2 + 2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 44.) $\text{BaAs}_2\text{S}_{12}$ . Insol. in  $\text{HCl} + \text{Aq}$ . (Nilson.)**Bismuth sulpharsenite,  $2\text{Bi}_2\text{S}_3, \text{As}_2\text{S}_5$ .**

Ppt.

**Cadmium sulpharsenite.**

Ppt. (Berzelius, Pogg. 7. 146.)

**Calcium sulpharsenite,  $\text{Ca}_2\text{As}_2\text{S}_5$ .**Sol. in  $\text{H}_2\text{O}$ , from which alcohol ppts.  $\text{Ca}_2(\text{As}_2\text{S}_5)_2$ . $\text{Ca}_2(\text{As}_2\text{S}_5)_2$ . Sol. in  $\text{H}_2\text{O}$ . $+ 15\text{H}_2\text{O}$ . Precipitated by alcohol. $\text{Ca}(\text{As}_2\text{S}_5)_2 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 54.) $\text{CaAs}_2\text{S}_{11} + 10\text{H}_2\text{O} (?)$ . Insol. in cold  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Nilson.) $\text{CaAs}_2\text{S}_{12} + 10\text{H}_2\text{O} (?)$ . Sl. sol. in hot  $\text{H}_2\text{O}$ . (Nilson.) $\text{Ca}_7\text{As}_2\text{S}_{18} + 25\text{H}_2\text{O}$ . Sl. sol. in cold or hot  $\text{H}_2\text{O}$ . (Nilson.)**Cerous sulpharsenite,  $\text{Ce}_2\text{As}_2\text{S}_5$ .**

Ppt.

**Chromic sulpharsenite,  $2\text{Cr}_2\text{S}_3, 3\text{As}_2\text{S}_3$ .**Ppt. Insol. in  $\text{Na}_2\text{S} + \text{Aq.}$ **Cobaltous sulpharsenite,  $2\text{CoS}, \text{As}_2\text{S}_3$ .**

Ppt. Sol. in excess of sodium sulpharsenite + Aq.

**Cuprous sulpharsenite,**Min. *Binnite*. Decomp. by hot acids and  $\text{KOH} + \text{Aq.}$  $2\text{Cu}_2\text{S}, \text{As}_2\text{S}_3 = \text{Cu}_4\text{As}_2\text{S}_5$ . Decomp. by acids,  $\text{KOH}$  and  $\text{K}_2\text{S} + \text{Aq.}$  (Sommerlad, Z. anorg. 1898, 18. 434.)**Cupric sulpharsenite,  $\text{Cu}_2\text{AsS}_3$ .**Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq.}$  Sol. in  $\text{Na}_2\text{AsS}_3 + \text{Aq.}$  $\text{Cu}_2\text{As}_2\text{S}_5$ . Ppt. (Berzelius.)**Glucinum sulpharsenite,  $2\text{GlS}, \text{As}_2\text{S}_3$ .**Ppt. Sol. in acids; partly sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$ **Gold sulpharsenite,  $2\text{Au}_2\text{S}_3, 3\text{As}_2\text{S}_3$ .**

Ppt. (Berzelius.)

**Iron (ferrous) sulpharsenite.**Ppt. Sol. in  $\text{Na}_2\text{AsS}_3 + \text{Aq.}$  (Berzelius.)**Iron (ferric) sulpharsenite.**Ppt. Sol. in excess of a ferric salt, or  $\text{Na}_2\text{AsS}_3 + \text{Aq.}$  (Berzelius.)**Lead sulpharsenite,  $\text{Pb}_2\text{As}_2\text{S}_3$ .**Ppt. Min. *Dufrenoyite*. $\text{Pb}(\text{AsS}_2)_2 = \text{PbS}, \text{As}_2\text{S}_3$ . Min. *Sartorite*. $\text{Pb}_2\text{As}_2\text{S}_7$ . Min. *Jordanite*.**Lithium sulpharsenites.**

Resemble K salts.

**Magnesium sulpharsenite,  $\text{Mg}_2\text{As}_2\text{S}_3$ .**Almost completely sol. in  $\text{H}_2\text{O}$ . Easily sol. in alcohol. (Berzelius.) $+ 8\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson.) $\text{Mg}(\text{AsS}_2)_2 + 5\text{H}_2\text{O}$ . Slowly sol. in both cold and hot  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 59.) $\text{Mg}_2(\text{AsS}_2)_2 + 9\text{H}_2\text{O}$ . (Nilson.)**Manganous sulpharsenite,  $\text{Mn}_2\text{As}_2\text{S}_3$ .**Ppt. Decomp. by  $\text{HCl} + \text{Aq.}$ **Mercurous sulpharsenite,  $(\text{Hg}_2)_2\text{As}_2\text{S}_3$ .**

Ppt. (Berzelius.)

**Mercuric sulpharsenite,  $\text{Hg}_2\text{As}_2\text{S}_3$ .**

Ppt.

 $\text{Hg}(\text{AsS}_2)_2$ . Ppt. (Berzelius, Pogg. 7. 149.)**Nickel sulpharsenite,  $\text{Ni}_2(\text{AsS}_2)_2$ .**

Ppt. (Berzelius.)

**Platinum sulpharsenite,  $\text{Pt}_2\text{As}_2\text{S}_3$ .**

Ppt.

**Potassium sulpharsenite,  $\text{K}_2\text{As}_2\text{S}_3$ .**Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Berzelius.)  $\text{K}_2\text{As}_2\text{S}_3$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Berzelius.) $\text{K}_2\text{As}_2\text{S}_7$ . Sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius.) $\text{K}_2\text{As}_2\text{S}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Berzelius.)  $+ 2\frac{1}{2}\text{H}_2\text{O}$ . Not wholly sol. in  $\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 30.) $\text{K}_2\text{As}_2\text{S}_3 + 8\text{H}_2\text{O}$ . (Nilson.) $\text{KAs}_2\text{S}_3 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Slowly attacked by hot  $\text{HCl} + \text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  (Nilson.)**Silver sulpharsenite,  $12\text{Ag}_2\text{S}, \text{As}_2\text{S}_3$ .**

Ppt. (Sommerlad, Z. anorg. 1898, 18. 428.)

 $5\text{Ag}_2\text{S}, \text{As}_2\text{S}_3 = \text{Ag}_2\text{AsS}_4$ . (Sommerlad.) $\text{Ag}_2\text{AsS}_4$ . Min. *Proustite*. Sol. in  $\text{HNO}_3 + \text{Aq.}$   $\text{KOH} + \text{Aq}$  dissolves out  $\text{Sb}_2\text{S}_3$ . (Senarmont, A. ch. (3) 32. 129; Wöhler, A. 27. 159.) $2\text{Ag}_2\text{S}, \text{As}_2\text{S}_3$ . Partially sol. in  $\text{HNO}_3 + \text{Aq.}$  (Berzelius.) $\text{AgAsS}_2$ . (Berzelius, Pogg. 7. 150.)**Sodium sulpharsenite,  $\text{NaAsS}_2 + \frac{1}{2}\text{H}_2\text{O}$ .**Attacked by  $\text{HCl} + \text{Aq}$  with difficulty. (Nilson, J. pr. (2) 14. 37.) $+ 1\frac{1}{2}\text{H}_2\text{O}$ . Forms coagulum with cold, sol. in hot  $\text{H}_2\text{O}$ . (Nilson.) $\text{Na}_2\text{As}_2\text{S}_7 + 6\text{H}_2\text{O}$ . Sol. in much  $\text{H}_2\text{O}$ ; not easily decomp. by  $\text{HCl} + \text{Aq.}$  (Nilson.) $\text{NaAsS}_2 + 4\text{H}_2\text{O}$ . Ppt. (Nilson, J. pr. (2) 14. 3.)**Strontium sulpharsenite,  $3\text{SrS}, \text{As}_2\text{S}_3 + 15\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O} + \text{Aq}$ ; insol. in alcohol. (Voigt and Götting.) $2\text{SrS}, \text{As}_2\text{S}_3$ . Sol. in  $\text{H}_2\text{O}$ ; decomp. by alcohol. $+ 15\text{H}_2\text{O}$ . (Nilson, J. pr. (2) 14. 53.) $\text{Sr}(\text{AsS}_2)_2 + 2\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Nilson.)**Thallous sulpharsenite,  $\text{TlAsS}_2$ .**Ppt. Decomp. by  $\text{KOH} + \text{Aq.}$  (Gunning, J. B. 1868. 247.)Above compound is a mixture of  $\text{As}_2\text{S}_3$  and  $\text{Tl}_2\text{S}$ . (Hawley, J. Am. Chem. Soc. 1907, 29. 1012.)Min. *Lorandite*. (Kuenner and Loezka, C. C. 1904, II. 844.)**Tin (stannous) sulpharsenite,  $\text{Sn}_2\text{As}_2\text{S}_3$ .**

Ppt.

**Tin (stannic) sulpharsenite,  $\text{SnAs}_2\text{S}_3$ .**

Ppt. (Berzelius, Pogg. 7. 147.)

**Uranic sulpharsenite,  $2\text{U}_2\text{S}_3, \text{As}_2\text{S}_3$ .**

Ppt.



**Zinc sulpharsenite.**

Ppt. (Berzelius, Pogg. 7. 145.)

**Zirconium sulpharsenite,  $2Zr_2S_3, As_2S_3$ .**

Ppt. Insol. in solutions of alkali sulpharsenites. Sl. sol. in  $Na_2S$  Aq. Not decomp. by acids. (Berzelius.)

**"Sulphatammon,"  $2NH_3, SO_3$ .**

(Rose.)

Is ammonium imidosulphonate, which see. (Berglund.)

**"Parasulphatammon,"  $3NH_3, 2SO_3$ .**

(Rose.)

Is basic ammonium imidosulphonate, which see. (Berglund.)

**Sulphatiodic acid.**

Potassium sulphatiodate,  $K_2HO_3SIO_4$  or  $KIO_3, KHSO_4$ .

Decomp. by  $H_2O$ . (Blomstrand, J. pr. (2) 40. 317.)

See Iodate sulphate, potassium.

**Sulphatoctamine cobaltic carbonate**

$(SO_4)_2Co_2(NH_3)_2CO_3+4H_2O$ .

Sol. in  $H_2C$ . (Vortmann and Blasberg, B. 22. 2650.)

$(SO_4)_2Co_2(NH_3)_2(CO_3)_2+3H_2O$ . Sol. in  $H_2O$ . (V. and B.)

See Carbonatotetramine cobaltic sulphate. (Jørgensen.)

**Sulphatoplatinamine sulphate,**

$SO_4Pt(NH_3)_2SO_4+3H_2O$ .

Easily sol. in  $H_2O$ . Sol. in  $H_2SO_4+Aq$ .

**Sulphatoplatindiamine sulphate,**

$SO_4Pt(N_2H_4)_2SO_4+H_2O$ .

Insol. in  $H_2O$ .

**Sulphatopurpureocobaltic bromide,**

$Co(SO_4)(NH_3)_2Br$ .

Sol. in  $H_2O$ , from which it is precipitated by conc.  $HBr+Aq$ . (Jørgensen, J. pr. (2) 25. 94.)

— carbonate,  $[(SO_4)Co(NH_3)_2]_2CO_3+4H_2O$ .

Sol. in  $H_2O$ . (Vortmann and Blasberg, B. 22. 2648.)

— chloroplatinate,  $2Co(SO_4)(NH_3)_2Cl, PtCl_4+2H_2O$ .

Sl. sol. in cold  $H_2O$ . (Jørgensen.)

— nitrate,  $Co(SO_4)(NH_3)_2(NO_3)$ .

Somewhat sl. sol. in cold  $H_2O$ . (Jørgensen.)

**Sulphatopurpureocobaltic sulphate,**

$[Co(SO_4)(NH_3)_2]_2SO_4+H_2O$ .

Very easily sol. in  $H_2O$ . (Jørgensen, J. pr. (2) 25. 94.)

$Co(SO_4)(NH_3)_2(HSO_4)+2H_2O$ . Sol. in about 25 pts. of cold  $H_2O$ . Sol. in dil., insol. in conc.  $NH_4OH+Aq$ . (Jørgensen.)

**Sulphazic acid,  $H_2S_2N_2O_3=$** 

$SO_3H-N(OH)-O-N-(OH)SO_3H$ .

Known only in its salts. (Raschig, A. 241. 161.)

**Potassium sulphazate,  $K_2HS_2N_2O_3=$** 

$(SO_3K)(OK)N-O-N(OH)-(SO_3K)$ .

Sol. in  $H_2O$ , but decomp. on standing. (Raschig, A. 241. 161.)

**Sulphazidic acid.**

(Fremy.)

See Hydroxylamine monosulphonic acid.

**Sulphazilinic acid.**

See Oxyulphazotic acid.

**Metasulphazilinic acid.**

See Trisulphoxyazotic acid.

**Sulphazinous acid.**

(Fremy.)

See Dihydroxylamine sulphonic acid.

**Sulphazotic acid,  $H_2N_2S_2O_4=$** 

$(SO_3H)_2\equiv NH-NO=OH(SO_3H)$ .

Known only in its salts. (Claus, A. 158. 52 and 194.) Has the formula

$(SO_3H)_2NH<\overset{O}{\underset{O}{\parallel}}>NH(SO_3H)_2$ .

(Raschig, A. 241. 161.)

**Lead potassium sulphazotate.**

Insol. in cold, decomp. by hot  $H_2O$ . Insol. in alcohol and ether. (Fremy, A. ch. (3) 15. 439.)

**Potassium sulphazotate,  $K_2HN_2S_2O_4+H_2O$** 

$=(SO_3K)_2NK<\overset{O}{\underset{O}{\parallel}}>NH(SO_3K)_2$ .

Very sol. in hot, less in cold  $H_2O$ . (Raschig, A. 241. 161.) Decomp. gradually by boiling. (Claus.) Insol. in alcohol or ether. (Fremy, A. ch. (3) 15. 428.)

True composition is  $HON(SO_3K)_2, KON(SO_3K)_2+H_2O$ . Potassium hydroxylamine disulphonate. (Divers and Haga, Chem. Soc. 1900, 77. 432.)

Forms basic salt

$(SO_3K)_2NK<\overset{O}{\underset{O}{\parallel}}>NK(SO_3K)_2$ , which is easily sol. and decomp. by  $H_2O$ . (Raschig.)

**Potassium sodium sulphazotate,**

$K_2NaHN_2S_2O_4+2H_2O$ .

Quite easily sol. in  $H_2O$ . (Raschig, A. 241. 161.)

**Disulphhydroxyazotic acid,  $\text{ONH}(\text{SO}_2\text{H})_2$ .**

Known only in its salts. (Claus, A. 158. 52 and 194.) Correct composition is hydroxylamine sulphonic acid  $\text{HON}(\text{SO}_2\text{H})_2$ , which see. (Raschig, A. 241. 161.)

**Sulphhydroxylic acid.**

(Claus.)

See Hydroxylamine monosulphonic acid.

**Disulphhydroxyazotic acid.**

(Claus.)

See Hydroxylamine disulphonic acid.

**Sulphides.**

The sulphides of the alkali metals are sol. in  $\text{H}_2\text{O}$ ; those of the alkali-earth metals are much less sol., and are decomp. upon solution into hydrosulphide and hydroxide.

The other sulphides are insol. in  $\text{H}_2\text{O}$ .

For each sulphide, see under the respective element.

**Sulphimide,  $\text{SO}_2\text{NH}$ .**

See Imidosulphamide.

**Trisulphimide,  $\text{OHSO} \begin{smallmatrix} \text{NSO.OH} \\ \text{NSO.OH} \end{smallmatrix} \text{N} \cdot$** 

$(\text{SO}_2\text{NH})_3$ .

Sol. in methyl alcohol; sl. sol. in ether; insol. in chloroform and benzene. (Hantzsch B. 1901, 34. 3440.)

**Ammonium sulphimide,  $\text{SO}_2\text{N}(\text{NH}_4)$ .**

Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Traube.)

**Barium —,  $(\text{SO}_2\text{N})_2\text{Ba} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Traube.)

**Potassium —,  $\text{SO}_2\text{NK}$ .**

Not very sol. in  $\text{H}_2\text{O}$ .

**Silver —,  $\text{SO}_2\text{NAg}$ .**

Sol. in 500–600 pts. cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in acids.

**Sodium —,  $\text{SO}_2\text{NNa}$ .**

Very sol. in  $\text{H}_2\text{O}$ .

**"Sulphitammon,"  $\text{NH}_4$ ,  $\text{SO}_2$ .**

See Thionamic acid.

**Sulphobismuthous acid.****Cuprous sulphobismuthite,  $\text{AuBiS}_2$ .**

Min. *Emplectite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

$\text{Cu}_2\text{Bi}_2\text{S}_7$ . Min. *Klaprothite*. Completely sol. in  $\text{HCl} + \text{Aq}$ .

$\text{Cu}_2\text{Bi}_2\text{S}_7$ . Min. *Wittichenite*. Sol. in  $\text{HCl} + \text{Aq}$  and in  $\text{HNO}_3 + \text{Aq}$ .

**Cuprous lead sulphobismuthite,  $\text{Cu}_2\text{S}$ ,  $2\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ .**

Min. *Patrinite*.

Sol. in  $\text{HNO}_3 + \text{Aq}$  with residue of S and  $\text{PbSO}_4$ .

**Lead —,  $2\text{PbS}$ ,  $\text{Bi}_2\text{S}_3$ .**

Min. *Cosalite*.

$2\text{PbS}$ ,  $3\text{Bi}_2\text{S}_3$ . Min. *Chiviatite*.

**Potassium —,  $\text{KBiS}$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{HCl} + \text{Aq}$ . (Schneider, Pogg. 1869, 136. 464.)

**Metasulphoboric acid,  $\text{B}_2\text{S}_3\text{H}_2\text{S}$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

1 pt. is sol. in 5 pts. benzene

1 pt. is " " 5 "  $\text{CS}_2$

Very sl. sol. in  $\text{CS}_2$  at  $-20^\circ$ . (Stock, B. 1901, 34. 401.)

**Sulphocarbonic acid.****Ammonium cuprous sulphocarbonate,  $\text{CS}_2\text{CuNH}_4$ .**

This salt was formerly described as cupric sulphocarbonate ammonia,  $\text{CS}_2\text{Cu}$ ,  $\text{NH}_4$ . (Hofmann, B. 1903, 36. 1146.)

**Cuprous potassium sulphocarbonate,  $\text{CS}_2\text{CuK}$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ .

Somewhat sol. in hot  $\text{H}_2\text{O}$ ,  $\text{NaOH}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . (Hofmann.)

**Cupric sulphocarbonate ammonia,  $\text{CS}_2\text{Cu}$ ,  $\text{NH}_4$ .**

Very sl. sol. in strong  $\text{NH}_4\text{OH} + \text{Aq}$ ; insol. in cold  $\text{H}_2\text{O}$ , sl. sol. in hot  $\text{H}_2\text{O}$ . (Hofmann, Z. anorg. 1897, 14. 295.)

Is ammonium cuprous sulphocarbonate. (Hofmann, B. 1903, 36. 1146.)

**Cuprous sulphocarbonate potassium cyanide,  $\text{CS}_2\text{Cu}$ ,  $2\text{KCN} + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and dil. alkalies on warming. (Hofmann, B. 1903, 36. 1148.)

**Zinc sulphocarbonate ammonia,  $\text{CS}_2\text{Zn}$ ,  $2\text{NH}_4$ .**

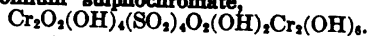
Ppt. (Hofmann, Z. anorg. 1897, 14. 277.)

**Sulphochromic acid,  $\text{H}_2\text{CrO}_4$ ,  $\text{SO}_2$ . (?)**

Sol. in  $\text{H}_2\text{O}$ . (Bolley, A. 56. 113.)

$(\text{SO}_2)_2\text{Cr}_2\text{O}_7(\text{OH})_2$ . Sol. in  $\text{H}_2\text{O}$ . All salts even alkali salts are insol. in  $\text{H}_2\text{O}$ . (Recoura, Bull. Soc. 1896, (3) 15. 315.)

$[\text{Cr}_2\text{O}_7(\text{OH})_2(\text{SO}_2)_2\text{O}_2]$ ,  $\text{Cr}_2\text{O}(\text{OH})_2(\text{SO}_2)_2(\text{OH})_2(\text{OH})_2$ . Sol. in  $\text{H}_2\text{O}$ . (Wyruboff, Bull. Soc. 1902, (3) 27. 721.)

**Chromium sulphochromate,**

Ppt.; decomp. by boiling  $\text{H}_2\text{O}$ . (Wyrzboff, Bull. Soc. 1902, (3) 27. 720.)

**Sulphochromous acid.****Ferrous sulphochromite,  $\text{FeCr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$ , and nearly so in  $\text{HCl} + \text{Aq}$ . (Gröger, W. A. B. 81, 2. 531.)

**Manganous —,  $\text{MnCr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$ . (Gröger.)

**Potassium —,  $\text{K}_2\text{Cr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$  and in hot  $\text{HCl} + \text{Aq}$ .

Easily sol. in aqua regia. Slowly sol. in cold, rapidly sol. in hot dil.  $\text{HNO}_3 + \text{Aq}$ . (Milbauer, Z. anorg. 1904, 42. 443.)

$\text{K}_2\text{Cr}_2\text{S}_7$ . Stable in the air; sol. in  $\text{HNO}_3$  and aqua regia with decomp. (Schneider, J. pr. 1897, (3) 56. 407.)

**Silver —,  $\text{Ag}_2\text{Cr}_2\text{S}_4$ .**

Not attacked by  $\text{HCl} + \text{Aq}$  even on heating. Decomp. by conc.  $\text{HNO}_3$ . (Schneider, J. pr. 1897, (2) 56. 401.)

**Sodium —,  $\text{Na}_2\text{Cr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sl. attacked by dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in cold conc.  $\text{HNO}_3$  or aqua regia. Sol. in hot dil.  $\text{HNO}_3 + \text{Aq}$ . (Gröger.)

Sol. in acids with decomp. (Schneider, J. pr. 1897, (3) 56. 415.)

**Zinc —,  $\text{ZnCr}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in traces in boiling conc.  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$ . (Gröger, W. A. B. 81, 2. 531.)

**Sulphochromic acid,  $\text{HSCN}$ .**

Sol. in  $\text{H}_2\text{O}$ .

Sat.  $\text{HSCN} + \text{Aq}$  has sp. gr. = 1.022. (Porrett, 1814.)  $\text{HSCN} + \text{Aq}$  containing 12.7%  $\text{HSCN}$  has sp. gr. 1.040 at 12.7°. (Hermes, Z. Ch. 1866. 417.)

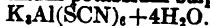
**Sulphocyanides.**

Most sulphocyanides are sol. in  $\text{H}_2\text{O}$ , but  $\text{Cu}$ ,  $\text{Pb}$ ,  $\text{Hg}$ , and  $\text{Ag}$  sulphocyanides are insol.

**Aluminum sulphocyanide,  $\text{Al}(\text{SCN})_3$ .**

Known only in solution.

$\text{Al}(\text{SCN})_2(\text{OH})_4$ . Known only in solution (Suida.)

**Aluminum potassium sulphocyanide,**

Very hygroscopic.

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Rosenheim, Z. anorg. 1901, 27. 302.)

**Ammonium sulphocyanide,  $\text{NH}_4\text{SCN}$ .**

Deliquescent, and very sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 128.1 pts. at 0° and 162.2 pts. at 20°.

$\text{NH}_4\text{SCN} + \text{Aq}$  sat. at ord. temp. has density of 1.138 and 100 cc. contains 69.16 g.  $\text{NH}_4\text{SCN}$ . (Klaason, J. pr. 1887, (2) 36. 67.)

By dissolving 90 g.  $\text{NH}_4\text{SCN}$  in 90 g.  $\text{H}_2\text{O}$  at 17°, the temp. falls to -12°. (Clowes, Z. Ch. 1866. 190.)

133 pts.  $\text{NH}_4\text{SCN} + 100$  pts.  $\text{H}_2\text{O}$  at 13.2° lower the temp. 31.2°. (Rüdorff, B. 2. 68.)

Sol. in liquid  $\text{SO}_2$ . (Walden, B. 1899, 32. 2864.)

Difficultly sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.)

Very easily sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Easily sol. in alcohol.

Easily sol. in acetone. (Krug and M'Elroy.

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

Difficultly sol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

**Ammonium bismuth sulphocyanide,**

As-K salt. (Rosenheim and Vogelsang Z. anorg. 1906, 48. 215.)

**Ammonium cadmium sulphocyanide,**

Somewhat deliquescent.

Melts in crystal  $\text{H}_2\text{O}$  at 25°.

Insol. in alcohol. (Grossmann, B. 1902, 35. 2667.)

**Ammonium cadmium molybdenyl sulphocyanide,  $\text{NH}_4\text{SCN}$ ,  $\text{Cd}(\text{SCN})_2$ ,  $\text{Mo}(\text{OH})(\text{SCN})_5 + 3\text{H}_2\text{O}$ .**

(Maas and Sand, B. 1906, 41. 1513.)

**Ammonium cobaltous sulphocyanide,**

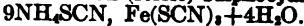
Decomp. in moist air.

Cannot be recryst. from  $\text{H}_2\text{O}$ . (Treadwell, Z. anorg. 1901, 26. 109.)

+4 $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

Sol. in methyl, ethyl and amyl alcohol, in acetone and in ether +  $\text{Aq}$ .

Can be recryst. from  $\text{H}_2\text{O}$  or alcohol without decomp. (Rosenheim and Cohn, Z. anorg. 1901, 27. 289.)

**Ammonium iron (ferric) sulphocyanide,**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Krüss and Morah, A. 260. 207.)

3 $\text{NH}_4\text{SCN}$ ,  $\text{Fe}(\text{SCN})_3$ . Extremely deliquescent.

**Ammonium mercuric sulphocyanide,**

Easily sol. in  $\text{H}_2\text{O}$ . (Fleischer, A. 179. 228.)

$\text{NH}_4\text{Hg}(\text{SCN})_2$ . Insol. in cold; sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 27. 284.)

**Ammonium molybdenyl sulphocyanide,**  
 $3\text{NH}_4\text{SCN}$ ,  $\text{Mo}(\text{OH})(\text{SCN})_3 + 3\text{H}_2\text{O}$ .  
 (Sand and Maas, B. 1907, 40. 4507.)

**Ammonium nickel sulphocyanide,**  
 $(\text{NH}_4)_2\text{Ni}(\text{SCN})_2 + 4\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$  with decomp.  
 Sl. sol. in cold; easily sol. in hot alcohol.  
 (Rosenheim, Z. anorg. 1901, 27. 292.)

**Ammonium silver sulphocyanide,**  $\text{NH}_4\text{SCN}$ ,  
 $\text{AgSCN}$ .  
 Decomp. by  $\text{H}_2\text{O}$ .

**Ammonium vanadium sulphocyanide,**  
 $\text{V}(\text{SCN})_3$ ,  $3\text{NH}_4\text{SCN} + 4\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ ; sol. in alcohol; sl. sol. in ether.  
 (Ciocci, Z. anorg. 1898, 19. 311.)

**Ammonium vanadyl sulphocyanide,**  
 $(\text{NH}_4)_2\text{VO}(\text{SCN})_2 + 5\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ , alcohol, ether, acetone, amyl alcohol and ethyl acetate. (Koppel, Z. anorg. 1903, 36. 290.)

**Ammonium zinc sulphocyanide,**  
 $(\text{NH}_4)_2\text{Zn}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .  
 Easily sol. in  $\text{H}_2\text{O}$  and in alcohol. (Walden, Z. anorg. 1900, 23. 374.)  
 $+ 4\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ , acetone, alcohols and ether. (Rosenheim and Huld-schinsky, B. 1901, 34. 3913.)

**Ammonium sulphocyanide mercuric bromide,**  
 $\text{NH}_4\text{SCN}$ ,  $\text{HgBr}_2$ .  
 Very sol. in  $\text{H}_2\text{O}$ .  
 Sol. in alcohol. (Grossmann, B. 1902, 35. 2945.)  
 $2\text{NH}_4\text{SCN}$ ,  $\text{HgBr}_2 + \text{H}_2\text{O}$ . Somewhat deliquescent.  
 Very sol. in  $\text{H}_2\text{O}$ .  
 Sol. in alcohol. (Grossmann.)

**Arsenic sulphocyanide,**  $\text{As}(\text{SCN})_3$ .  
 Decomp. by  $\text{H}_2\text{O}$ . Insol. in all ordinary solvents. (Miguel, A. ch. (5) 11. 341.)

**Barium sulphocyanide,**  $\text{Ba}(\text{SCN})_2 + 2\text{H}_2\text{O}$ .  
 Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Boiling solution in alcohol contains 32.8% anhydrous salt. Solution sat. at  $20^\circ$  contains 30%. (Tscherniak, B. 16. 349.)  
 Cryst. with  $3\text{H}_2\text{O}$ . (Tscherniak, B. 25. 2627.)

**Barium cadmium sulphocyanide,**  
 $4\text{Ba}(\text{SCN})_2$ ,  $\text{Cd}(\text{SCN})_2 + 10\text{H}_2\text{O}$ .  
 Deliquescent. (Grossmann, B. 1902, 36. 2669.)

**Barium caesium cuprous sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $3\text{CsSCN}$ ,  $2\text{CuSCN}$ .  
 Rapidly decomp. by  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1902, 28. 273.)

**Barium caesium silver sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $3\text{CsSCN}$ ,  $2\text{AgSCN}$ .  
 100 pts.  $\text{H}_2\text{O}$  dissolve 92 pts. at  $19^\circ$ .  
 Decomp. by much  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1902, 28. 272.)

**Barium cobaltous sulphocyanide,**  
 $\text{BaCo}(\text{SCN})_4 + 8\text{H}_2\text{O}$ .  
 Ppt. (Rosenheim, Z. anorg. 1901, 27. 290.)

**Barium mercuric sulphocyanide,**  
 $\text{BaHg}(\text{SCN})_4$ .  
 Very sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1901, 27. 286.)  
 $\text{BaHg}(\text{SCN})_4 + 2\text{H}_2\text{O}$ . Ppt. Nearly insol. in cold; easily sol. in hot  $\text{H}_2\text{O}$ . (Rosenheim.)

**Barium potassium silver sulphocyanide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $4\text{KSCN}$ ,  $2\text{AgSCN} + \text{H}_2\text{O}$ .  
 Very sol. in a little  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1902, 28. 283.)

**Barium rubidium silver sulphocyanide,**  
 $\text{BaRb}_2\text{Ag}_2(\text{SCN})_6 + 2\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1903, 30. 186.)  
 $\text{BaRb}_2\text{Ag}_2(\text{SCN})_6 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Wells.)

**Barium silver sulphocyanide,**  $\text{Ba}(\text{SCN})_2$ ,  
 $2\text{AgSCN} + 2\text{H}_2\text{O}$ .  
 Stable in the air. (Wells, Am. Ch. J. 1902, 28. 269.)

**Barium zinc sulphocyanide,**  $\text{BaZn}(\text{SCN})_2$ ,  
 $+ 3\text{H}_2\text{O}$ .  
 Easily sol. in alcohol. (Walden, Z. anorg. 1900, 23. 374.)

**Barium sulphocyanide mercuric bromide,**  
 $\text{Ba}(\text{SCN})_2$ ,  $2\text{HgBr}_2 + 5\text{H}_2\text{O}$ .  
 Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37. 420.)

**Bismuth sulphocyanide, basic,**  
 $\text{Bi}(\text{OH})(\text{SCN})_2 + 5\text{H}_2\text{O}$ .  
 (Rosenheim and Vogelgesang, Z. anorg. 1906, 48. 214.)  
 $\text{Bi}(\text{SCN})_3$ ,  $2\text{Bi}_2\text{O}_3$ . Insol. in  $\text{H}_2\text{O}$ , but when recently pptd. decomp. by boiling therewith. Insol. in  $\text{HSCN} + \text{Aq}$ . (Meitzen-dorf.)

**Bismuth sulphocyanide,**  $\text{Bi}(\text{SCN})_3$ .  
 Insol. or sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ , and  $\text{HSCN} + \text{Aq}$ . (Meitzen-dorf, Pogg. 56. 83.)

Decomp. by cold  $H_2O$ . (Bender, B. 20 723.)

+14 $H_2O$ . Extremely deliquescent.

Decomp. by  $H_2O$ . (Rosenheim and Vogelgesang, Z. anorg. 1906, 43. 214.)

**Bismuth potassium sulphocyanide,**  
 $K_3Bi(SCN)_4$ .

Decomp. by  $H_2O$ . (Rosenheim and Vogelgesang, Z. anorg. 1906, 43. 215.)

Not hygroscopic.

Decomp. by  $H_2O$ .

Easily sol. in alcohol. (Vanino, Z. anorg. 1901, 28. 220.)

$Bi(SCN)_3$ , 9KSCN. Very hygroscopic.

Decomp. by  $H_2O$ .

Sol. in alcohol. (Vanino, Z. anorg. 1901, 28. 221.)

**Bismuth sodium sulphocyanide,**  
 $Na_3Bi(SCN)_4$ .

As K salt. (Rosenheim and Vogelgesang, Z. anorg. 1906, 43. 215.)

**Boron sulphocyanide,  $B(SCN)_3$ .**

Sol. in benzene and ether. (Cocksedge, Chem. Soc. 1908, (2) 93. 217.)

**Cadmium sulphocyanide,  $Cd(SCN)_2$ .**

Sl. sol. in  $H_2O$ . Sol. in  $NH_4OH$  + Aq with combination.

**Cadmium caesium sulphocyanide,**  
 $CsCd(SCN)_2$ .

Recryst. from  $H_2O$ . (Wells, Am. Ch. J. 1903, 30. 148.)

$Cs_2Cd(SCN)_4 + 2H_2O$ . Very sol. in  $H_2O$ . Can be recryst. from conc. solution but decomp. on dilution to  $CsCd(SCN)_2$ . (Wells.)

**Cadmium caesium silver sulphocyanide,**  
 $Cs_2CdAg_2(SCN)_4$ .

(Wells.)

+2 $H_2O$ . (Wells.)

$(Cs_2CdAg_2(SCN)_4 + 2H_2O)$ . (Wells.)

$Cs_2CdAg_{10}(SCN)_{20} + 6H_2O$ . (Wells.)

**Cadmium mercuric sulphocyanide,  $Cd(SCN)_2$ ,  $Hg(SCN)_2$ .**

Very sol. in hot  $H_2O$ . (Grossmann, Z. anorg. 1903, 37. 414.)

**Cadmium molybdenum sulphocyanide,**  
 $Cd(SCN)_2$ ,  $Mo(SCN)_4 + 2H_2O$ .

(Maas and Sand, B. 1908, 41. 1513.)

+3 $H_2O$ . (Maas and Sand.)

**Cadmium molybdenyl potassium sulphocyanide,  $KSCN$ ,  $4Cd(SCN)_2$ ,  $3Mo(OH)(SCN)_3 + 18H_2O$ .**

(Maas and Sand, B. 1908, 41. 1513.)

**Cadmium molybdenyl sulphocyanide ammonia,  $3Cd(SCN)_2$ ,  $2Mo(OH)(SCN)_3$ , 13 $NH_3$ .**

(Maas and Sand, B. 1908, 41. 1512.)

+2 $H_2O$ . (Maas and Sand.)

**Cadmium potassium sulphocyanide,**  
 $K_2Cd(SCN)_4 + 2H_2O$ .

Very sol. in  $H_2O$ . (Grossmann, B. 1902, 35. 2668.)

**Cadmium rubidium sulphocyanide,**  
 $Rb_2Cd(SCN)_4 + 2H_2O$ .

Very sol. in  $H_2O$ . (Grossmann, B. 1902, 35. 2668.)

**Cadmium sodium sulphocyanide,**  
 $NaCd(SCN)_2 + 3H_2O$ .

(Grossmann, B. 1902, 35. 2668.)

**Cadmium sulphocyanide ammonia,  $Cd(SCN)_2$ ,  $NH_3$ .**

Decomp. by  $H_2O$ . (Grossmann, B. 1902, 35. 2666.)

$Cd(SCN)_2$ , 2 $NH_3$ . Decomp. by pure  $H_2O$ . (Grossmann.)

**Cadmium sulphocyanide ammonium bromide,**  
 $Cd(SCN)_2$ ,  $NH_4Br + H_2O$ .

Can be recryst. from  $H_2O$ . Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, 37. 425.)

$Cd(SCN)_2$ , 2 $NH_4Br$ . Easily splits off  $NH_4Br$ . (Grossmann.)

**Cadmium sulphocyanide ammonium chloride,**  
 $Cd(SCN)_2$ , 2 $NH_4Cl$ .

Can be recryst. from  $H_2O$ . Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, 37. 423.)

**Cadmium sulphocyanide potassium bromide,**  
 $Cd(SCN)_2$ ,  $KBr + H_2O$ .

Recryst. from  $H_2O$ . (Grossmann, Z. anorg. 1903, 37. 425.)

$Cd(SCN)_2$ , 2KBr. Recryst. from  $H_2O$ . (Grossmann.)

**Cadmium sulphocyanide potassium chloride,**  
 $Cd(SCN)_2$ , 2KCl.

Recryst. from  $H_2O$ . Decomp. in dil. solution. (Grossmann, Z. anorg. 1903, 37. 423.)

**Cadmium sulphocyanide potassium iodide,**  
 $Cd(SCN)_2$ , 2KI.

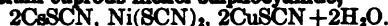
Recryst. from  $H_2O$ . (Grossmann.)

**Cesium calcium silver sulphocyanide,**  
 $2CsSCN$ ,  $Ca(SCN)_2$ ,  $2AgSCN + 2H_2O$ .

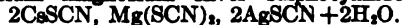
Recryst. from  $H_2O$ . (Wells, Am. Ch. J. 1902, 28. 275.)

**Cæsium chromium sulphocyanide.***See Chromisulphocyanide, cæsium.***Cæsium cobaltous sulphocyanide,**

Stable in the air. (Shinn and Wells, Am. Ch. J. 1903, 29. 476.)

**Cæsium cobaltous silver sulphocyanide,**Slowly attacked by  $\text{H}_2\text{O}$ ; decomp. by boiling  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{CaSCN}$  or  $\text{Co}(\text{SCN})_2$  + Aq. (Shinn and Wells, Am. Ch. J. 1903, 29. 478.)**Cæsium cuprous sulphocyanide,  $\text{CsSCN}$ ,  $\text{CuSCN}$ .** $\text{H}_2\text{O}$  separates  $\text{CuSCN}$ . (Roberts, Am. Ch. J. 1902, 28. 262.)**Cæsium cuprous nickel sulphocyanide,**Sl. sol. in  $\text{H}_2\text{O}$ . (Roberts and Wells, Am. Ch. J. 1902, 28. 277.)**Cæsium cuprous strontium sulphocyanide,**

As Ba salt. (Wells, Am. Ch. J. 1902, 28. 275.)

**Cæsium magnesium silver sulphocyanide,**

As Ca comp. (Wells, Am. Ch. J. 1902, 28. 275.)

**Cæsium manganous silver sulphocyanide,**Rather sl. sol. in  $\text{H}_2\text{O}$ . (Wells.)**Cæsium mercuric sulphocyanide,  $\text{CsSCN}$ ,  $\text{Hg}(\text{SCN})_2.$** Sl. sol. in hot  $\text{H}_2\text{O}$ . (Bristol and Wells, Am. Ch. J. 1902, 28. 260.)**Cæsium mercuric sulphocyanide,  $2\text{CsSCN}$ ,  $\text{Hg}(\text{SCN})_2 + \text{H}_2\text{O}.$** Moderately sol. in  $\text{H}_2\text{O}$ , especially when warm. Recryst. without decomp. (Bristol and Wells, Am. Ch. J. 1902, 28. 260.)**Cæsium nickel silver sulphocyanide,**Slowly decomp. by hot  $\text{H}_2\text{O}$ . (Wells, Am. Ch. J. 1902, 28. 277.)**Cæsium silver sulphocyanide,  $\text{CsSCN}$ ,  $\text{AgSCN}.$** 

Easily forms supersat. solution. (Wells, Am. Ch. J. 1902, 28. 264.)

▶  $2\text{CsSCN}$ ,  $\text{AgSCN}$ . Stable in the air. (Wells.) $3\text{CsSCN}$ ,  $\text{AgSCN}$ . Stable in the air. (Wells.)**Cæsium silver strontium sulphocyanide,**

As Ba comp. (Wells.)

**Cæsium silver zinc sulphocyanide,**

(Wells.)

 $\text{Cs}_2\text{ZnAg}(\text{SCN})_4$ . Ppt. Stable in the air. (Wells.) $\text{CsZn}_2\text{Ag}_2(\text{SCN})_8$ . Decomp. by cold, more rapidly by hot  $\text{H}_2\text{O}$ . (Wells.) $\text{CsZn}_2\text{Ag}_2(\text{SCN})_8$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (Wells.)**Cæsium zinc sulphocyanide,  $\text{Cs}_2\text{Zn}(\text{SCN})_4 + 2\text{H}_2\text{O}.$** Moderately sol. in  $\text{H}_2\text{O}$  and can be recryst. therefrom. (Wells.)**Calcium sulphocyanide,  $\text{Ca}(\text{SCN})_2 + 3\text{H}_2\text{O}.$** Deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol.**Calcium silver sulphocyanide,  $\text{Ca}(\text{SCN})_2$ ,  $2\text{AgSCN} + 2\text{H}_2\text{O}.$** 

(Wells.)

**Calcium stannic sulphocyanide,  $\text{CaSn}(\text{SCN})_4 + 7\text{H}_2\text{O}.$** Very sol. in  $\text{H}_2\text{O}$ . Can be recryst. therefrom. Sol. in alcohol and acetone. (Weinland and Barnes, Z. anorg. 1909, 62. 258.)**Cerous sulphocyanide,  $\text{Ce}(\text{SCN})_3 + 7\text{H}_2\text{O}.$** Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Jolin, Bull. Soc. (2) 21. 534.)**Chromous sulphocyanide with  $\text{MSCN}.$** *See Chromosulphocyanide, M.***Chromic sulphocyanide,  $\text{Cr}(\text{SCN})_3.$** Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Somewhat sol. in organic solvents. (Speransky, C. C. 1897, I. 141.)

*See also Chromisulphocyanhydric acid.***Chromic sulphocyanide with  $\text{MSCN}.$** *See Chromisulphocyanide, M.***Cobaltous sulphocyanide,  $\text{Co}(\text{SCN})_2 + \frac{1}{2}\text{H}_2\text{O}.$** Sol. in  $\text{H}_2\text{O}$  and alcohol; also in ether. Sol. in liquid  $\text{SO}_2$ . (Walden, B. 1899, 22. 2864.)

Sol. in acetone. (Krug and M'Elroy.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

 $+3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim and Cohn, Z. anorg. 1901, 27. 288.)**Cobaltous mercuric sulphocyanide,  $\text{Co}(\text{SCN})_2$ ,  $\text{Hg}(\text{SCN})_2.$** Very sl. sol. in  $\text{H}_2\text{O}$  and dil.  $\text{HCl}$  + Aq. Easily sol. in  $\text{HNO}_3$  + Aq. (Cleve, J. pr. 91. 227.)

**Cobaltous potassium sulphocyanide,**  
 $\text{CoK}_2(\text{SCN})_4$ .Decomp. by  $\text{H}_2\text{O}$ . (Treadwell, Z. anorg. 1901, 26, 109.)+ $4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Sol. in methyl, ethyl and amyl alcohol, in acetone and in ether + Aq. Can be recryst. from  $\text{H}_2\text{O}$  or alcohol without decomp. (Rosenheim and Cohn, Z. anorg. 1901, 27, 289.)**Cobaltous silver sulphocyanide,  $\text{CoAg}(\text{SCN})_2$ ,**  
+ $2\text{H}_2\text{O}$ .Decomp. by  $\text{H}_2\text{O}$ . (Shinn and Wells, Am. Ch. J. 1903, 29, 476.) $\text{Ag}_2\text{Co}(\text{SCN})_4$ . Almost insol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1901, 27, 291.)**Cobaltous sodium sulphocyanide,**  
 $\text{Na}_2\text{Co}(\text{SCN})_4 + 8\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim.)**Cobaltous sulphocyanideammonia,  $\text{Co}(\text{SCN})_2$ ,**  
 $2\text{NH}_3$  and  $\text{Co}(\text{SCN})_2, 6\text{NH}_3$ .

(Peters, B. 1908, 41, 3178.)

 $\text{Co}(\text{SCN})_2, 4\text{NH}_3$ . Sol. in  $\text{H}_2\text{O}$  and alcohol. (Sand, B. 1903, 36, 1439.)**Cobaltous sulphocyanide mercuric chloride,**  
 $2\text{Co}(\text{SCN})_2, 2\text{HgCl}_2$ .

(Hantzsch and Shibata, Z. anorg. 1912, 73, 320.)

 $2\text{Co}(\text{SCN})_2, 3\text{HgCl}_2$ . Easily decomp. (Hantzsch and Shibata.)**Cuprous sulphocyanide,  $\text{CuSCN}$ .**1 l.  $\text{H}_2\text{O}$  at  $18^\circ$  dissolves 0.004 mg. mols. or 0.5 mg.  $\text{CuSCN}$ . (Kohlrausch and Rose, Z. phys. Ch. 1893, 12, 241.)Insol. in dil. acids. Sl. sol. in cold, easily in warm conc.  $\text{HCl}$  + Aq. Decomp. by conc.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  + Aq. Sol. with combination in  $\text{NH}_4\text{OH}$  + Aq. Insol. in  $\text{KSCN}$  + Aq.Less sol. in  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{SO}_4$  + Aq than in  $\text{HNO}_3$ . (Kuhn, Ch. Z. 1908, 32, 1056.)Sol. in  $\text{Fe}_2(\text{SO}_4)_3$  + Aq. (Johnson, J. Soc. Chem. Ind. 1889, 8, 603.) $\text{KSCN}$  + Aq. (85-90 g. in 50 g.  $\text{H}_2\text{O}$ ) dissolves 18 g.  $\text{CuSCN}$ . (Thurnauer, B. 1890, 23, 770.)

Sol. in ether. (Skey, C. N. 1867, 16, 201.)

**Cupric sulphocyanide,  $\text{Cu}(\text{SCN})_2$ .**Decomp. by  $\text{H}_2\text{O}$  to cuprous salt. Sol. in warm  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$  + Aq. Sol. in  $\text{MSCN}$  + Aq, but solutions decomp. by dilution. Sol. in  $\text{NH}_4\text{OH}$  + Aq.Solubility in  $\text{NH}_4\text{OH}$  + Aq at  $25^\circ$  and at  $40^\circ$ .At  $25^\circ$ .

Sp. gr. $25^\circ/25^\circ$	One gram of solution contains			1000 mols. $\text{H}_2\text{O}$ dissolve		Composition of solid salt in contact with solution
	g. $\text{NH}_3$	g. $\text{Cu}(\text{SCN})_2$	g. $\text{H}_2\text{O}$	Mols. $\text{NH}_3$	Mols. $\text{Cu}(\text{SCN})_2$	
0.99853	0.2147	0.1522	0.6331	358.04	24.09	$\text{Cu}(\text{SCN})_2, 4\text{NH}_3$
0.99871	0.1655	0.1124	0.7221	242.02	15.60	
1.00703	0.0993	0.0798	0.8209	127.76	9.74	
1.01336	0.0639	0.0659	0.8702	77.51	7.59	
1.01506	0.0535	0.0622	0.8843	64.05	7.04	
1.01705	0.0426	0.0596	0.8978	50.21	6.65	$\text{Cu}(\text{SCN})_2, 2\text{NH}_3$
1.02132	0.0250	0.0511	0.9239	28.55	5.55	
1.01661	0.0198	0.0408	0.9394	22.27	4.35	
1.00816	0.0079	0.0245	0.9676	18.61	2.54	

At  $40^\circ$ .

	0.1802	0.1976	0.6222	306.28	31.83	$\text{Cu}(\text{SCN})_2, 4\text{NH}_3$
	0.1398	0.1658	0.6944	213.10	23.93	
	0.0758	0.1299	0.7943	101.00	16.38	
	0.0550	0.1207	0.8243	70.59	14.67	
	0.0435	0.1178	0.8388	54.82	14.07	
	0.0352	0.0876	0.8772	42.53	10.00	$[\text{Cu}(\text{SCN})_2, 2\text{NH}_3]$
	0.0257	0.0655	0.9088	30.00	7.22	
	0.0177	0.0418	0.9405	19.86	4.46	
	0.0094	0.0281	0.9625	10.31	2.93	

(Horn, Am. Ch. J. 1907, 37, 471.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

**Cuprocupric sulphocyanide,  $\text{Cu}(\text{SCN})_2$ ,**  
 $\text{Cu}_2(\text{SCN})_2$ .Not attacked by hot  $\text{HCl}$  + Aq. Insol. in  $\text{KSCN}$  + Aq.

**Cupric mercuric sulphocyanide,  $\text{CuHg}(\text{SCN})_4$ .**

Almost insol. in cold  $\text{H}_2\text{O}$  and in alcohol; al. sol. in boiling  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 27. 286.)

**Cuprous potassium sulphocyanide,  $\text{CuSCN}$ ,  $6\text{KSCN}$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Thurnauer, B. 1890, 23. 770.)

**Cuprous sulphocyanide ammonia,  $\text{Cu}_2(\text{SCN})_2$ ,  $2\text{NH}_3$ .**

Decomp. in the air. (Richards, Z. anorg. 1898, 17. 247.)

$\text{Cu}_2(\text{SCN})_2$ ,  $5\text{NH}_3$ . Very unstable in the air. (Richards.)

**Cupric sulphocyanide ammonia,  $\text{Cu}(\text{SCN})_2$ ,  $2\text{NH}_3$ .**

Sol. in little  $\text{H}_2\text{O}$ , but decomp. by dilution with pptn. of basic salt. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . By long standing a small amount dissolves in  $\text{H}_2\text{O}$  with separation of  $\text{CuSCN}$ . (Litterscheid, Arch. Pharm. 1901, 239. 337.)

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  containing a small amount of ammonia. (Horn, Am. Ch. J. 1907, 37. 477.)

$\text{Cu}(\text{SCN})_2$ ,  $4\text{NH}_3$ . Very unstable in the air.

Sol. in  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$  with pptn. of a basic salt. (Horn.)

100 pts. N/10  $\text{NH}_4\text{OH} + \text{Aq}$  dissolve 10.4 pts. anhydrous salt at  $25^\circ$ . (Pudschies, Desert.)

Looses  $\text{NH}_3$  in the air.

Sol. in  $\text{H}_2\text{O}$ . (Kohlschütter, B. 1904, 37. 1156.)

Decomp. in the air and by  $\text{H}_2\text{O}$  and dil. and conc. acids; sol. in cold conc.  $\text{HNO}_3$  and  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in boiling conc.  $\text{HCl}$ . (Richards, Z. anorg. 1898, 17. 250.)

**Didymium sulphocyanide,  $\text{Di}(\text{SCN})_2 + 6\text{H}_2\text{O}$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ .

**Erbium sulphocyanide,  $\text{Er}(\text{SCN})_3 + 6\text{H}_2\text{O}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Höglund.)

**Glucinum sulphocyanide,  $\text{Gl}(\text{SCN})_3$  (?).**

Sol. in  $\text{H}_2\text{O}$ . (Hermes, J. pr. 97. 465.)

**Gold (aurous) potassium sulphocyanide,  $\text{AuSCN}$ ,  $\text{KSCN}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , less in absolute alcohol. (Cleve, J. pr. 94. 16.)

**Gold (aurous) potassium sulphocyanide ammonia,  $\text{KAu}(\text{SCN})_2$ ,  $5\text{NH}_3$ .**

(Peters, B. 1908, 41. 3178.)

**Gold (auric) potassium sulphocyanide ammonia,  $\text{KAu}(\text{SCN})_4$ ,  $4\text{NH}_3$ .**

(Peters.)

**Gold (aurous) silver sulphocyanide,  $\text{AuSCN}$ ,  $\text{AgSCN}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Gold (auric) potassium sulphocyanide.**

Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. (Cleve.)

**Gold (aurous) sulphocyanide ammonia,  $\text{AuSCN}$ ,  $\text{NH}_3$ .**

Very sl. sol. in cold, decomp. by hot  $\text{H}_2\text{O}$ .

**Iron (ferrous) sulphocyanide,  $\text{Fe}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.

Sol. in acetone. (Krug and M'Elroy.)

**Iron (ferric) sulphocyanide,  $\text{Fe}(\text{SCN})_3 + 3\text{H}_2\text{O}$ .**

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ , alcohol, or ether. Ether extracts the salt from  $\text{Fe}(\text{SCN})_3 + \text{Aq}$ . Decomp. by much  $\text{H}_2\text{O}$  if pure. Not decomp. by monobasic acids, but conc.  $\text{H}_2\text{SO}_4$  and  $\text{H}_3\text{PO}_4$ , also oxalic, tartaric, malic, etc., acids destroy the colour.

**Iron (ferric) lithium sulphocyanide,  $\text{Fe}(\text{SCN})_3$ ,  $9\text{LiSCN} + 4\text{H}_2\text{O}$ .**

More deliquescent than the other ferric sulphocyanides. (Krüss and Moraht.)

**Iron (ferrous) mercuric sulphocyanide,  $\text{Fe}(\text{SCN})_2$ ,  $\text{Hg}(\text{SCN})_2 + 2\text{H}_2\text{O}$ .**

Moderately sol. in hot  $\text{H}_2\text{O}$ . (Cleve, J. pr. 91. 227.)

**Iron (ferric) potassium sulphocyanide,  $\text{Fe}(\text{SCN})_3$ ,  $3\text{KSCN} + x\text{H}_2\text{O}$ .**

Extremely deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Krüss and Moraht.)

$\text{Fe}(\text{SCN})_3$ ,  $9\text{KSCN} + 4\text{H}_2\text{O}$ . Hygroscopic. Sol. in  $\text{H}_2\text{O}$  without decomp. Insol. in pure anhydrous ether, but decomp. by ether containing traces of  $\text{H}_2\text{O}$  into  $\text{Fe}(\text{SCN})_3$  and  $\text{KSCN}$ . (Krüss and Moraht, A. 260. 204.)

**Iron (ferrous) sodium sulphocyanide,  $\text{Na}_2\text{Fe}(\text{SCN})_6 + 12\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Rosenheim, Z. anorg. 1901, 27. 299.)

**Iron (ferric) sodium sulphocyanide,  $\text{Fe}(\text{SCN})_3$ ,  $9\text{NaSCN} + 4\text{H}_2\text{O}$ .**

Less deliquescent than the corresponding  $\text{NH}_4$  or  $\text{K}$  salt. (Krüss and Moraht.)

$\text{Na}_2\text{Fe}(\text{SCN})_6 + 12\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1901, 27. 297.)

**Lanthanum sulphocyanide,  $\text{La}(\text{SCN})_3 + 7\text{H}_2\text{O}$ .**

Deliquescent; sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Lead sulphocyanide, basic,  $6\text{PbO}$ ,  $\text{Pb}(\text{SCN})_2 + 2\text{H}_2\text{O}$ . Ppt.**

$\text{Pb}(\text{SCN})_2$ ,  $\text{PbO} + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Strömholm, Z. anorg. 1904, 38. 440.)



**Lead sulphocyanide,  $\text{Pb}(\text{SCN})_2$ .**

Nearly insol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . (Liebig.)

Sl. sol. in  $\text{H}_2\text{O}$ .

$4.5 \times 10^{-1}$  g. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

**Lead sulphocyanide bromide,  $\text{Pb}(\text{SCN})_2 \cdot 8\text{PbBr}_2$ .**

(Grissom and Thorp, Am. Ch. J. 10. 219.)

**Lead sulphocyanide chloride,  $\text{PbSCNCl}$ .**

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Murtry, Chem. Soc. 55. 50.)

Sol. in  $\text{H}_2\text{O}$ . (Grissom and Thorp, Am. Ch. J. 10. 229.)

**Lead sulphocyanide iodide,  $3\text{Pb}(\text{SCN})_2 \cdot \text{PbI}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (Grissom and Thorp, Am. Ch. J. 10. 229.)

**Lithium sulphocyanide,  $\text{LiSCN}$ .**

Very deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Hermes, Z. Ch. 1866. 417.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

**Magnesium sulphocyanide,  $\text{Mg}(\text{SCN})_2 + 4\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Magnesium stannic sulphocyanide,**

$\text{MgSn}(\text{SCN})_6 + 6\text{H}_2\text{O}$ .

Hygroscopic. Sol. in  $\text{H}_2\text{O}$ , alcohol and acetone. (Weinland and Barnes, Z. anorg. 1909, 62. 258.)

**Manganous sulphocyanide,  $\text{Mn}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Mercurous sulphocyanide,  $\text{Hg}_2(\text{SCN})_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in hot  $\text{HCl} + \text{Aq}$ . Slowly decomp. by hot aqua regia. Sol. in hot  $\text{KSCN} + \text{Aq}$ .

**Mercuric sulphocyanide, basic,  $\text{Hg}(\text{SCN})_2 \cdot 3\text{HgO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . Insol. in  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3 + \text{Aq}$ . (Fleischer.)

$\text{Hg}(\text{SCN})_2 \cdot 2\text{HgO}$ . Insol. in  $\text{H}_2\text{O}$ . Sl. attacked by acids. (Claus, J. pr. 15. 401.)

**Mercuric sulphocyanide,  $\text{Hg}(\text{SCN})_2$ .**

Very sl. sol. in cold, much more easily in hot  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . (Crookes, Chem. Soc. 4. 18.)

Solubility in  $\text{H}_2\text{O} = 0.00218$  mol. in 1 l. (Grossmann, Z. anorg. 1904, 43. 358.)

More sol. in  $\text{H}_2\text{O}$  than in alcohol. (Peters, B. 1908, 41. 3180.)

Very sl. sol. in  $\text{H}_2\text{O}$  at  $25^\circ$ . Appreciably sol. only in boiling  $\text{H}_2\text{O}$ . (Jander, Dissert. 1902.)

Sol. in  $\text{Hg}(\text{NO}_3)_2$  or  $\text{KSCN} + \text{Aq}$ , also in  $\text{NH}_4\text{Cl} + \text{Aq}$ . Sol. in many sulphocyanides  $+ \text{Aq}$ .

Easily sol. in cold  $\text{HCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$  or  $\text{BaCl}_2 + \text{Aq}$ . (Hermes, J. pr. 1866, (1) 97. 477.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

**Mercuric hydrogen sulphocyanide,**

$\text{Hg}(\text{SCN})_2 \cdot 2\text{HSCN}$ .

Easily decomp. (Hermes, Dissert. 1866.)

**Mercuric nickel sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{Ni}(\text{SCN})_2 + 2\text{H}_2\text{O}$ .**

Moderately sol. in hot  $\text{H}_2\text{O}$ . (Cleve, J. pr. 91. 227.)

Very sol. in  $\text{MSCN} + \text{Aq}$ . (Orloff, C. C. 1906, I. 1411.)

**Mercuric potassium sulphocyanide,**

$\text{Hg}(\text{SCN})_2 \cdot \text{KSCN}$ .

Sol. in cold, more easily in hot  $\text{H}_2\text{O}$ . Sol. in alcohol and ether. Very sol. in  $\text{NH}_4\text{Cl}$  or  $\text{KCl} + \text{Aq}$ . (Claus.)

$\text{K}_2\text{Hg}(\text{SCN})_4$ . Very sol. in  $\text{H}_2\text{O}$ ; sol. in alcohol.

Insol. in anhydrous ether. (Rosenheim, Z. anorg. 1901, 27. 285.)

**Mercuric rubidium sulphocyanide,**

$\text{Hg}(\text{SCN})_2 \cdot \text{RbSCN}$ .

Sol. in alcohol without decomp. Decomp. by  $\text{H}_2\text{O}$ .

$\text{Hg}(\text{SCN})_2 \cdot 2\text{RbSCN} + \frac{1}{2}\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  without decomp. (Grossmann, B. 1904, 37. 1259.)

**Mercuric sodium sulphocyanide,**

$\text{Na}_2\text{Hg}(\text{SCN})_2$ .

Very hygroscopic. (Rosenheim, Z. anorg. 1901, 27. 286.)

**Mercuric zinc sulphocyanide,  $\text{Hg}(\text{SCN})_2 \cdot \text{Zn}(\text{SCN})_2$ .**

Scarcely sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Cleve.)

**Mercuric sulphocyanide ammonia,**

$2\text{Hg}(\text{SCN})_2 \cdot 3\text{NH}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

$\text{Hg}(\text{SCN})_2 \cdot 4\text{NH}_3$ . (Peters, B. 1908, 41. 3178.)

**Mercuric sulphocyanide ammonium bromide,  $\text{Hg}(\text{SCN})_2 \cdot \text{NH}_4\text{Br}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alcohol. (Grossmann, Z. anorg. 1903, 37. 418.)

**Mercuric sulphocyanide ammonium chloride**,  $\text{Hg}(\text{SCN})_2, \text{NH}_4\text{Cl}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm alcohol from which it can be cryst. (Grossmann.)

**Mercuric sulphocyanide bromide**,  $\text{HgSCNBr}$ .

Insol. in cold  $\text{H}_2\text{O}$ ; sol. in hot  $\text{H}_2\text{O}$  and in alcohol. (Rosenheim, Z. anorg. 1901, 27. 282.)

**Mercuric sulphocyanide chloride**,  $\text{HgSCNCl}$ .

Insol. in cold  $\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$  and alcohol. (Rosenheim.)

**Mercuric sulphocyanide potassium bromide**,  $\text{Hg}(\text{SCN})_2, 2\text{KBr}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Grossmann, Z. anorg. 1903, 37. 418.)

**Mercuric sulphocyanide potassium chloride**,  $\text{Hg}(\text{SCN})_2, \text{KCl}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Not decomp. by recryst. from warm alcohol (Grossmann.)

**Molybdenum sulphocyanide**,  $\text{Mo}(\text{SCN})_2(?)$ .

Sol. in  $\text{H}_2\text{O}$  and ether. (Braun, Z. anal. 6. 86.)

**Molybdenum potassium sulphocyanide**,  $\text{K}_2\text{Mo}(\text{SCN})_6 + 4\text{H}_2\text{O}$ .

Cryst. from boiling  $\text{H}_2\text{O}$  and alcohol. (Chilesotti, Gazz. ch. it. 1904, 34. (2) 493.)

**Molybdenum sodium sulphocyanide**,  $\text{Na}_2\text{Mo}(\text{SCN})_6 + 12\text{H}_2\text{O}$ .

(Rosenheim, B. 1909, 42. 154.)

**Molybdenum thallous sulphocyanide**,  $\text{MoTl}_2(\text{SCN})_6$ .

(Rosenheim and Garfunkel, B. 1908, 41. 2388.)

**Molybdenum sulphocyanide zinc amine**,  $2\text{Mo}(\text{SCN})_6, 3\text{Zn}(\text{NH}_3)_4$ .

(Rosenheim and Garfunkel, B. 1908, 41. 2390.)

$2\text{Mo}(\text{SCN})_6(\text{OH})_2, \text{Zn}_3(\text{NH}_3)_{11}$ . Can be cryst. from boiling  $\text{NH}_4\text{OH} + \text{Aq}$ . Air-dried salt probably has the composition  $2\text{Mo}(\text{SCN})_6(\text{OH})_2, 3\text{Zn}(\text{NH}_3)_4 + 2\text{H}_2\text{O}$ . (Maas and Sand, B. 1908, 41. 1510.)

$2\text{Mo}(\text{SCN})_6(\text{OH})_2, \text{Zn}_3(\text{NH}_3)_{11}$ . (Maas and Sand.)

**Nickel sulphocyanide**,  $\text{Ni}(\text{SCN})_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Grossmann, B. 1904, 37. 565.)

$+ \frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and alcohol. Insol. in acetone. (Krug and M'Elroy.)

$+ 1\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rosenheim and Cohn, Z. anorg. 1901, 27. 292.)

**Nickel potassium sulphocyanide**,  $\text{K}_2\text{Ni}(\text{SCN})_6 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sl. sol. in cold, easily sol. in hot alcohol. (Rosenheim, Z. anorg. 1901, 27. 292.)

**Nickel sodium sulphocyanide**,  $\text{NiNa}_2(\text{SCN})_4 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Sl. sol. cold, readily sol. hot alcohol. (Rosenheim, Z. anorg. 1901, 27. 292.)

**Nickel sulphocyanide ammonia**,  $\text{Ni}(\text{SCN})_2, 3\text{NH}_3$ .

(Peters, B. 1908, 41. 3178.)

$\text{Ni}(\text{SCN})_2, 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ .

**Platinous sulphocyanide**,  $\text{Pt}(\text{SCN})_2(?)$ .

Insol. in  $\text{H}_2\text{O}$ .

See **Platinosulphocyanides**, and **Platinosulphocyanides**.

**Potassium sulphocyanide**,  $\text{KSCN}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 177.2 pts. at  $0^\circ$ , and 217.0 pts. at  $20^\circ$ .

100 g. sat.  $\text{KSCN} + \text{Aq}$  contain 70.5 g.  $\text{KSCN}$  at  $25^\circ$ . (Foote, Z. phys. Ch. 1903, 46. 81.)

150 pts.  $\text{KSCN} + 100$  pts.  $\text{H}_2\text{O}$  at  $10.8^\circ$  lower the temp.  $34.5^\circ$ . (Rüdorff, B. 2. 68.)

Solubility of  $\text{KSCN} + \text{AgSCN}$  at  $25^\circ$ .

$\text{KSCN}$	$\text{AgSCN}$	Solid phase
70.53	0.00	$\text{KSCN}$
66.55	9.32	$\text{KSCN} + 2\text{KSCN}, \text{AgSCN}$
64.47	10.62	$2\text{KSCN}, \text{AgSCN}$
61.25	11.76	"
58.34	13.55	"
53.21	17.53	"
50.68	20.43	$2\text{KSCN}, \text{AgSCN} + \text{KSCN}, \text{AgSCN}$
49.43	20.32	$\text{KSCN}, \text{AgSCN}$
32.51	18.34	"
24.68	16.41	"
23.86	16.07	$\text{KSCN}, \text{AgSCN} + \text{AgSCN}$

(Foote, Z. phys. Ch. 1903, 46. 81.)

See also  $\text{AgSCN}$ .

Sol. in alcohol, especially easily if boiling.

Sol. in acetone. (Krug and M'Elroy.)

Sol. in liquid  $\text{SO}_2$ . (Walden, Z. anorg. 1902, 30. 160.)

100 g. acetone dissolve 20.75 g.  $\text{KSCN}$  at  $22^\circ$ , and 20.40 g. at  $58^\circ$ .

100 g. amyl alcohol dissolve 0.18 g.  $\text{KSCN}$  at  $13^\circ$ ; 1.34 g. at  $65^\circ$ ; 2.14 g. at  $100^\circ$ ; 3.15 g. at  $133.5^\circ$ .

100 g. ethyl acetate dissolve 0.44 g.  $\text{KSCN}$  at  $0^\circ$ ; 0.40 g. at  $14^\circ$ ; 0.20 g. at  $79^\circ$ .

100 g. pyridine dissolve 6.75 g.  $\text{KSCN}$  at  $0^\circ$ ; 6.15 g. at  $20^\circ$ ; 4.97 g. at  $58^\circ$ ; 3.88 g. at

97°; 3.21 g. at 115°. (Laszcynski, B. 1894, 27. 2285.)

100 g. acetonitrile dissolve 11.31 g. KSCN at 18°. (Naumann and Schier, B. 1914, 47. 249.)

Sl. sol. in benzonitrile. (Naumann, B. 1914, 47. 1369.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3789.)

**Potassium molybdenyl sulphocyanide,**  $3\text{KSCN}, \text{Mo}(\text{OH})(\text{SCN})_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Sand and Maas, B. 1908, 41. 1506.)

**Potassium silver sulphocyanide,**  $\text{KSCN}, \text{AgSCN}$ .

Decomp. by  $\text{H}_2\text{O}$ .

See Donk under KSCN.

2KSCN, AgSCN. Stable in the air. (Wells, Am. Ch. J. 1902, 23. 265.)

See Donk under KSCN.

3KSCN, AgSCN. (Wells.)

**Potassium stannic sulphocyanide,**  $\text{K}_2\text{Sn}(\text{SCN})_6 + 4\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ .

Sol. in alcohol and acetone. (Weinland and Barnes, Z. anorg. 1909, 62. 258.)

**Potassium titanyl sulphocyanide,**  $2\text{KSCN}, \text{TiO}(\text{SCN})_2 + \text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$  without immediate decomp. but slowly decomp. (Rosenheim and Cohn, Z. anorg. 1901, 23. 169.)

**Potassium vanadium sulphocyanide,**  $3\text{KSCN}, \text{V}(\text{SCN})_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol with a green color. Sl. sol. in ether. (Ciocci, Z. anorg. 1898, 19. 309.)

Sol. in  $\text{H}_2\text{O}$  with decomp.; stable in aq. solution in the presence of an excess of KSCN; sol. in alcohol. (Locke, Am. Ch. J. 1898, 20. 604.)

**Potassium vanadyl sulphocyanide,**  $\text{K}_2\text{VO}(\text{SCN})_4 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , alcohol, ether, amyl alcohol and ethyl acetate. (Koppel, Z. anorg. 1903, 36. 292.)

**Potassium zinc sulphocyanide,**  $2\text{KSCN}, \text{Zn}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .

Easily sol. in alcohol. (Walden, Z. anorg. 1900, 23. 374.)

**Potassium sulphocyanide mercuric bromide,**  $\text{KSCN}, \text{HgBr}_2$ .

Very sol. in  $\text{H}_2\text{O}$ .

Sol. in alcohol. (Grossmann, B. 1902, 35. 2945.)

2KSCN,  $\text{HgBr}_2$ . Very sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol. (Grossman.)

**Potassium sulphocyanide mercuric iodide,**  $2\text{KSCN}, \text{HgI}_2$ .

Undecomp. by solution in conc. alcohol, or in KSCN + Aq. (Grossmann, Z. anorg. 1903, 37. 421.)

+2 $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Philipp, Pogg, 1867, 131. 94.)

**Silicon sulphocyanide,**  $\text{Si}(\text{SCN})_4$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

Sol. in  $\text{CS}_2$ ,  $\text{CHCl}_3$  and ligroin, (Reynolds, Proc. Chem. Soc. 1906, 22. 17.)

**Silver sulphocyanide,**  $\text{AgSCN}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $1.08 \times 10^{-4}$  g. mols. AgSCN at 25°. (Küster and Thiel, Z. anorg. 1902, 33. 139.)

1 l.  $\text{H}_2\text{O}$  dissolves  $1.25 \times 10^{-4}$  gram-atoms of silver at 25°. (Abegg and Cox, Z. phys. Ch. 1903, 46. 11.)

Sl. sol. in  $\text{H}_2\text{O}$ . 1 liter of sat. solution at 19.96° contains  $1.37 \times 10^{-4}$  g. (Böttger, Z. phys. Ch. 1903, 46. 603.)

6.4 milligrams are dissolved in 1 liter of sat. solution at 100°. (Böttger, Z. phys. Ch. 1906, 56. 93.)

Solubility product of AgSCN is 0.49 and  $1.16 \times 10^{-12}$  mols. per l. at 18° and 25° respectively. (Kirschner, Z. phys. Ch. 1912, 79. 245.)

Solubility in  $\text{H}_2\text{O} = 1.2 \times 10^{-6}$  g. mol. per liter at 25°. (A. E. Hill, J. Am. Chem. Soc. 1908, 30. 74.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.00025 g. AgSCN at 21°. (Whitby, Z. anorg. 1910, 67. 108.)

Insol. in acids, excepting conc.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ . Insol. in dil. sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . Sol. in KSCN + Aq. Insol. in  $\text{AgNO}_3$  or  $\text{NH}_4\text{SCN} + \text{Aq}$ . Sol. in  $\text{Hg}_2(\text{NO}_3)_2 + \text{Aq}$ .

Solubility in KSCN at 25°.

Mol. KSCN in 1 litre	g. AgSCN in 1 litre
1.25	22.34
1.20	19.93
1.12	16.18
1.066	14.10
0.626	2.80
0.573	2.06

(Hellwig, Z. anorg. 1900, 25. 184.)

Solubility in N/10 KSCN + Aq at 18° =  $2.5 \times 10^{-4}$ . (Kirschner, Z. phys. Ch. 1912, 79. 247.)

See also KSCN.

1 l. of a 3-N solution of  $\text{AgNO}_3$  dissolves 0.432 g. AgSCN at 25°. Nearly insol. in less dil. solution. (Hellwig, Z. anorg. 1900, 25. 179.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in ethyl acetate. (Hamers, Dissert. 1906; Naumann, B. 1910, 43. 314.)

**Silver strontium sulphocyanide**,  $2\text{AgSCN}$ ,  $\text{Sr}(\text{SCN})_2 + 2\text{H}_2\text{O}$ .

Stable in the air. (Wells, *Am. Ch. J.* 1902, 28. 270.)

**Silver zinc sulphocyanide**,  $2\text{AgSCN}$ ,  $\text{Zn}(\text{SCN})_2$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Wells.)

**Silver sulphocyanide ammonia**,  $\text{AgSCN}$ ,  $2\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .

**Samarium sulphocyanide**,  $\text{Sm}(\text{SCN})_2 + 6\text{H}_2\text{O}$ .

Very deliquescent. (Cleve.)

**Sodium sulphocyanide**,  $\text{NaSCN}$ .

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  and alcohol.

Sol. in benzonitrile. (Naumann, *B.* 1914, 47. 1369.)

Sol. in methyl acetate. (Naumann, *B.* 1909, 42. 3789.)

**Sodium stannic sulphocyanide**,  $\text{Na}_2\text{Sn}(\text{SCN})_6 + 6\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . Sol. in alcohol and acetone. (Weinland and Bames, *Z. anorg.* 1909, 62. 257.)

**Sodium vanadium sulphocyanide**,  $3\text{NaSCN}$ ,  $\text{V}(\text{SCN})_3 + 12\text{H}_2\text{O}$ .

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  and alcohol. (Ciocci, *Z. anorg.* 1898, 19. 313.)

**Strontium sulphocyanide**,  $\text{Sr}(\text{SCN})_2 + 3\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  and alcohol.

**Strontium stannic sulphocyanide**,  $\text{SrSn}(\text{SCN})_6 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , alcohol and acetone. (Weinland and Bames, *Z. anorg.* 1909, 62. 259.)

**Thallium sulphocyanide**,  $\text{TlSCN}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . 3.15 g. are contained in 1 liter of sat. solution at  $20^\circ$ ; 3.905 g. at  $25^\circ$ ; 7.269 g. at  $39.75^\circ$ . Insol. in alcohol. (Böttger, *Z. phys. Ch.* 1903, 46. 603.)

**Titanyl sulphocyanide**,  $\text{TiO}(\text{SCN})_2 + 2\text{H}_2\text{O}$ .

Sol. in cold  $\text{H}_2\text{O}$ .

**Tin (stannous) sulphocyanide**,  $\text{Sn}(\text{SCN})_2$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Classen, *J. pr.* 96. 349.)

Sol. in cold  $\text{H}_2\text{O}$ . (Rosenheim, *Z. anorg.* 1901, 28. 168.)

**Yttrium sulphocyanide**,  $\text{Y}(\text{SCN})_3 + 6\text{H}_2\text{O}$ .

Not deliquescent. Very sol. in  $\text{H}_2\text{O}$ , alcohol, or ether.

**Zinc sulphocyanide**,  $\text{Zn}(\text{SCN})_2$ .

Less sol. in  $\text{H}_2\text{O}$  and alcohol than most other cyanides.

**Zinc sulphocyanide ammonia**,  $\text{Zn}(\text{SCN})_2$ ,  $12\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

**Sulphocyanoplatinic acid**.

See *Platinosulphocyanhydric acid*.

**Sulphocyanoplatinous acid**.

See *Platinosulphocyanhydric acid*.

**Sulphohypophosphoric acid**.

**Aluminum sulphohypophosphate**,  $\text{Al}_2(\text{PS}_3)_3$ .

Unstable in the air. Sol. in  $\text{H}_2\text{O}$  with decomp. (Friedel, *C. R.* 1894, 119. 262.)

**Cadmium —**,  $\text{Cd}_2\text{P}_2\text{S}_6$ .

Partially decomp. in moist air. Decomp. by  $\text{H}_2\text{O}$ , cold  $\text{HNO}_3$  or alkalis +  $\text{Aq}$ . (Ferrand, *A. ch.* 1899, (7) 17. 423; *Bull. Soc.* 1895, (3) 13. 116.)

**Chromium —**,  $\text{Cr}_2\text{P}_2\text{S}_6$ .

Insol. in  $\text{HNO}_3$ . Very sl. attacked by aqua regia. (Ferrand.)

**Cupric —**,  $\text{Cu}_2\text{P}_2\text{S}_6$ .

Ppt. (Friedel, *C. R.* 1894, 119. 262.)

**Iron (ferrous) —**,  $\text{Fe}_2\text{P}_2\text{S}_6$ .

Sol. in  $\text{HNO}_3$  and in a mixture of  $\text{HNO}_3$  with  $\text{KClO}_3$ . (Friedel.)

**Lead —**,  $\text{Pb}_2\text{P}_2\text{S}_6$ .

Not decomp. by boiling  $\text{H}_2\text{O}$ . (Friedel.)

**Mercuric —**,  $\text{Hg}_2\text{P}_2\text{S}_6$ .

Slowly decomp. by boiling  $\text{H}_2\text{O}$ , more rapidly by  $\text{KOH} + \text{Aq}$ . (Friedel.)

**Nickel —**,  $\text{Ni}_2\text{P}_2\text{S}_6$ .

Not attacked by boiling  $\text{H}_2\text{O}$  or hot or cold acids. Sl. attacked by aqua-regia. (Ferrand, *A. ch.* 1899, (7) 17. 416.)

**Silver —**,  $\text{Ag}_2\text{P}_2\text{S}_6$ .

Ppt. (Friedel, *C. R.* 1894, 119. 263.)

**Tin (stannous) hypophosphate —**,  $\text{SnPS}_3$ .

Decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{KOH} + \text{Aq}$ . (Friedel, *C. R.* 1894, 119. 264.)

**Tin (stannic) —**,  $\text{SnP}_2\text{S}_6$ .

Easily decomp. by boiling  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{KOH} + \text{Aq}$ . (Friedel.)

**Zinc sulphohypophosphate,  $Zn_2P_2S_4$ .**

Decomp. in moist air. Insol. in  $H_2O$ . Partially decomp. by boiling  $H_2O$ . Violently attacked by  $HNO_3$ . Sol. in aqua regia. Not attacked by  $HCl$ . (Ferrand, A. ch. 1899, (7) 17. 421.)

**Zinc —,  $Zn_2P_2S_4$ .**

Insol. in  $H_2O$ . Partly decomp. by boiling  $H_2O$ . Not decomp. by  $HCl$  or  $HNO_3$  but by aqua regia. (Ferrand, Bull. Soc. 1895, (3) 13. 115.)

**Sulphomolybdic acid.****Ammonium sulphomolybdate,  $(NH_4)_2MoS_4$ .**

Easily sol. in  $H_2O$ ; very sl. sol. in alcohol. (Berzelius, Pogg. 83. 261.)

**Ammonium cupric sulphomolybdate.**

Sl. sol. in  $H_2O$ . (Debray, C. R. 96. 1616.)

**Barium sulphomolybdate,  $BaMoS_4$ .**

More sol. in  $H_2O$  than  $BaMo_2S_{10}$ . Known only in solution. (Berzelius.)

$BaS, 3MoS_3 = BaMo_2S_{10}$ . Sl. sol. in cold, easily sol. in hot  $H_2O$ . Not decomp. by conc. cold  $HNO_3 + Aq$ , but more easily by dil.  $HNO_3 + Aq$ . (Berzelius.)

**Cadmium sulphomolybdate.**

Insol. in  $H_2O$ . (Berzelius.)

**Cesium sulphomolybdate,  $Cs_2S, 3MoS_4 + 7H_2O$ .**

As Rb comp. (Herschfinkel, Dissert. 1907.)  
 $3Cs_2S, 5MoS_4$ . (Herschfinkel.)

**Calcium sulphomolybdate,  $CaS, 3MoS_3$ .**

Sol. in  $H_2O$ . (Berzelius.)

$CaMoS_4$ . More sol. in  $H_2O$  than  $CaS, 3MoS_3$ . Known only in solution. (Berzelius.)

**Cerium sulphomolybdate.**

Precipitate. (Berzelius.)

**Cobalt sulphomolybdate,  $CoMoS_4$ .**

Sol. in  $K_2MoS_4 + Aq$ . (Berzelius.)

**Cupric sulphomolybdate.**

(Debray, C. R. 96. 1616.)

**Ferrous sulphomolybdate,  $FeMoS_4$ .**

Sol. in  $H_2O$ . (Berzelius.)

**Ferric sulphomolybdate,  $Fe_3(MoS_4)_2$ .**

Sol. in  $K_2MoS_4 + Aq$ .

**Lead sulphomolybdate.**

Ppt. (Berzelius.)

**Lithium sulphomolybdate.**

Not deliquescent, but very easily sol. in  $H_2O$ . (Berzelius.)

**Magnesium sulphomolybdate,  $MgMoS_4$ .**

Sol. in  $K_2MoS_4 + Aq$ . (Berzelius.)

**Manganous sulphomolybdate,  $MnMoS_4$ .**

Sol. in  $H_2O$ . (Berzelius.)

**Mercurous sulphomolybdate,  $Hg_2MoS_4$  (?)**

Ppt.

**Mercuric sulphomolybdate,  $HgMoS_4$ .**

Insol. in  $K_2MoS_4 + Aq$ .

**Nickel sulphomolybdate,  $NiMoS_4$ .**

Sol. in  $K_2MoO_4 + Aq$ . (Berzelius.)

**Potassium sulphomolybdate, basic,  $K_4Mo_2S_8$ .**

Easily sol. in  $H_2O$ . Insol. in alcohol and ether. (Krus, B. 16. 2050.)

**Potassium sulphomolybdate,  $K_2MoS_4$ .**

Sol. in  $H_2O$ , from which it is precipitated by alcohol. (Berzelius.)

**Rubidium sulphomolybdate,  $3Rb_2S, 8MoS_3 + 30H_2O$ .**

Very sl. sol. in  $H_2O$ . Sol. by addition of  $NH_3$ . (Herschfinkel, Dissert. 1907.)

$5Rb_2S, 6MoS_3$ . (Herschfinkel.)

**Silver sulphomolybdate,  $Ag_2MoS_4$ .**

Ppt.

**Sodium sulphomolybdate,  $Na_2MoS_4$ .**

Sol. in  $H_2O$ , and not precipitated by alcohol from aqueous solution. (Berzelius.)

**Strontium sulphomolybdates.**

Exactly analogous to the Ba salts, which see. (Berzelius.)

**Zinc sulphomolybdate.**

Ppt. Insol. in  $H_2O$ . (Berzelius.)

**Monosulphomolybdic acid.****Sodium monosulphomolybdate,  $Na_2MoO_3S$ .**

Rather hygroscopic. Sol. in  $H_2O$ ; forms deep blue solution with  $H_2SO_4$ . Sol. in  $HC_2H_3O_2 + Aq$ . (Krus, A. 225. 1.)

**Disulphomolybdic acid.****Ammonium disulphomolybdate,**

$(NH_4)_2MoO_3S_2$ .

Sl. sol. in cold, easily in hot  $H_2O$ . Insol. in sat.  $NH_4Cl + Aq$  and absolute alcohol.

Aqueous solution is decomp. by boiling. (Bodenstab, J. pr. 78. 186.)

**Potassium disulphomolybdate,  $K_2MoO_4S_2$ .**

Very sol. in  $H_2O$  and alcohol. Sol. in  $HC_2H_3O_2 + Aq.$  (Krüss, B. 16. 2046.)

**Trisulphomolybdic acid.****Ammonium hydrogen trisulphopyromolybdate,  $NH_4HMoO_4O_3S_3$ .**

Precipitate. Insol. in alcohol or  $CS_2$ . (Krüss, B. 16. 2047.)

**Potassium hydrogen trisulphopyromolybdate,  $KHMoO_4O_3S_3$ .**

Very easily sol. in  $H_2O$ . (Krüss, B. 16. 2048.)

**Sodium hydrogen trisulphopyromolybdate,  $NaHMoO_4O_3S_3$ .**

Precipitate. Much more sol. in  $H_2O$  than the  $NH_4$  compound. (Krüss, B. 16. 2047.)

**Potassium sulphomolybdate,  $K_2MoO_4S_2O_7$ .**

Sol. in  $H_2O$ ,  $HC_2H_3O_2$ , and  $H_2SO_4$ . (Krüss, B. 17. 1771.)

**Pentasulphomolybdic acid.****Potassium pentasulphomolybdate,  $KMoS_5$ .**

Sol. in warm  $H_2O$ . (Hofmann, Z. anorg. 1896, 12. 62.)

**Persulphomolybdic acid,  $H_2MoS_5$ .**

Precipitate. Insol. in  $H_2O$ , alcohol, ether,  $CS_2$ , and acetic acid.

Decomp. slowly by hot  $H_2SO_4$ . Sol. in warm  $KOH + Aq.$  and cold  $K_2S + Aq.$  Not attacked by cold  $KSH + Aq.$  but dissolves on warming. (Krüss, B. 17. 1773.)

**Ammonium persulphomolybdate,  $(NH_4)_2MoS_5$ .**

Very sl. sol. in cold, more easily in hot  $H_2O$ . Insol. in  $NH_4OH + Aq.$  (Berselius.)

**Barium —,  $BaMoS_5$ .**

Insol. in boiling  $H_2O$  or dil.  $HCl + Aq.$  (Berselius.)

**Calcium —.**

Difficultly sol. in  $H_2O$ . (Berselius.)

**Cerium —.**

Precipitate. (Berselius.)

**Ferrous —.**

Insol. in  $Fe$  salts +  $Aq.$  but sol. in  $K_2MoS_5 + Aq.$  (Berselius.)

**Ferric —.**

Ppt.

**Lithium persulphomolybdate.**

Sl. sol. in cold, easily sol. in hot  $H_2O$ . (Berselius.)

**Magnesium —.**

Insol. precipitate. (Berselius.)

**Nickel —.**

Ppt. Sol. in  $K_2MoS_5 + Aq.$  from which it separates in 24 hours. (Berselius.)

**Potassium —,  $K_2MoS_5$ .**

Almost insol. in cold, more sol. in hot  $H_2O$ . Insol. in cold  $KOH + Aq.$  (Berselius.)

**Potassium hydrogen —,  $KHMoS_5$ .**

Sol. in  $H_2O$ . (Krüss.)

**Sodium —,  $Na_2MoS_5$ .**

Sl. sol. in cold, easily in hot  $H_2O$ . (Berselius.)

**Sodium hydrogen —,  $NaHMoS_5$ .**

(Krüss.)

**Persulphomolybdic acid,  $HMoS_5$ .**

Sol. in  $H_2O$ . (Hofmann, Z. anorg. 1896, 12. 59.)

**Ammonium —,  $NH_4MoS_5 + H_2O$ .**

Sl. sol. in  $H_2O$  and in alcohol with decomp. (Hofmann.)

**Cesium —,  $CaMoS_5$ .**

Almost insol. in  $H_2O$ . (Hofmann.)

**Potassium —,  $KMoS_5$ .**

Sol. in  $H_2O$ . (Hofmann.)

**Thallium —,  $TlMoS_5$ .**

Insol. in  $H_2O$ . (Hofmann.)

**Sulphonosmic acid.****Potassium sulphonosmate,**

$7K_2O, 4O_5O_3, 10SO_3$ .

Sol. in  $H_2O$ . (Rosenheim, Z. anorg. 1899, 21. 127.)

+  $3H_2O$ . Sol. in  $H_2O$ . (Rosenheim.)

+  $7H_2O$ . Easily sol. in  $H_2O$ ; decomp. in aq. solution at  $70^\circ$ . (Rosenheim.)

$11K_2O, 4O_5O_3, 14SO_3 + 7H_2O$ . Sol. in  $H_2O$ . (Rosenheim.)

**Sodium sulphonosmate,**

$3Na_2O, O_5O_3, 4SO_3 + 5H_2O$ .

Easily sol. in  $H_2O$ ; decomp. in aq. solution. (Rosenheim.)

**Sulphopalladic acid.**

**Potassium palladious sulphopalladate**,  $K_2S, Pd_2S, PdS_2 = K_2Pd_2S_4$ .

Insol. in  $H_2O$ . Moderately conc.  $HCl + Aq$  dissolves out  $K$  without evolution of  $H_2S$ . (Schneider, Pogg. 141. 526.)

**Silver sulphopalladate**,  $Ag_2PdS$ .

(Schneider.)

**Silver palladious sulphopalladate**,  $Ag_2S, Pd_2S, PdS_2 = Ag_2Pd_2S_4$ .

Extraordinarily stable. (Schneider.)

**Sodium sulphopalladate**,  $Na_2PdS$ .

Slowly sol. in  $H_2O$ . Insol. in alcohol. (Schneider, Pogg. 141. 520.)

**Sulphophosphide of M.**

See **M phosphosulphide**.

**Sulphophosphamic acid**,  $PS(OH)_2(?)$ ,  $NH_2$ .

See **Thiophosphamic acid**.

**Sulphophosphodiamic acid**,  $PS(OH)(NH_2)_2(?)$ .

See **Thiophosphodiamic acid**.

**Sulphophosphotriamide**,  $PS(NH_2)_3$ .

See **Thiophosphoryl triamide**.

**Sulphophosphoric acid**,  $H_3PSO_3$ .

See **Thiophosphoric acid**.

$H_3PS_4$ . Known only in its salts.

**Ammonium sulphophosphate**,  $(NH_4)_2PS_4$ .

Stable in the air. (Ephraim, B. 1911, 44. 3408.)

**Antimony sulphophosphate**,  $SbPS_4$ .

Insol. in  $H_2O$ , alcohol, ether,  $CS_2$ ,  $HCl + Aq$ , dil.  $H_2SO_4 + Aq$ ,  $C_2H_5$ , or  $HC_2H_3O_2$ . Decomp. by boiling with conc.  $HNO_3 + Aq$ ,  $H_2SO_4$ , aqua regia,  $KOH$ ,  $NaOH$  or  $NH_4OH + Aq$ . (Glatzel, B. 24. 3886.)

**Arsenic sulphophosphate**,  $AsPS_4$ .

Insol. in  $H_2O$ , alcohol,  $HCl + Aq$ , etc. Decomp. by warm  $HNO_3$ , aqua regia, dil.  $H_2SO_4$ ; also sol. in  $KOH$  or  $NH_4OH + Aq$ . (Glatzel, Z. anorg. 4. 186.)

**Barium sulphophosphate**,  $Ba_2(PS_4)_2 + xH_2O$ .

(Ephraim, B. 1911, 44. 3409.)

**Bismuth sulphophosphate**,  $BiPS_4$ .

Insol. in  $H_2O$ , alcohol, ether,  $CS_2$ , benzene,  $HC_2H_3O_2$ , or dil.  $H_2SO_4 + Aq$ . Decomp. by boiling  $HCl + Aq$ , conc.  $H_2SO_4$ ,  $HNO_3$ , or aqua regia; also by  $NaOH$ ,  $KOH$ , or  $NH_4OH + Aq$ . (Glatzel, Z. anorg. 4. 186.)

**Cadmium sulphophosphate**,  $Cd_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, ether, benzene,  $CS_2$ , and  $HC_2H_3O_2$ . Decomp. by hot  $HCl + Aq$ . Very sl. attacked by dil.  $H_2SO_4 + Aq$ . Slowly sol. in hot  $HNO_3$ , rapidly in aqua regia or hot conc.  $H_2SO_4$ . (Glatzel, Z. anorg. 4. 186.)

**Cuprous sulphophosphate**,  $Cu_2PS_4$ .

Insol. in  $H_2O$ , alcohol, etc.; also in  $HCl$  or dil.  $H_2SO_4 + Aq$ . Decomp. by  $HNO_3$ , aqua regia, etc., not by  $KOH$  or  $NaOH + Aq$ . (Glatzel.)

**Ferrous sulphophosphate**,  $Fe_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, ether, etc.; insol. in  $HCl$  or hot dil.  $H_2SO_4 + Aq$ . Decomp. by  $HNO_3$ , aqua regia, or conc.  $H_2SO_4$ . Not attacked by  $KOH$  or  $NH_4OH + Aq$ . (Glatzel.)

**Lead sulphophosphate**,  $Pb_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, etc. Decomp. by warm  $HCl + Aq$ , conc.  $HNO_3 + Aq$ ; not attacked by  $NH_4OH + Aq$ ; sl. decomp. by  $KOH + Aq$ . (Glatzel.)

**Manganous sulphophosphate**,  $Mn_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, ether, benzene,  $CS_2$ , or  $HC_2H_3O_2$ . Not attacked by  $HCl + Aq$ . Sol. in  $HNO_3$  or aqua regia, with separation of  $S$ . Not attacked by dil.  $H_2SO_4 + Aq$ . (Glatzel, Z. anorg. 4. 186.)

**Mercuric sulphophosphate**,  $Hg_2(PS_4)_2$ .

Insol. in  $H_2O$ , alcohol, etc.; also in  $HCl$ , dil.  $HNO_3$ , or  $H_2SO_4 + Aq$ . Not attacked by conc.  $HNO_3$ , or aqua regia; easily sol. in  $HNO_3 + Br_2 + Aq$ . (Glatzel.)

**Nickel sulphophosphate**,  $Ni_2(PS_4)_2$ .

As the ferrous salt. (Glatzel.)

**Potassium sulphophosphate**,  $K_2PS_4 + H_2O$ .

Easily sol. in  $H_2O$ . (Ephraim, B. 1911, 44. 3407.)

**Silver sulphophosphate**,  $Ag_2PS_4$ .

Insol. in  $H_2O$ , alcohol, etc.; also in  $HCl$ ,  $HNO_3$ , or dil.  $H_2SO_4 + Aq$ . Decomp. by conc.  $H_2SO_4$ , and aqua regia. (Glatzel.)

**Sodium sulphophosphate**,  $Na_2PS_4 + 8H_2O$ .

Decomp. by  $H_2O$ .

Sol. in  $Na_2S + Aq$ . (Glatzel, Z. anorg. 1905, 44. 65.)

**Thallous sulphophosphate**,  $Tl_2PS_4$ .

Insol. in  $H_2O$ , alcohol, etc. Sol. in  $HCl$ , dil.  $H_2SO_4 + Aq$ , etc. Not attacked by  $NH_4OH + Aq$ ; sl. decomp. by conc.  $KOH + Aq$ . (Glatzel.)

**Tin (stannous) sulphophosphate,  $\text{Sn}_2(\text{PS}_2)_2$ .**

Insol. in  $\text{H}_2\text{O}$ , alcohol, etc. Insol. in dil.  $\text{H}_2\text{SO}_4$  or  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{HNO}_3 + \text{Aq}$ , aqua regia,  $\text{NH}_4\text{OH}$ , or  $\text{KOH} + \text{Aq}$ . (Glatzel.)

**Zinc sulphophosphate,  $\text{Zn}_2(\text{PS}_2)_2$ .**

Insol. in  $\text{H}_2\text{O}$ , alcohol, ether, etc. Sol. in  $\text{HCl} + \text{Aq}$  or dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily attacked by  $\text{KOH} + \text{Aq}$ ; sl. decomp. by  $\text{NH}_4\text{OH} + \text{Aq}$ . (Glatzel.)

**Sulphopyrophosphoric acid.****Aluminum sulphopyrophosphate,  $\text{Al}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Violently decomp. by  $\text{H}_2\text{O}$  or acids. (Ferrand, A. ch. 1899, (7) 429.)

**Cadmium —,  $\text{Cd}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Not attacked by cold acids. (Ferrand.)

**Chromium —,  $\text{Cr}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Not readily attacked by acids. (Ferrand.)

**Cuprous —,  $\text{Cu}_2\text{P}_2\text{S}_7$ .**

Not attacked by cold  $\text{H}_2\text{SO}_4$  or boiling  $\text{HCl}$ . (Ferrand.)  
Sol. in hot conc.  $\text{HNO}_3$ . (Ferrand.)  
Sol. in alkalis, and in all acids except  $\text{HCl}$ . (Ferrand, C. R. 1896, 122. 886.)

**Ferrous —,  $\text{Fe}_2\text{P}_2\text{S}_7$ .**

Insol. in cold acids.  
Sl. attacked by boiling  $\text{HCl}$  or hot  $\text{KOH} + \text{Aq}$ .  
Decomp. by fused  $\text{KOH}$ . (Ferrand, A. ch. 1899, (7) 17. 410.)

**Lead —,  $\text{Pb}_2\text{P}_2\text{S}_7$ .**

Not attacked by cold  $\text{HNO}_3$ . (Ferrand,)

**Mercurous —,  $\text{Hg}_2\text{P}_2\text{S}_7$ .**

Decomp. by moist air or hot  $\text{HNO}_3$ . (Ferrand.)  
Almost insol. in acids; decomp. by  $\text{H}_2\text{O}$  and moist air. (Ferrand, C. R. 1896, 122. 888.)

**Nickel —,  $\text{Ni}_2\text{P}_2\text{S}_7$ .**

Decomp. by  $\text{H}_2\text{O}$  and by conc.  $\text{HNO}_3$  at  $150^\circ$  in a sealed tube. (Ferrand, A. ch. 1899, (7) 17. 418.)

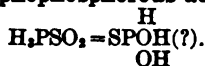
**Silver —,  $\text{Ag}_2\text{P}_2\text{S}_7$ .**

Not decomp. by  $\text{H}_2\text{O}$ .  
Decomp. by aqua regia.  
Not attacked by  $\text{HNO}_3$ . (Ferrand.)

**Zinc —,  $\text{Zn}_2\text{P}_2\text{S}_7$ .**

Decomp. in moist air.  
Decomp. by  $\text{H}_2\text{O}$ .

Violently attacked by cold  $\text{HNO}_3$ . (Ferrand.)

**Sulphophosphorous acid,**

See Thiophosphorous acid.

$\text{H}_2\text{PS}_2$ . Known only in its salts.

**Aluminum sulphophosphite,  $\text{Al}_2(\text{PS}_2)_2$ .**

Very unstable.  
Decomp. in the air. (Ferrand, C. R. 1896, 122. 622.)

**Barium sulphophosphite,  $\text{Ba}_2(\text{PS}_2)_2 + x\text{H}_2\text{O}$ .**

Sol. in dil. acids.  
Insol. in alcohol. (Ephraim, B. 1911, 44. 3412.)

**Chromous sulphophosphite,  $\text{Cr}_2(\text{PS}_2)_2$ .**

Easily attacked by hot conc.  $\text{HNO}_3$  or aqua regia.  
Decomp. by boiling  $\text{NaOH} + \text{Aq}$ . (Ferrand, A. ch. 1899, (7) 17. 419.)  
Quite stable in moist air; very slowly attacked by acids. (Ferrand, C. R. 1896, 122. 622.)

**Cuprous sulphophosphite,  $\text{Cu}_2\text{PS}_2$ .**

Not attacked by  $\text{H}_2\text{O}$  or hot conc.  $\text{HCl}$ .  
Sl. attacked by cold fuming  $\text{HNO}_3$ .  
Violently attacked by  $\text{HNO}_3$ , aqua regia and boiling conc.  $\text{H}_2\text{SO}_4$ .  
Not attacked by boiling  $\text{NaOH} + \text{Aq}$ . (Ferrand, A. ch. 1899, (7) 17. 398.)  
Fairly stable; decomp. by damp air. (Ferrand, C. R. 1896, 122. 621.)

**Iron (ferrous) sulphophosphite,  $\text{Fe}_2(\text{PS}_2)_2$ .**

Very stable and resists the action of alkalis and acids. (Ferrand, C. R. 1896, 122. 622.)  
Insol. in cold acids or hot  $\text{NCl}$ .  
Sol. in hot fuming  $\text{HNO}_3$ .  
Insol. in hot 40%  $\text{KOH} + \text{Aq}$ . (Ferrand, A. ch. 1899, (7) 17. 412.)

**Mercuric sulphophosphite,  $\text{Hg}_2(\text{PS}_2)_2$ .**

Decomp. in moist air.  
Not attacked by cold  $\text{HNO}_3$ . Decomp. by hot  $\text{HNO}_3$ . (Ferrand.)  
Unstable in the air.  
Very slowly attacked by acids. (Ferrand, C. R. 1896, 122. 622.)

**Nickel sulphophosphite,  $\text{Ni}_2(\text{PS}_2)_2$ .**

Unstable in the air.  
Attacked slowly by  $\text{HNO}_3$ . (Ferrand.)

**Silver sulphophosphite,  $\text{Ag}_2\text{PS}_2$ .**

Insol. in most reagents. (Ferrand, C. R. 1896, 122. 622.)  
Not decomp. by  $\text{H}_2\text{O}$ .  
Not easily attacked by acids. (Ferrand, A. ch. 1899, (7) 17. 414.)



**Sodium sulphophosphite,  $\text{Na}_2\text{PS}_2 \cdot x\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ , probably with decomp. (Ephraim, B. 1911, 44. 3410.)

**Zinc sulphophosphite,  $\text{Zn}_2(\text{PS}_2)_2$ .**

Decomp. in moist air.

Sl. attacked by  $\text{H}_2\text{O}$ .

Decomp. by  $\text{HNO}_3$ . (Ferrand, A. ch. 1899, (7) 17. 422.)

Very unstable in the air, and attacked violently by acids. (Ferrand, C. R. 1896, 122. 622.)

**Sulphoplatinic acid,  $\text{H}_2\text{Pt}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$ , but decomp. on air. (Schneider, Pogg. 138. 604.)

$\text{H}_2\text{Pt}_2\text{S}_4$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. very rapidly on air. (Schneider.)

**Copper sulphoplatinate,  $2\text{CuS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .**

Insol. in  $\text{H}_2\text{O}$ .  $\text{HCl}$ ,  $\text{HNO}_3$ , or aqua regia dissolve out part of the Cu. (Schneider, Pogg. 139. 661.)

**Lead sulphoplatinate,  $2\text{PbS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .**

Insol. in hot or cold  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3 + \text{Aq}$  dissolves out Pb partly; aqua regia dissolves completely with difficulty. (Schneider, Pogg. 139. 662.)

**Mercuric sulphoplatinate chloride,  $2\text{HgS}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ ,  $2\text{HgCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; not attacked by  $\text{HCl} + \text{Aq}$ , and only partially sol. in boiling aqua regia. (Schneider.)

**Potassium sulphoplatinate,  $\text{K}_2\text{Pt}_2\text{S}_4$ .**

Insol. in  $\text{H}_2\text{O}$ .  $\text{HCl} + \text{Aq}$  dissolves out K without evolution of  $\text{H}_2\text{S}$ .

Composition its potassium platinous sulphoplatinate,  $\text{K}_2\text{S}$ ,  $3\text{PtS}$ ,  $\text{PtS}_2$ . (Schneider, Pogg. 138. 604.)

$\text{K}_2\text{PtS}_2$ .

**Silver sulphoplatinate,  $2\text{Ag}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ .  $\text{HNO}_3 + \text{Aq}$  dissolves out Ag on warming. Aqua regia decomp. with formation of  $\text{AgCl}$ . (Schneider, Pogg. 138. 664.)

**Sodium sulphoplatinate,  $\text{Na}_4\text{Pt}_2\text{S}_4 = 2\text{Na}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .**

Decomp. by hot  $\text{H}_2\text{O}$ , with residue of  $\text{PtS}_2$ . (Schneider.)

$\text{Na}_4\text{Pt}_2\text{S}_4 = \text{Na}_2\text{S}$ ,  $\text{PtS}$ ,  $2\text{PtS}_2$ . Insol. in  $\text{H}_2\text{O}$ . (Schneider, J. pr. (2) 48. 418.)

**Thallium sulphoplatinate,  $2\text{Tl}_2\text{S}$ ,  $2\text{PtS}$ ,  $\text{PtS}_2$ .**

Insol. in cold  $\text{H}_2\text{O}$ . Dil. acids dissolve out all the thallium. (Schneider, Pogg. 138. 626.)

**Sulphoplatinous acid,  $\text{H}_2\text{PtS}_2$ .**

Known only in solution in  $\text{H}_2\text{O}$ , which soon decomposes. (Schneider, J. pr. (2) 48. 424.)

**Sodium sulphoplatinite,  $\text{Na}_2\text{PtS}_2$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Schneider, J. pr. (2) 48. 420.)

$\text{H}_2\text{Na}_2(\text{PtS}_2)_2$ . Sol. in  $\text{H}_2\text{O}$ , from which it is pptd. by alcohol. (Schneider.)

**Sulphoselenantimonous acid.**

See Selenosulphantimonous acid.

**Sulphoselenarsenic acid.**

See Selenosulpharsenic acid.

**Sulphoselenostannic acid.**

See Selenosulphostannic acid.

**Sulphoselenoxyarsenic acid.**

See Selenosulphoxyarsenic acid.

**Sulphoselenyl chloride,  $\text{SSeO}_2\text{Cl}_4$ .**

Deliquescent; decomposed by  $\text{H}_2\text{O}$ . (Clausnitzer, B. 11. 2007.)

**Metasulphosilicic acid.**

**Sodium metasulphosilicate,  $\text{Na}_2\text{SiS}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Hempel, Z. anorg. 1900, 23. 41.)

**Sulphostannic acid,  $\text{H}_2\text{SnS}_2$ .**

Ppt. (Kühn, A. 84. 110.)

Does not exist. (Storch, W. A. B. 96. 2b. 236.)

**Ammonium sulphostannate,  $(\text{NH}_4)_2\text{S}$ ,  $3\text{SnS}_2 + 6\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ , and easily decomp. (Ditte, C. R. 95. 641.)

$(\text{NH}_4)_2\text{SnS}_2 + 3\text{H}_2\text{O}$ , and  $+7\text{H}_2\text{O}$ . Decomp. by acid. (Stanek, Z. anorg. 1898, 17. 124.)

**Barium sulphostannate,  $\text{BaSnS}_2 + 8\text{H}_2\text{O}$ .**

Sol. in cold  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

**Calcium sulphostannate,  $2\text{CaS}$ ,  $\text{SnS}_2 + 14\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

**Tetraplatinous sulphostannate,  $4\text{PtS}$ ,  $\text{SnS}_2$ .**

Not decomp. by acids. (Schneider, J. pr. (2) 7. 214.)

**Platinum potassium sulphostannate,  $3\text{PtS}$ ,  $\text{K}_2\text{S}$ ,  $\text{SnS}_2$ .**

Insol. in cold  $\text{H}_2\text{O}$ . Dil.  $\text{HCl}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$  dissolves out all the potassium. (Schneider, Pogg. 138. 109.)

**Platinum sodium sulphostannate**,  $3\text{PtS}$ ,  $\text{Na}_2\text{S}$ ,  $\text{SnS}_2$ .

Insol. in cold  $\text{H}_2\text{O}$ . (Schneider, Pogg. 136. 109.)

**Potassium sulphostannate**,  $\text{K}_2\text{SnS}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Kühn, A. 84. 110.)

+  $3\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

$\text{K}_2\text{SnS}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ : pptd. by alcohol. (Weinland, Z. anorg. 1898, 17. 419.)

**Sodium sulphostannate**,  $\text{Na}_2\text{SnS}_3 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Kühn, A. 84. 110.)

+  $3\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

+  $7\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Höring, Zeitsch. Pharm. 1861. 120.)

$\text{Na}_2\text{SnS}_3 + 12\text{H}_2\text{O}$ . Melts in crystal  $\text{H}_2\text{O}$  on heating. Very sol. in  $\text{H}_2\text{O}$ . (Kühn.)

**Strontium sulphostannate**,  $\text{SrSnS}_3 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 95. 641.)

**Thallium sulphostannate**,  $\text{Tl}_2\text{SnS}_3$ .

Ppt. Practically insol. in  $\text{H}_2\text{O}$ . (Hawley, J. Am. Chem. Soc. 1907, 29. 1011.)

**Disulphopersulphuric acid**.

**Sodium disulphopersulphate**,  $\text{Na}_2\text{S}_4\text{O}_6$ .

Sol. in  $\text{H}_2\text{O}$ . Cryst. in cold with  $2\text{H}_2\text{O}$ . (Villiers, C. R. 106. 851, 1354.)

Contains 4H more and is sodium tetrathionate,  $\text{Na}_2\text{S}_4\text{O}_6$ ,  $2\text{H}_2\text{O}$ . (Villiers, C. R. 106. 402.)

**Sulphotelluric acid**.

**Mercurous sulphotellurate**,  $3\text{Hg}_2\text{S}$ ,  $\text{TeS}_4$ .

Ppt.

**Mercuric** —,  $3\text{HgS}$ ,  $\text{TeS}_4$ .

Ppt. (Berzelius.)

**Potassium** —,  $\text{K}_2\text{TeS}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Oppenheim, J. pr. 71. 279.)

**Sodium** —.

Sol. in  $\text{H}_2\text{O}$ . (Oppenheim.)

**Sulphotellurous acid**.

**Ammonium sulphotellurite**,  $3(\text{NH}_4)_2\text{S}$ ,  $\text{TeS}_4$ .

Decomp. on air. Sol. in  $\text{H}_2\text{O}$ .

**Barium** —.

Very slowly sol. in  $\text{H}_2\text{O}$ .

**Calcium** —.

Somewhat sol. in  $\text{H}_2\text{O}$ .

**Cerium** —.

Insol. ppt.

**Cobalt sulphotellurite**,  $\text{Co}_2\text{TeS}_4$ .

Ppt.

**Copper** —,  $\text{Cu}_2\text{TeS}_4$ .

Ppt.

**Ferrous** —.

Ppt.

**Ferric** —.

Ppt.

**Lead** —.

Ppt.

**Lithium** —.

Sol. in  $\text{H}_2\text{O}$ .

**Magnesium** —.

Sol. in  $\text{H}_2\text{O}$  and alcohol.

**Manganous** —.

Ppt.

**Potassium** —,  $3\text{K}_2\text{S}$ ,  $\text{TeS}_4$ .

Sol. in  $\text{H}_2\text{O}$ .

**Silver** —,  $3\text{Ag}_2\text{S}$ ,  $\text{TeS}_4$ .

(Berzelius.)

**Sodium** —.

Sol. in  $\text{H}_2\text{O}$ .

**Strontium** —.

Sol. in  $\text{H}_2\text{O}$ .

**Zinc** —,  $3\text{ZnS}$ ,  $\text{TeS}_4$ .

Ppt. (Berzelius.)

**Sulphotungstic acid**.

**Ammonium sulphotungstate**,  $(\text{NH}_4)_2\text{WS}_4$ .

Very deliquescent. Easily sol. in  $\text{H}_2\text{O}$ , and still more easily in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Corleis, A. 232. 244.)

More sol. in pure  $\text{H}_2\text{O}$  than in  $\text{H}_2\text{O}$  acidified with  $\text{HCl}$ . Decomp. slowly on air. (Berzelius.)

**Barium** —.

Sol. in  $\text{BaS} + \text{Aq}$ .

**Cadmium** —,  $\text{CdWS}_4$ .

Ppt. (Berzelius.)

**Calcium** —.

Sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius.)

**Cobalt** —,  $\text{CoWS}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ .

**Copper sulphotungstate,  $\text{CuWS}_4$ .**

Ppt.

**Glucinum —,  $\text{GlWS}_4$ .**Sol. in  $\text{H}_2\text{O}$ (?).**Ferrous —,  $\text{FeWS}_4$ .**Sol. in  $\text{H}_2\text{O}$ .**Ferric —.**

Ppt.

**Lead —,  $\text{PbWS}_4$ .**

Ppt. (Berzelius.)

**Magnesium —,  $\text{MgWS}_4$ .**Easily sol. in  $\text{H}_2\text{O}$  or alcohol.**Manganous —,  $\text{MnWS}_4$ .**Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Mercurous —.**

Ppt. (Berzelius.)

**Mercuric —,  $\text{HgWS}_4$ .**

Ppt. (Berzelius.)

**Nickel —,  $\text{NiWS}_4$ .**

Ppt. (Berzelius.)

**Potassium —,  $\text{K}_2\text{WS}_4$ .**Sol. in  $\text{H}_2\text{O}$ . Alcohol precipitates from aqueous solutions, but is not entirely insol. in alcohol. (Berzelius.)Very sol. in  $\text{H}_2\text{O}$ . (Corleis, A. 232. 264.)**Potassium — nitrate,  $\text{K}_2\text{WS}_4$ ,  $\text{KNO}_3$ .**Very sol. in cold or hot  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol. (Berzelius.)**Potassium — tungstate,  $\text{K}_2\text{WO}_4$ ,  $\text{K}_2\text{WS}_4$ ,  $\text{K}_2\text{WO}_4$ .**Easily sol. in  $\text{H}_2\text{O}$ . Not precipitated by alcohol. (Berzelius.)Is potassium trisulphotungstate,  $\text{K}_2\text{WOS}_4$ , which see. (Corleis, A. 232. 244.)**Silver —,  $\text{Ag}_2\text{WS}_4$ .**

Ppt. (Berzelius.)

**Sodium —,  $\text{Na}_2\text{WS}_4$ .**Very sol. in  $\text{H}_2\text{O}$ ; less sol. in alcohol. (Berzelius.)

Very deliquescent. (Corleis, A. 232. 264.)

**Strontium —.**Sol. in  $\text{H}_2\text{O}$ , and in  $\text{SrS} + \text{Aq}$ .**Stannous —,  $\text{SnWS}_4$ .**

Ppt. (Berzelius.)

**Stannic —,  $\text{SnWS}_4$ .**

Ppt. (Berzelius.)

**Zinc sulphotungstate,  $\text{ZnWS}_4$ .**Sol. in  $\text{H}_2\text{O}$  with subsequent pptn. (Berzelius.)**Monosulphotungstic acid.****Potassium monosulphotungstate,** $\text{K}_2\text{WOS} + \text{H}_2\text{O}$ .Deliquescent in moist air. Very sol. in  $\text{H}_2\text{O}$ . (Corleis, A. 232. 244.)**Disulphotungstic acid.****Ammonium disulphotungstate,  $(\text{NH}_4)_2\text{WO}_2\text{S}_2$ .**Sol. in  $\text{H}_2\text{O}$  and alcohol. (Berzelius.)

Decomp. easily when moist. (Corleis, A. 232. 264.)

**Trisulphotungstic acid.****Potassium trisulphotungstate,  $\text{K}_2\text{WOS}_3 + \text{H}_2\text{O}$ .**Hygroscopic. Effloresces on dry air and easily decomposed. Easily sol. in  $\text{H}_2\text{O}$ . (Corleis, A. 232. 244.)**Sulphovanadic acid,  $\text{V}_2\text{O}_5, 3\text{SO}_3 + 3\text{H}_2\text{O}$ .**

See Vanadiousulphuric acid, and Sulphate, vanadium.

**Sulphovanadates.**Alkali sulphovanadates are sol. in  $\text{H}_2\text{O}$ . Ca, Sr, and Ba sulphovanadates are sl. sol. in  $\text{H}_2\text{O}$ , and all other sulphovanadates are insol. in  $\text{H}_2\text{O}$ . (Berzelius.)**Ammonium sulphovanadate,  $(\text{NH}_4)_2\text{VS}_4$ .**Easily sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in conc.  $\text{NH}_4\text{SH} + \text{Aq}$ . Insol. in ether,  $\text{CS}_2$ , or  $\text{CHCl}_3$ . (Krüss and Ohnmaier, A. 263. 46.)

See also Sulphoxyvanadic acid.

**Sodium pentasulphopyrovanadate,  $\text{Na}_4\text{V}_2\text{O}_{10}\text{S}_5$ .**Hydroscopic; sol. in  $\text{H}_2\text{O}$  with rapid decomp. (Locke, Am. Ch. J. 1898, 20. 375.)**Sulphoxyantimonic acid.****Potassium sulphonyantimonate,  $\text{K}_2\text{HSbO}_3\text{S}_2 + 2\text{H}_2\text{O}$ .**Sol. in hot, less sol. in cold  $\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Weinland and Gutmann, Z. anorg. 1898, 17. 414.)**Sulphoxyarsenic acid,  $\text{H}_2\text{AsO}_3\text{S}$ .**

Known only in aqueous solution. (McCay, Am. Ch. J. 10. 459.)

**Ammonium monosulphonyarsenate,  $(\text{NH}_4)_2\text{AsSO}_3 + 3\text{H}_2\text{O}$ .**Decomp. in the air; sol. in  $\text{H}_2\text{O}$ , decomp. on boiling. (Weinland, B. 1896, 29. 1009.)

Very sol. in  $H_2O$ ; insol. in alcohol; decomp. in aq. solution and also in the air. (Weinland, Z. anorg. 1897, 14. 53.)

Decomp. in the air. (McLauchlan, B. 1901, 34. 2166.)

**Ammonium hydrogen monosulphoxyarsenate,**  $(NH_4)_2HASO_3$ .

Ppt. (McLauchlan, B. 1901, 34. 2168.)

**Barium monosulphoxyarsenate,**  $BaHASO_3 + 10H_2O$ .

(Preis, A. 257. 184.)

$Ba_2(AsSO_3)_2 + 6H_2O$ . Ppt. (Weinland, Z. anorg. 1897, 14. 54.)

**Barium disulphoxyarsenate,**  $Ba_2(AsS_2O_3)_2 + 4H_2O$ .

Ppt. (Preis, A. 257. 185.)

$+6H_2O$ . (Weinland and Rumpf, Z. anorg. 1897, 14. 64.)

**Barium potassium trisulphoxyarsenate,**  $KBaAsS_3O + 7H_2O$ .

Ppt. (McCay, Z. anorg. 1904, 41. 469.)

**Barium sodium monosulphoxyarsenate,**  $BaNaAsSO_3 + 9H_2O$ .

Ppt. (Weinland, Z. anorg. 1897, 14. 55.)

**Barium sodium sulphoxyarsenate,**  $Ba_7Na_2As_5O_7S_{14} + 12H_2O$ .

(McCay and Foster, Z. anorg. 1904, 41. 467.)

**Calcium trisulphoxyarsenate,**  $Ca_3(AsS_2O_3)_2 + 20H_2O$ .

Ppt. (McCay and Foster, Z. anorg. 1904, 41. 463.)

**Potassium monosulphoxyarsenate,**  $K_2AsSO_3$ .  
Hydroscopic. (Weinland, B. 1896, 29. 109.)

Sol. in conc. KOH + Aq. free from carbonate; very hydroscopic. (Weinland, Z. anorg. 1897, 14. 51.)

**Potassium hydrogen monosulphoxyarsenate,**  $K_2HASO_3 + 2\frac{1}{2}H_2O$ .

Very hygroscopic. (Weinland and Rumpf, Z. anorg. 1897, 14. 59.)

$KH_2AsSO_3$ . Sol. in  $H_2O$ ; solution slowly decomp. on standing. (McCay, Am. Ch. J. 10. 459.)

Formula given by Bouquet and Cloez (A. ch. (3) 13. 44) is  $K_2H_4As_2S_2O_4$ .

**Potassium disulphoxyarsenate,**  $K_2AsS_2O_3 + 10H_2O$ .

Very hygroscopic; decomp. by  $H_2O$ . (Weinland, Z. anorg. 1897, 14. 63.)

**Potassium trisulphoxyarsenate,**  $K_3AsS_3O + 7H_2O$ .

Yellow oil which cryst. at  $-20^\circ$ . (McCay and Foster, Z. anorg. 1904, 41. 468.)

**Sodium monosulphoxyarsenate,**  $Na_2AsSO_3 + 12H_2O$ .

Easily sol. in  $H_2O$ . (Preis, A. 257. 180.) (McLauchlan, B. 1901, 34. 2170.)

Sol. in  $H_2O$ . (Weinland, B. 1896, 29. 1009.) Sl. efflorescent. Insol. in alcohol. (McCay, Z. anorg. 1902, 29. 42.)

Sol. in NaOH + Aq; decomp. by boiling with conc. NaOH. (Weinland, Z. anorg. 1897, 14. 49.)

**Sodium hydrogen monosulphoxyarsenate,**  $NaHSO_3$ .

Decomp. by  $H_2O$ ; insol. in alcohol. (Weinland, Z. anorg. 1897, 14. 58.)

$Na_2HASO_3 + 8H_2O$ . Easily sol. in  $H_2O$ . (Preis.)

**Sodium disulphoxyarsenate,**  $Na_2AsS_2O_3 + 10H_2O$ .

Easily sol. in  $H_2O$ . (Preis.)

Sol. in  $H_2O$ ; pptd. by alcohol. (McCay, B. 1899, 32. 2472.)

Not decomp. by boiling NaOH + Aq. (Weinland, Z. anorg. 1897, 14. 62.)

Insol. in alcohol. (McCay, Z. anorg. 1900, 25. 461.)

$+11H_2O$ . (McLaughlan, B. 1901, 34. 2170.)

Insol. in alcohol. (McCay, Z. anorg. 1902, 29. 46.)

**Sodium trisulphoxyarsenate,**  $Na_4AsS_3O + 11H_2O$ .

Decomp. by  $H_2O$ . (McCay and Foster, Z. anorg. 1904, 41. 454.)

**Sodium trisulphoxydiarsenate,**  $As_2O_3S_3, 3Na_2O + 24H_2O$ .

Easily sol. in  $H_2O$ . (Geuther, A. 240. 208.)  $2As_2O_3S_3, Na_2O + 7H_2O$ . Sol. in  $H_2O$ .

(Nilson, J. pr. (2) 14. 14.)

Correct composition is  $Na_8As_{18}S_{24}O_7 + 30H_2O$ . (Preis.)

**Sodium sulphoxyarsenate,**  $Na_2As_{18}S_3O_7 + 30H_2O = 4Na_2O, 6As_2S_3, 3As_2S_3O + 30H_2O$ .

Decomp. by  $H_2O$ . Sol. in  $NH_4OH$  or KOH + Aq. (Preis, A. 257. 187.)

= Sodium oxytrisulpharsenate of Nilson.

**Sodium pentasulphoxytetraarsenate,**  $Na_{18}As_4S_5O_{11} + 48H_2O$ .

Less sol. in  $H_2O$  than other sulphoxyarsenates. (Preis.)

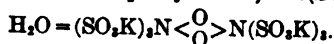
**Sodium strontium trisulphoxyarsenate,**  $NaSrAsS_3O + 10H_2O$ .

Unstable. (McCay and Foster, Z. anorg. 1904, 41. 462.)

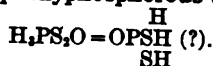
**Trisulphoxyazotic acid, ON(SO<sub>2</sub>H)<sub>3</sub>.**

Known only in its salts. (Claus, A., 158. 52 and 194.)

Has the formula  $(\text{SO}_2\text{H})_3\text{N} < \overset{\text{O}}{\underset{\text{O}}{\text{O}}} > \text{N}(\text{SO}_2\text{H})_3$ .  
(Raschig, A. 241. 161.)

**Potassium trisulphoxyazotate, ON(SO<sub>2</sub>K)<sub>3</sub> +**

Easily sol. in H<sub>2</sub>O without decomp., even on boiling. (Claus, A. 157. 210.)

**Sulphoxyphosphorous acid,**

See Thiophosphorous acid.

**Sulphoxyvanadic acid.****Ammonium pyrohexasulphoxyvanadate,**  
(NH<sub>4</sub>)<sub>4</sub>V<sub>6</sub>S<sub>6</sub>O.

Sol. in H<sub>2</sub>O. (Krüss and Ohnmais, A. 263. 53.)

**Potassium pyrohexasulphoxyvanadate,**  
K<sub>4</sub>V<sub>6</sub>S<sub>6</sub>O + 3H<sub>2</sub>O.

Melts in crystal H<sub>2</sub>O. (Krüss and Ohnmais.)

K<sub>4</sub>V<sub>6</sub>S<sub>6</sub>O<sub>2</sub> + 3H<sub>2</sub>O. More sol. in H<sub>2</sub>O than preceding comp. (K. and O.)

**Sodium orthotrisulphoxyvanadate, Na<sub>3</sub>VS<sub>3</sub>O + 5H<sub>2</sub>O.**

Very deliquescent, and easily sol. in H<sub>2</sub>O. Somewhat sol. in alcohol. (Krüss and Ohnmais.)

**Sodium orthomonosulphoxyvanadate,**  
Na<sub>2</sub>VSO<sub>4</sub> + 10H<sub>2</sub>O.

Less sol. in H<sub>2</sub>O than other sulphoxyvanadates. (K. and O.)

**Sulphur, S.**

The various modifications of sulphur have been classified in many different ways, and there is a difference of opinion as to whether certain forms are true allotropic modifications or not.

The data, as far as concerns the solubility, may be arranged as follows:—

A. Sol. in CS<sub>2</sub>. 1. Rhombic, octahedral, or alpha sulphur, ordinary sulphur. Easily sol. in CS<sub>2</sub>, etc. See below for solubility in various solvents.

2. Prismatic, monoclinic, or beta sulphur. Sol. in CS<sub>2</sub>, but is converted into A, 1. Prismatic sulphur obtained by melting brimstone is not wholly sol. in CS<sub>2</sub>, on account of admixture of gamma sulphur.

Monoclinic modification is more sol. than rhombic in CHCl<sub>3</sub>, ether and benzene. (Meyer C. C. 1903, II. 481.)

3. Soft sulphur, milk of sulphur.

4. Amorphous sol. sulphur is also a separate modification, according to Berthollet.

B. Soft sulphur, obtained by strongly heating and quickly cooling, is sol. in CS<sub>2</sub>, but becomes insol. therein by repeatedly dissolving and evaporating. More easily sol. in CS<sub>2</sub> than A, 1.

C. Insol. in CS<sub>2</sub>. 1. By action of strong light on S in CS<sub>2</sub>.

2. By heating to b.-pt., cooling suddenly, and allowing to stand until hard. Has been called gamma sulphur, but is a mixture of  $\frac{2}{3}$ , A, 4 and  $\frac{1}{3}$ , insol. S.

3. Insol. S in flowers of sulphur. Converted into A. 1 by standing 3 days with alcohol.

According to Berthollet (A. ch. (3) 49. 430) there are only two varieties of S. I. "Octahedral," II. "Amorphous."

I. Octahedral. Sol. in CS<sub>2</sub>. Scarcely acted upon by KHSO<sub>4</sub> + Aq. Converted by oxidising agents into II.

II. Amorphous. Insol. in neutral solvents, viz. H<sub>2</sub>O, alcohol, ether, CS<sub>2</sub>, etc.

Sol. with tolerable rapidity in KHSO<sub>4</sub> + Aq. By long action of Na<sub>2</sub>S + Aq, a portion is dissolved, and the remainder converted into I. Less easily oxidised by HNO<sub>3</sub> + Aq than I. Some varieties of this modification are sol. to a certain extent in alcohol and ether, and by boiling the rest of the sulphur is converted into I; also by long-continued contact with cold alcohol. Berthollet holds that the modification is changed before dissolving. Solutions of the alkalies, alkali salts, and alkali sulphides change insol. into sol. sulphur. (Berthollet.)

Elastic sulphur obtained by pouring molten sulphur at a temp. of over 260° into H<sub>2</sub>O contains 35% or more of a modification of S which is insol. in CS<sub>2</sub>, hot or cold, but sol. in absolute alcohol; this modification can be converted back into ord. sulphur by heating to 100°. (Pelouse and Fremy.) (See C. 2.)

This modification can be obtained also by action of HCl on thiosulphates. (Fordos and Gélis.)

The soft pasty sulphur obtained by decomposition of H<sub>2</sub>S by SO<sub>2</sub> forms an almost clear emulsion (pseudo-solution) with H<sub>2</sub>O, from which it is pptd. by various salts and substances which have no chemical affinity for it. 23 pts. S combine in this way with 100 pts. H<sub>2</sub>O. When pptd. by saline solutions, some of the S remains in solution. When solution is exposed to the light, S gradually separates out; also on boiling the same takes place. The above pseudo-solution is pptd. by mineral acids, and the pptd. S may still be dissolved in fresh water, if not left in contact for some time with the acid. Also pptd. by K salts, with loss of power of forming pseudo-solutions. Pptd. by NH<sub>4</sub> and Na salts without losing that power.

Alkali hydrates, carbonates, or sulphides convert it into insol. S.

The solution may be mixed with alcohol without change. Decomp. by long shaking with naphtha or oil of turpentine. The pseudo-solution combines with  $\text{CS}_2$ , forming an emulsion which subsequently decomposes. The S itself is only partially sol. in  $\text{CS}_2$ . (Selm, J. pr. 57. 49.)

By treatment of amorphous "insoluble" S with  $\text{CS}_2$  or  $\text{CCl}_4$ , a small part goes into solution, the amount being dependent on the time of contact with the temp., and nature of the solvent, but independent of the amount of the solvent. It is assumed that this is due to a partial change of the "insoluble" into soluble S. (Wigand, Z. phys. Ch. 1910, 75. 235.)

"Delta" sulphur. Partly sol. in  $\text{H}_2\text{O}$ . (Debus, Chem. Soc. 53. 18.)

A colloidal form wholly sol. in  $\text{H}_2\text{O}$  exists, which, however, decomposes very easily. (Engel, C. R. 112. 866.)

Black sulphur. Insol. in alcohol, ether,  $\text{CS}_2$ , fatty oils even at  $200^\circ$ , cold alkali hydroxides + Aq,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or aqua regia. (Knapp, J. pr. (2) 43. 305.)

Green modification. Five times more sol. than ordinary sublimed sulphur in a mixture of salicylaldehyde and benzene. (Orloff, C. C. 1902, I. 1264.)

The following data relate to octahedral or ordinary sulphur (A. 1):—

Sol. in warm liquid  $\text{H}_2\text{S}$  (Niemann); warm  $\text{P}_2\text{S}_5$ ,  $\text{SBr}_2$ ,  $\text{SCl}_2$ ,  $\text{Br}_2$ ,  $\text{NCl}_3$ ,  $\text{BaS}$ +Aq (Dumas); in alcoholic solution of  $\text{K}_2\text{S}_2$ , but is reprecipd. by addition of  $\text{H}_2\text{O}$  to sat. solution.

Sol. in liquid  $\text{SO}_2$ .

Sol. in aqueous solution of alkali sulphates, especially when hot. Sl. sol. in boiling conc.  $\text{HSCN}$ +Aq, from which it mostly separates on cooling.

$\text{Na}_2\text{CO}_3$ +Aq (5.6%  $\text{Na}_2\text{CO}_3$ ) dissolves no S at  $20^\circ$ ; 0.06775% at  $100^\circ$ . (Pohl, Dingl. 197. 508.)

The solubility of S in  $\text{Na}_2\text{S}$ +Aq between  $0^\circ$  and  $50^\circ$  diminishes slightly with increase in temp., but increases with dilution of the solution, having its largest value in a N/16 solution of  $\text{Na}_2\text{S}$ +Aq when the relation of  $\text{Na}_2\text{S}$  to dissolved S equals about 1:4. (Küster, Z. anorg. 1905, 43. 56.)

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, 84. 27.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 874.)

Sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 822.)

Sol. in liquid  $\text{NH}_3$ . 1 gr. S is sol. in 3-4 ccm. liquid  $\text{NH}_3$ . (Hugot, A. ch. 1900, (7) 21. 32.)

The solubility of S in liquid  $\text{NH}_3$  is constant from  $-23^\circ$  to  $-84^\circ$  and equals 39%. (Ruff, Z. anorg. Ch. 1910, 23. 1830.)

### Solubility in liquid $\text{NH}_3$ . (g. S in 100 g. solution.)

$t^\circ$	S	$t^\circ$	S
$-78$	38.6	16.4	25.65
$-20.5$	38.1	30	21.0
0	32.34	40	18.5

(Ruff and Hecht, Z. anorg. 1911, 70. 62.)

Sl. sol. in liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

$\text{S}_2\text{Cl}_2$  dissolves 66.74% S at ord. temp. to form a liquid of 1.7 sp. gr. (Rose.)

Solubility of S in  $\text{S}_2\text{Cl}_2$  varies according to the variety of sulphur used. Aten has published an extended investigation on the subject, which see for details. (Z. phys. Ch. 1905-14, 54. 86, 124; 81. 268; 83. 443; 86. 1; 88. 321.)

Solubility in  $\text{SnCl}_4$ .

100 g.  $\text{SnCl}_4$  dissolve at:

$99^\circ$	$101^\circ$	$110^\circ$	$110^\circ$
5.8	6.2	8.7	9.1 pts. solid S,
$112^\circ$	$112^\circ$	$121^\circ$	
9.4	9.9	17.0 pts. liquid S.	

(Gerardin.)

Sol. in alkalis + Aq with decomp.

Sol. in 1926.7 pts. absolute alcohol at  $15^\circ$ . (Pohl, W. A. B. 6. 600.)

Sol. in 20 pts. hot nearly absolute alcohol, less sol. in weaker alcohol. (Laurouais.)

Sol. in 600 pts. boiling alcohol of  $40^\circ$  B. (Chevallier, J. ch. méd. 2. 587); in 500 pts. alcohol (Meissner); 200 pts. alcohol (Pelouse and Fremy).

100 pts. absolute alcohol dissolve 0.42 pt. at b.-pt., and 0.12 pt. S at  $16^\circ$ ; 100 pts. ether dissolve 0.54 pt. at b.-pt., and 0.19 pt. S at  $16^\circ$ ; 100 pts. benzene dissolve 17.04 pts. at b.-pt., and 1.79 pts. S at  $16^\circ$ ; 100 pts. oil of turpentine dissolve 16.16 pts. at b.-pt., and 1.35 pts. S at  $16^\circ$ ; 100 pts.  $\text{CS}_2$  dissolve 73.46 pts. at b.-pt., and 38.70 pts. S at  $16^\circ$ ; 100 pts. naphtha dissolve 10.56 pts. at b.-pt., and 2.77 pts. S at  $16^\circ$ ; 100 pts. tar-oil dissolve 26.98 pts. at b.-pt., and 1.51 pts. S at  $16^\circ$ . (Payen, C. R. 34. 456.)

100 pts. absolute methyl alcohol dissolve 0.028 pt. at  $18.5^\circ$ ; 100 pts. absolute ethyl alcohol dissolve 0.053 pt. at  $18.5^\circ$ . (de Bruyn, Z. phys. Ch. 10. 781.)

Solubility in amyl alcohol.

$95^\circ$	$110^\circ$	$110^\circ$
1.5	2.1	2.2 pts. solid S,

$112^\circ$	$112^\circ$	$120^\circ$	$131^\circ$
2.6	2.7	3.0	5.3 pts. liquid S.

(Gerardin, A. ch. (4) 5. 134.)

Quickly sol. in 12.5 pts. ether. (Favre.)

100 pts. benzene dissolve 0.965 pt. S at  $26^\circ$ ; 100 pts. benzene dissolve 4.377 pts. S at  $71^\circ$ ; 100 pts. toluene dissolve 1.479 pts. S at  $23^\circ$ ; 100 pts. ethyl ether dissolve 0.972 pt. S at

23.5°; 100 pts. chloroform dissolve 1.205 pts. S at 22°; 100 pts. phenol dissolve 16.35 pts. S at 174°; 100 pts. aniline dissolve 85.27 pts. S at 130°. (Cossa, B. 1. 139.)

### Solubility in benzene at t°.

t°	g. S in 10 g. of solution
15.17	0.1480
19.29	0.1692

(Brönsted, Z. phys. Ch. 1906, 55. 377.)

A mixture of S and toluene separates into two layers, containing 33 and 92.5% S respectively. (Haywood, J. phys. Ch. 1897, 1. 232.)

CS<sub>2</sub> dissolves 0.35 pt. ordinary sulphur; some varieties of S, however, are not entirely sol. in CS<sub>2</sub>, thus—

Variety of Sulphur	Pts. sol. in 1 pt. CS <sub>2</sub>	Fraction of original wt. insol. in CS <sub>2</sub>
Octahedral, from Sicily	0.335	0.000
Crystallised in dry way, recently prepared	0.415	0.029
Do., prepared 8 years	0.33	0.004
Do., prepared 9 years	...	0.020
Do., prepared 15 years	...	0.051
Red needles, recently prepared	0.382	0.023
Soft yellow, do.	...	0.353
Do., prepared 2 years	0.316	0.157
Soft red, recently prepared	0.374	0.157
Do., prepared 5 years	...	0.181
Flowers of sulphur	0.351	0.113
Do., another sample	...	0.234
Roll brimstone, outside	...	0.029
Do., inside	...	0.073

(Deville, A. ch. (3) 47. 99.)

The pt. insol. in CS<sub>2</sub> is sol. in hot absolute alcohol, crystallising on cooling; less sol. in chloroform or ether. (Deville.)

100 pts. pure CS<sub>2</sub> dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S
-11	16.54	22	46.05
-6	18.75	38	94.57
0	23.99	48.5	146.21
+15	37.15	55	181.34
18.5	41.65	...	...

(Cossa, B. 1. 138.)

Neither ordinary stick S nor flowers of S is completely sol. in CS<sub>2</sub>. Pptd. S is completely sol. in 5 pts. CS<sub>2</sub>. (Tittenger, C. C. 1894, II. 267.)

2.99 g. S are sol. in 100 grams CS<sub>2</sub> at -116°. (Arctowski, C. R. 1895, 121. 124.)

Solubility in CS<sub>2</sub>.

100 g. of the sat. solution contain at:

-77°	-84.5°	-89°	-116°
4.84	4.46	4.29	2.99 g. S.

(Arctowski, Z. anorg. 1896, 11. 274.)

When 20 pts. S dissolve in 50 pts. CS<sub>2</sub> at 22° the temp. is lowered 5°. (Cossa.)

Sat. solution of S in CS<sub>2</sub> boils at 55°. (Cossa.)

Sp. gr. of S dissolved in CS<sub>2</sub> at 15°.

(Pts. S per 100 pts. CS<sub>2</sub>.)

Sp. gr.	Pts. S	Sp. gr.	Pts. S	Sp. gr.	Pts. S
1.271	0.0	1.312	9.9	1.352	19.6
1.272	0.2	1.313	10.2	1.353	19.9
1.273	0.4	1.314	10.4	1.354	20.1
1.274	0.6	1.315	10.6	1.355	20.4
1.275	0.9	1.316	10.9	1.356	20.6
1.276	1.2	1.317	11.1	1.357	21.0
1.277	1.4	1.318	11.3	1.358	21.2
1.278	1.6	1.319	11.6	1.359	21.5
1.279	1.9	1.320	11.8	1.360	21.8
1.280	2.1	1.321	12.1	1.361	22.1
1.281	2.4	1.322	12.3	1.362	22.3
1.282	2.6	1.323	12.6	1.363	22.7
1.283	2.9	1.324	12.8	1.364	23.0
1.284	3.1	1.325	13.1	1.365	23.2
1.285	3.4	1.326	13.3	1.366	23.6
1.286	3.6	1.327	13.5	1.367	24.0
1.287	3.9	1.328	13.8	1.368	24.3
1.288	4.1	1.329	14.0	1.369	24.8
1.289	4.4	1.330	14.2	1.370	25.1
1.290	4.6	1.331	14.5	1.371	25.6
1.291	4.8	1.332	14.7	1.372	26.0
1.292	5.1	1.333	15.0	1.373	26.5
1.293	5.3	1.334	15.2	1.374	26.9
1.294	5.6	1.335	15.4	1.375	27.4
1.295	5.8	1.336	15.6	1.376	28.1
1.296	6.0	1.337	15.9	1.377	28.5
1.297	6.3	1.338	16.1	1.378	29.0
1.298	6.5	1.339	16.4	1.379	29.7
1.299	6.7	1.340	16.6	1.380	30.2
1.300	7.0	1.341	16.9	1.381	30.8
1.301	7.2	1.342	17.1	1.382	31.4
1.302	7.5	1.343	17.4	1.383	31.9
1.303	7.8	1.344	17.6	1.384	32.6
1.304	8.0	1.345	17.9	1.385	33.2
1.305	8.2	1.346	18.1	1.386	33.8
1.306	8.5	1.347	18.4	1.387	34.5
1.307	8.7	1.348	18.6	1.388	35.2
1.308	8.9	1.349	18.9	1.389	36.1
1.309	9.2	1.350	19.0	1.390	36.7
1.310	9.4	1.351	19.3	1.391	37.2
1.311	9.7	...	...	...	...

(Mascagno, C. N. 43. 192.)

Sp. gr. of S dissolved in CS<sub>2</sub> at 15°. Water at 4° = 1.

Sp. gr.	% S	Sp. gr.	% S	Sp. gr.	% S
1.2708	0.0	1.2736	0.6	1.2764	1.2
1.2717	0.2	1.2745	0.8	1.2774	1.4
1.2727	0.4	1.2755	1.0	1.2783	1.6
1.2792	1.8	1.3096	8.0	1.3409	14.2
1.2802	2.0	1.3105	8.2	1.3419	14.4
1.2812	2.2	1.3115	8.4	1.3430	14.6
1.2822	2.4	1.3125	8.6	1.3440	14.8
1.2832	2.6	1.3135	8.8	1.3450	15.0
1.2842	2.8	1.3145	9.0	1.3460	15.2
1.2852	3.0	1.3155	9.2	1.3471	15.4
1.2862	3.2	1.3165	9.4	1.3481	15.6
1.2872	3.4	1.3175	9.6	1.3491	15.8
1.2882	3.6	1.3185	9.8	1.3502	16.0
1.2892	3.8	1.3195	10.0	1.3512	16.2
1.2901	4.0	1.3205	10.2	1.3522	16.4
1.2911	4.2	1.3215	10.4	1.3532	16.6
1.2921	4.4	1.3226	10.6	1.3543	16.8
1.2930	4.6	1.3236	10.8	1.3553	17.0
1.2940	4.8	1.3246	11.0	1.3563	17.2
1.2949	5.0	1.3256	11.2	1.3573	17.4
1.2959	5.2	1.3266	11.4	1.3584	17.6
1.2969	5.4	1.3277	11.6	1.3594	17.8
1.2978	5.6	1.3287	11.8	1.3604	18.0
1.2988	5.8	1.3297	12.0	1.3615	18.2
1.2998	6.0	1.3307	12.2	1.3625	18.4
1.3008	6.2	1.3317	12.4	1.3635	18.6
1.3017	6.4	1.3328	12.6	1.3646	18.8
1.3027	6.6	1.3338	12.8	1.3656	19.0
1.3037	6.8	1.3348	13.0	1.3667	19.2
1.3047	7.0	1.3358	13.2	1.3677	19.4
1.3056	7.2	1.3368	13.4	1.3688	19.6
1.3066	7.4	1.3379	13.6	1.3698	19.8
1.3076	7.6	1.3389	13.8	1.3709	20.0
1.3086	7.8	1.3399	14.0	...	...

(Pfeiffer, Z. anorg. 1897, 15. 200.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Solubility of S in acetone + Aq at 25°.

S = millimols. g. S in 100 cc. of the solution.  
A = g. acetone in 100 g. acetone + Aq.

A	S	Sp. gr.
100	65.0	0.78540
95.36	45.0	0.79114
90.62	33.0	0.81654
85.38	25.3	0.82958

(Hers and Knoch, Z. anorg. 1905, 45. 263.)

### Solubility in organic solvents.

Solvent	t°	Sat. solution contains % S
CS <sub>2</sub>	-61	3.6
	-55	4.4
	-19	10.6
	-18	10.8
	-17	11.5
	-13	12.4
	-11	13.3
	-11	13.5
	-2	17.2
	+3	19.5
	9	23.1
	11	23.7
	14	25.9
	17	27.2
	19	28.9
	20	28.5
	21	29.7
	26	33.4
	27	34.6
	29	37.8
	30.5	39.7
	33	42.2
	40	48.7
	44	53.2
	46	56.2
	48	57.5
	53	60.0
	54	60.6
	65	67.9
	77.5	76.4
	81.0	79.4
	92.0	87.8
	98.0	90.1
Ethylene dibromide	9	1.7
	22	2.4
	40	4.4
	50	6.4
	72	12.4
	95	30.2
	108	60.0
Benzene	8	1.2
	10	1.3
	21	1.8
	30	2.6
	39	3.3
	47	4.0
	54	4.9
	65	6.8
	72	8.6
	100	17.5
	123	31.9
	127	34.0
	150	36.8
Hexane	-20	0.07
	0	0.16
	+26	0.41
	+68	1.2
	+130	5.2
	+142	6.2
	+184	8.3

(Étard, A. ch. 1894, (7) 2. 571.)



Solubility in  $\text{CHCl}_3$  at  $t^\circ$ .

$t^\circ$	g. S in 10 g. of solution
12.25	0.0744
19.29	0.0918

(Brönsted, Z. phys. Ch. 1906, 55. 377.)

Solubility of octahedral and prismatic S in organic solvents at  $t^\circ$ .

Solvent	$t^\circ$	% prismatic S	% octahedral S
Benzene	18.6	2.004	1.512
	25.3	2.335	1.835
Chloroform	0	1.101	0.788
	15.5	1.658	1.253
	40	2.9	2.4
Ethyl ether	0	0.113	0.080
	25.3	0.253	0.200
Ethyl bromide	0	0.852	0.611
	25.3	1.676	1.307
Ethyl formate	0	0.028	0.019
Ethyl alcohol	25.3	0.066	0.052

(Brönsted, Z. phys. Ch. 1906, 55. 377.)

Solubility in organic solvents at  $25^\circ$ . (G. S dissolved in 1 g. mol. of solvent.)

Solvent	g. S
Ethylene chloride	0.831
Tetrachlorethane	2.063
Dichlorethylene	1.237
Pentachlorethane	2.421
Trichlorethylene	2.43
Perchlorethylene	2.537
Carbon tetrachloride	1.354

(Hoffmann et al. 1910, B. 43. 188.)

100 g. trichlorethylene dissolve 1.19 g. S at  $15^\circ$ . (Wester and Bruins, Pharm. Weekbl. 1914, 51. 1443.)

Solubility in benzyl chloride at  $t^\circ$ .

$t^\circ$	g. S per 100 g. of solution	
	in upper layer	in lower layer
0	0.99	
17	1.78	
35	2.57	
46.1	3.64	
63.3	6.15	
78.0	9.88	
99.1	19.89	
109.6	...	90.62
114.6	...	87.99
118.8	37.29	...
121.4	40.04	85.02
130.0	49.71	80.07
134.2	56.20	72.23

Above  $134.2^\circ$  sulphur is miscible with

benzyl chloride in all proportions; below this temp. two layers are formed.

(Bogusky, J. Russ. Phys. Chem. Soc. 1905, 37. 92-99; C. C. 1905, 1. 1207.)

Easily sol. in boiling acetic anhydride. (Rosenfeld, B. 13. 1475.)

Sol. in considerable amount in warm conc.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2$  + Aq, but very sl. sol. if dil. (Liebmann, B. 10. 866.)

Sol. in stearic acid + Aq. (Vulpinus, Arch. Pharm. (3) 13. 38.)

Acetic ether dissolves 6% S. (Favre.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

Sl. sol. in benzonitrile at ord. temp., much more sol. at higher temp. (Naumann, B. 1914, 47. 1369.)

Sol. in 12 pts. hot petroleum from Amiano, but nearly insol. in cold. (de Saussure.)

100 pts. nicotine at  $100^\circ$  dissolve 10.58 pts S, but this separates out as the solution cools. (Klever, C. C. 1872. 434.)

Sol. in warm aniline. (Barral, A. ch. (3) 20. 352.)

Easily sol. in hot, less sol. in cold aniline. (Fritzsche.)

Very sol. in aniline and quinoline, especially when warm. (Hofmann.)

Sol. in quinoline but reacts with the solvent with evolution of H. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0335 g. S in 6 days. (Gates, J. phys. Chem. 1911, 15. 143.)

Sol. in 2.6 pts. of boiling, sl. sol. in cold creosote.

Sol. by digestion in 2 pts. oil of turpentine. Sol. in hot oil of copaiba, crystallising on cooling.

Sol. in hot oil of mandarin, crystallising on cooling.

Sol. in hot oil of caraway, crystallising on cooling.

Somewhat sol. in hot, less in cold wood-spirit.

Sl. sol. in lignone, bromoform, cold benzene, but easily in hot benzene. (Mansfield, Chem. Soc. 1. 262.)

Sol. in ethyl sulphide, and carbon chloride. (Rathke, A. 152. 187.)

Sol. in mercuric methyl.

Sol. in 20 pts. ethyl nitrate, from which is not pptd. by  $\text{H}_2\text{O}$ .

Sol. in naphtha, aldehyde, iodol, bromal, chloroform, warm chloral, sinkaline + Aq, ethyl chloride, warm benzoyl chloride.

100 pts. methylene iodide dissolve 10 pts. S at  $10^\circ$ . Melted sulphur is miscible with hot methylene iodide. (Retgers, Z. anorg. 3. 343.)

S dissolves in 2000 pts. glycerine. (Cap and Garot, J. Pharm. (3) 26. 81.)

Glycerine dissolves 0.10% S. (Klever, C. C. 1872. 434.)

100 g. glycerine dissolve 0.14 g. at 15.5°.  
(Ossendowski, Pharm. J. 1907, 79. 575.)

Sol. in butyl sulphhydrate, and warm retinole.

Sol. in ethyl sulphhydrate.

Very sol. in conine, hexyl alcohol, warm allyl sulphocyanide, cacodyl oxide. Somewhat sol. in hot styrene, separating out on cooling.

Readily sol. in warm, less readily in cold toluene or resin-oil.

Sol. in olive oil at 115°, from which it mostly separates on cooling.

Sol. in hot oil of amber, crystallising upon cooling. Sol. in 2 pts. hot, sl. sol. in cold caoutchouin.

Insol. in valerianic acid, amyl valerate, valeryl hydride.

Linseed oil dissolves % S at t°.

t°	% S	t°	% S	t°	% S
25	0.630	95	2.587	160	9.129
60	1.852	130	4.935	...	...

(Pohl.)

Solubility in olive oil (sp. gr. = 0.885).

100 pts. dissolve pts. S at t°.

t°	Pts. S	t°	Pts. S	t°	Pts. S
15	2.3	65	20.6	110	30.3
40	5.6	100	25.0	130	43.2

(Pelouze, C. R. 68. 1179.)

Solubility in 100 pts. coal-tar oil at t°.

t°	Pts. S in		
	Oil of 0.870 sp. gr. B.-pt. 80-100°	Oil of 0.880 sp. gr. B.-pt. 85-120°	Oil of 0.882 sp. gr. B.-pt. 120-200°
15	2.1	2.3	2.5
30	3.0	4.0	5.3
50	5.2	6.1	8.3
80	11.8	13.7	15.2
100	15.2	18.7	23.0
110	...	23.0	26.2
120	...	27.0	32.0
130	...	...	38.7

Pts. S in

	Pts. S in		
	Oil of 0.885 sp. gr. B.-pt. 150-200°	Oil of 1.010 sp. gr. B.-pt. 210-300°	Oil of 1.020 sp. gr. B.-pt. 220-300°
15	2.6	6.0	7.0
30	5.8	8.5	8.5
50	8.7	10.0	12.0
80	21.0	37.0	41.0
100	26.4	52.5	54.0
110	31.0	105.0	115.0
120	38.0	∞	∞
130	43.8	∞	∞

(Pelouze, C. R. 69. 56.)

**Sulphur bromide, S<sub>2</sub>Br<sub>2</sub>.**

Decomp. gradually with H<sub>2</sub>O. Dissolves S on warming, which crystallises out on cooling. Sol. in CS<sub>2</sub>.

Decomp. by current of dry air into S and Br. (Hannay, Chem. Soc. 35. 16.)

Decomp. slowly by cold H<sub>2</sub>O, rapidly by hot H<sub>2</sub>O. Decomp. by dil. KOH + Aq or NaHCO<sub>3</sub> + Aq. (Korndörfer, Arch. Pharm. 1904, 242. 156.)

A study of the mpt. curve of a series of mixtures of sulphur and bromine gave no evidence for the existence of the compounds SBr<sub>2</sub> and SBr<sub>4</sub>. (Ruff, B. 1903, 36. 2446.)

**Sulphur monochloride, S<sub>2</sub>Cl<sub>2</sub>.**

Slowly decomp. by H<sub>2</sub>O. Miscible with CS<sub>2</sub> and C<sub>6</sub>H<sub>6</sub>. Sol. in alcohol and ether with subsequent decomposition. Sol. in oil of turpentine.

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 830.)

Sol. in CCl<sub>4</sub> and C<sub>6</sub>H<sub>6</sub>. (Oddo, Gazz. ch. it. 1899, 29. (2) 318.)

**Sulphur dichloride, SCl<sub>2</sub>.**

Decomp. slowly with H<sub>2</sub>O, immediately by alcohol or ether.

**Sulphur tetrachloride, SCl<sub>4</sub>.**

Violently decomp. by H<sub>2</sub>O. Decomp. at temperatures above -22°. (Michaelis, A. 170. 1.)

**Sulphur stannic chloride, 2SnCl<sub>4</sub>, SnCl<sub>4</sub>.**

Decomp. by H<sub>2</sub>O. Sol. in dil. HNO<sub>3</sub> + Aq. Forms a mass with fuming HNO<sub>3</sub>, which is sol. in HNO<sub>3</sub> + Aq. Sol. in POCl<sub>3</sub>. (Casselmann.)

Very hygroscopic. Fumes in moist air. Very easily sol. in dry abs. ether and in benzene. Sol. in CHCl<sub>3</sub>, SO<sub>2</sub>Cl<sub>2</sub>, CS<sub>2</sub>, POCl<sub>3</sub>, ligroin and petroleum ether. (Ruff, B. 1904, 37. 4517.)

**Sulphur titanium chloride, SCl<sub>4</sub>, 2TiCl<sub>4</sub>.**

Very deliquescent. Easily sol. in dil. HNO<sub>3</sub> + Aq. (Weber, Pogg. 132. 454.)

SCl<sub>4</sub>, TiCl<sub>4</sub>. Sol. in SO<sub>2</sub>Cl<sub>2</sub>, CHCl<sub>3</sub>, CS<sub>2</sub>, and petroleum ether. (Ruff, B. 1904, 37. 4516.)

**Sulphur chloride ammonia, S<sub>2</sub>Cl<sub>2</sub>, 4NH<sub>3</sub>.**

Insol. in H<sub>2</sub>O, but gradually decomp. thereby; sol. without decomp. in absolute alcohol, from which it is pptd. by H<sub>2</sub>O. (Mertens.)

Does not exist. (Fordos and Gélis, C. R. 31. 702.)

SCl<sub>2</sub>, 2NH<sub>3</sub>. Decomp. by H<sub>2</sub>O. Sol. in alcohol or ether. (Soubeiran, A. ch. 67. 71.) Not a true chemical compound, but a mixture. (Fordos and Gélis, C. R. 31. 702.)

$\text{SCl}_2$ ,  $4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in absolute alcohol and ether (Soubeiran, A. ch. 67. 71); mixture (Fordos and Gélis).

### Sulphur chloride nitrogen sulphide.

See Nitrogen sulphochloride.

### Sulphur perfluoride, $\text{SF}_6$ .

Very sl. sol. in  $\text{H}_2\text{O}$ ; sl. sol. in alcohol. (Moissan, C. R. 1900, 130. 868.)

### Sulphur moniodide, $\text{S}_2\text{I}_2$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol, which dissolves out  $\text{I}_2$ . Sl. sol. in cold caoutchou, the solution decomposing when boiled. Freely sol. in glycerine. Sol. in 60 pts. glycerine, and 82 pts. olive oil. (Cap and Garot, J. Pharm. (3) 26. 81.)

Very sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Sol. in  $\text{CS}_2$ . (Linebarger, Am. Ch. J. 1895, 17. 58.)

### Sulphur hexiodide, $\text{SI}_6$ .

Decomp. on air. Alcohol or alkalis dissolve out iodine. (vom Rath, Pogg. 110. 116.)

Does not exist. (M'Leod, Rep. Brit. Assn. Advn. Sci. 1892. 690.)

### Sulphur stannic iodide.

See Tin sulphur iodide.

### Sulphur sesquioxide, $\text{S}_2\text{O}_3$ .

Deliquescent. Violently decomp. by  $\text{H}_2\text{O}$  at ordinary temp. Sol. in fuming  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{SO}_2$ . Decomp. by alcohol or other. (Weber, Pogg. 156. 531.)

### Sulphur dioxide, $\text{SO}_2$ .

Liquid. Insol. in  $\text{H}_2\text{O}$  if brought in contact therewith below the b.-pt. of  $\text{SO}_2$ .

Sol. in 3 vols.  $\text{CS}_2$  on warming, separating out on cooling. Dissolves some P, little S, and no sulphuric or phosphoric acids.

Dissolves ether, chloroform, P, Br, S, I,  $\text{CS}_2$ , colophonium, and other gums; also benzene when warmed. (Sestini, Bull. Soc. (2) 10. 226.)

Miscible with liquid  $\text{SO}_2$ , but not with  $\text{H}_2\text{SO}_4$ .

Gas.

1 vol.  $\text{H}_2\text{O}$  absorbs 30 vols.  $\text{SO}_2$  gas at  $18^\circ$  (Davy); 20 vols. at ord. temp. (Dalton); 43.78 vols. at ord. temp. (de Saussure); 50 vols. at  $20^\circ$  and 760 mm. (Pelouse and Fremy); 33 vols. at ord. temp. (Thomson).

1 pt.  $\text{SO}_2$  (by weight) is sol. in 0.1429 pt.  $\text{H}_2\text{O}$  at  $5^\circ$ , and the solution has 1.020 sp. gr.

1 pt.  $\text{SO}_2$  is sol. in 0.0400 pt.  $\text{H}_2\text{O}$  at ord. temp. (Priestley); in 0.0969 pt.  $\text{H}_2\text{O}$  at  $16^\circ$ , and sp. gr. of the solution = 1.0513 (Thomson).

Sol. in 2 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Pierre, A. ch. (3) 23. 421.)  
100 vols.  $\text{H}_2\text{O}$  at  $18^\circ$  and 760 mm. absorb 4378 vols.  $\text{SO}_2$  gas; 100 vols. alcohol of 0.84 sp. gr. at 760 mm. absorb 11,577 vols. (de Saussure, 1814.)

Solubility of  $\text{SO}_2$  gas in  $\text{H}_2\text{O}$ .  $t^\circ$  = temp.; V = vols.  $\text{SO}_2$  reduced to  $0^\circ$  and 760 mm. contained in 1 vol. sat.  $\text{SO}_2$  + Aq;  $V_1$  = vols.  $\text{SO}_2$  gas reduced to  $0^\circ$  and 760 mm. dissolved by 1 vol.  $\text{H}_2\text{O}$  under 760 mm. pressure.

$t^\circ$	V	$V_1$	$t^\circ$	V	$V_1$
0	68.861	79.789	21	34.986	37.970
1	67.003	77.210	22	33.910	36.617
2	65.169	74.691	23	32.847	35.302
3	63.360	72.230	24	31.800	34.026
4	61.576	69.828	25	30.766	32.786
5	59.816	67.485	26	29.748	31.584
6	58.080	65.200	27	28.744	30.422
7	56.369	62.973	28	27.754	29.314
8	54.683	60.805	29	26.788	28.210
9	53.021	58.697	30	25.819	27.161
10	51.383	56.647	31	24.873	26.151
11	49.770	54.655	32	23.942	25.178
12	48.182	52.723	33	23.025	24.244
13	46.618	50.849	34	22.122	23.347
14	45.079	49.033	35	21.234	22.489
15	43.564	47.276	36	20.361	21.668
16	42.073	45.578	37	19.502	20.886
17	40.608	43.939	38	18.658	20.141
18	39.165	42.360	39	17.827	19.435
19	37.749	40.838	40	17.013	18.766
20	36.206	39.374	...	...	...

(Schönfeld, A. 95. 5.)

This table may be formulated as follows:

1 vol.  $\text{H}_2\text{O}$  absorbs  $79.789 - 2.6077t + 0.029349t^2$  vols.  $\text{SO}_2$  at temp. between  $0^\circ$  and  $20^\circ$ , or 1 vol. sat. solution contains  $68.861 - 1.87025t + 0.01225t^2$  vols.  $\text{SO}_2$ . Coefficient of absorption between  $21^\circ$  and  $40^\circ = 75.182 - 2.1716t + 0.01903t^2$  vols.  $\text{SO}_2$  or 1 vol. sat. solution between  $21^\circ$  and  $40^\circ$  contains  $60.952 - 1.38898t + 0.00726t^2$  vols.  $\text{SO}_2$ .

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at various temps. and 760 mm.  $t^\circ$  = temp.; G = grammes  $\text{SO}_2$  dissolved in 1 g.  $\text{H}_2\text{O}$ ; V = vols.  $\text{SO}_2$  dissolved in 1 g.  $\text{H}_2\text{O}$ .

$t^\circ$	G	V	$t^\circ$	G	V
8	0.168	58.7	30	0.078	27.3
10	0.154	53.9	32	0.073	25.7
12	0.142	49.6	34	0.069	24.3
14	0.130	45.6	36	0.065	22.8
16	0.121	42.2	38	0.062	21.6
18	0.112	39.3	40	0.058	20.4
20	0.104	36.4	42	0.055	19.3
22	0.098	34.2	44	0.053	18.4
24	0.092	32.3	46	0.050	17.4
26	0.087	30.5	48	0.047	16.4
28	0.083	28.9	50	0.045	15.6

(Sims, A. 118. 340.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at various pressures.

P = "partial pressure," i. e. the total pressure minus the tension of aqueous vapour at given temp.; G at P = weight  $\text{SO}_2$  in grammes, which is dissolved in 1 g.  $\text{H}_2\text{O}$  at pressure P; G at 760 = calculated weight  $\text{SO}_2$  that would be contained in 1 g.  $\text{H}_2\text{O}$  at 760 mm. if the absorption were proportional to the pressure; V = the volume of G grammes of  $\text{SO}_2$  at  $0^\circ$  and 760 mm.

P	$7^\circ$			
	G at P	G at 760	V at P	V at 760
30	0.010	0.263	3.634	92.06
40	0.013	0.242	4.451	84.55
50	0.015	0.223	5.129	77.95
60	0.017	0.218	6.024	76.28
70	0.020	0.213	6.868	74.55
80	0.022	0.210	7.743	73.55
90	0.025	0.208	8.598	72.62
100	0.027	0.205	9.421	71.60
120	0.032	0.201	11.09	70.20
140	0.036	0.197	12.71	69.00
160	0.041	0.195	14.34	68.15
180	0.046	0.193	15.97	67.40
200	0.050	0.191	17.59	66.83
220	0.055	0.190	19.19	66.30
240	0.059	0.188	20.79	65.84
260	0.064	0.187	22.40	65.44
280	0.069	0.186	23.99	65.10
300	0.073	0.185	25.59	64.81
350	0.085	0.184	29.55	64.16
400	0.096	0.182	33.51	63.65
450	0.107	0.181	37.44	63.25
500	0.118	0.180	41.42	62.94
550	0.130	0.179	45.31	62.60
600	0.141	0.178	49.20	62.32
650	0.152	0.178	53.10	62.09
700	0.163	0.177	56.98	61.86
750	0.174	0.176	60.88	61.69
760	0.176	0.176	61.65	61.65
800	0.185	0.176	64.74	61.50
850	0.196	0.175	68.57	61.30
900	0.207	0.175	72.41	61.15
950	0.218	0.175	76.25	61.00
1000	0.229	0.174	80.01	60.88
1050	0.240	0.174	83.97	60.77
1100	0.251	0.174	87.80	60.65
1200	0.273	0.173	95.45	60.45
1300	0.295	0.172	103.00	60.25

P	$20^\circ$			
	G at P	G at 760	V at P	V at 760
40	0.007	0.143	2.637	50.09
50	0.009	0.138	3.171	48.20
60	0.011	0.135	3.718	47.10
70	0.012	0.131	4.205	45.64
80	0.013	0.127	4.663	44.30
90	0.015	0.125	5.169	43.65
100	0.016	0.124	5.692	43.25
120	0.019	0.121	6.683	42.33
140	0.022	0.119	7.690	41.75
160	0.025	0.118	8.666	41.17
180	0.028	0.117	9.652	40.75
200	0.030	0.116	10.62	40.35
220	0.033	0.115	11.59	40.03
240	0.036	0.114	12.54	39.70
260	0.038	0.112	13.45	39.30
280	0.041	0.112	14.41	39.10
300	0.044	0.111	15.34	38.87
350	0.050	0.110	17.66	38.35
400	0.059	0.109	20.56	38.10
450	0.064	0.108	22.37	37.77
500	0.071	0.107	24.67	37.50
550	0.077	0.106	26.93	37.20
600	0.083	0.105	29.14	36.90
650	0.090	0.105	31.39	36.70
700	0.096	0.105	33.62	36.50
750	0.103	0.104	35.94	36.43
760	0.104	0.104	36.43	36.43
800	0.110	0.104	38.32	36.40
1000	0.137	0.104	47.85	36.37
1300	0.178	0.104	62.10	36.31
1600	0.218	0.104	76.35	36.27
1900	0.259	0.104	90.53	36.21

P	$39.8^\circ$			
	G at P	G at 760	V at P	V at 760
200	0.016	0.062	5.675	21.57
300	0.024	0.061	8.368	21.20
400	0.031	0.060	11.03	20.95
500	0.039	0.059	13.67	20.77
600	0.047	0.059	16.29	20.64
760	0.059	0.059	20.50	20.50
800	0.062	0.059	21.58	20.50
1000	0.077	0.058	26.84	20.40
1500	0.113	0.057	39.65	20.09
2000	0.149	0.057	52.11	19.80

P	$50^\circ$			
	G at P	G at 760	V at P	V at 760
200	0.012	0.045	4.156	15.97
400	0.024	0.045	8.275	15.72
600	0.035	0.045	12.36	15.65
760	0.045	0.045	15.62	15.62
800	0.047	0.045	16.43	15.60
1000	0.059	0.045	20.51	15.59
1500	0.088	0.044	30.73	15.57
2000	0.012	0.044	39.07	15.55

1 g.  $\text{H}_2\text{O}$  dissolves 0.0909 g.  $\text{SO}_2 = 34.73$  cc. (at  $25^\circ$ ) at  $25^\circ$  and 748 mm. pressure. (Walden and Centnerswer, Z. phys. Ch. 1901, 42, 462.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$  and 760 mm. pressure.

$t^\circ$	G. $\text{SO}_2$ per 1 g. $\text{H}_2\text{O}$	$t^\circ$	G. $\text{SO}_2$ per 1 g. $\text{H}_2\text{O}$
0	0.236	7	0.176
2	0.218	8	0.168
4	0.201	10	0.154
6	0.184	12	0.142

(Rooseboom, R. t. c. 1884, 3, 29.)

From a gas containing 10% by vol. of  $\text{SO}_2$  at  $10^\circ$ , 1.63% by wt. is dissolved by 1 litre of  $\text{H}_2\text{O}$ ; if the pressure is increased to 5 atmospheres, 8.14% by wt. is dissolved. (Harpe, Chem. Zeitschr., 1905, 4, 136.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

C = g.  $\text{SO}_2$  in 1 cc. of the solution.

P = Pressure in mm. of Hg.

$t^\circ$	C	P	$\frac{C}{P} \times 10^4$
0	0.000537	0.4	13.4
"	0.00237	3.5	6.78
"	0.01227	29.4	4.17
"	0.03834	109.4	3.48
25	0.000534	1.4	3.81
"	0.00234	11.75	2.00
"	0.01212	87.9	1.379
"	0.03750	313.0	1.198
50	0.000525	4.9	1.07
"	0.002276	30.5	0.746
"	0.01181	204.5	0.577
"	0.03628	696.0	0.521

(Lindner, M. 1912, 33, 645.)

Sp. gr. of sat. solution at—

$0^\circ$        $10^\circ$        $20^\circ$        $40^\circ$   
1.06091 1.05472 1.02386 0.95548  
(Bunsen and Schönfeld, A. 95, 2.)

Sat.  $\text{SO}_2 + \text{Aq}$  has sp. gr. = 1.0040. (Berthollet.)

Sp. gr. of sat.  $\text{SO}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	Sp. gr.	$t^\circ$	Sp. gr.	$t^\circ$	Sp. gr.
0	1.0609	9	1.0548	17	1.0358
1	1.0596	10	1.0547	18	1.0321
2	1.0585	11	1.0528	19	1.0281
3	1.0576	12	1.0505	20	1.0239
4	1.0569	13	1.0481	21	1.0195
5	1.0562	14	1.0454	22	1.0147
6	1.0557	15	1.0424	23	1.0099
7	1.0552	16	1.0392	24	0.9991
8	1.0549	..	...	..	...

(Schiff, A. 107, 312.)

Sp. gr. of  $\text{SO}_2 + \text{Aq}$  at  $4^\circ$ .

% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.
1	1.0024	8	1.0217	15	1.0445
2	1.0049	9	1.0247	16	1.0480
3	1.0075	10	1.0278	17	1.0517
4	1.0102	11	1.0311	18	1.0553
5	1.0130	12	1.0343	19	1.0591
6	1.0158	13	1.0376	20	1.0629
7	1.0187	14	1.0410	21	1.0667

(Schiff, calculated by Gerlach, Z. anal. 8, 292.)

Sp. gr. of  $\text{SO}_2 + \text{Aq}$ .

% $\text{SO}_2$	Temp.	Sp. gr.
0.99	$15.5^\circ$	1.0051
2.05	"	1.0102
2.87	"	1.0148
4.04	"	1.0204
4.99	"	1.0252
5.89	"	1.0297
7.01	"	1.0353
8.08	"	1.0399
8.68	"	1.0438
9.80	"	1.0492
10.75	"	1.0541
11.65	$12.5^\circ$	1.0597
13.09	$11.0^\circ$	1.0668

(Giles and Scheerer, Jour. Soc. Ch. Ind. 4, 303.)

Sp. gr. of  $\text{SO}_2 + \text{Aq}$ .

% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.
1	1.0052	4	1.0167	7	1.0283
2	1.0094	5	1.0208	8	1.0329
3	1.0134	6	1.0242	9	1.0402

(Anthon.)

Sp. gr. of  $\text{SO}_2 + \text{Aq}$ .

% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.	% $\text{SO}_2$	Sp. gr.
1	1.0042	5	1.0210	8	1.0348
2	1.0083	6	1.0252	9	1.0392
3	1.0125	7	1.0295	10	1.0438
4	1.0167	..	...	..	...

(Hager, Adjumenta varia, Leipsig, 1876, Digit. 146.)

Sp. gr. of  $\text{SO}_2$  + Aq at  $15^\circ$ .

$\% \text{SO}_2$	Sp. gr.	$\% \text{SO}_2$	Sp. gr.	$\% \text{SO}_2$	Sp. gr.
0.5	1.0028	4.0	1.0221	7.5	1.0401
1.0	1.0056	4.5	1.0248	8.0	1.0426
1.5	1.0085	5.0	1.0275	8.5	1.0450
2.0	1.0113	5.5	1.0302	9.0	1.0474
2.5	1.0141	6.0	1.0328	9.5	1.0497
3.0	1.0168	6.5	1.0353	10.0	1.0520
3.5	1.0194	7.0	1.0377	...	...

(Scott, Polyt. Centralbl. 1873. 826.)

Conc.  $\text{H}_2\text{SO}_4$  absorbs 0.009 pt. by weight (58 vols.), and  $\text{SO}_2$  is more soluble in dilute  $\text{H}_2\text{SO}_4$  + Aq, the more  $\text{H}_2\text{O}$  there is present. (Kolb, Dingl. 209. 270.)

Solubility in  $\text{H}_2\text{SO}_4$ .

Sp. gr. of $\text{H}_2\text{SO}_4$	Absorbs $\text{SO}_2$ per kg.	Absorbs $\text{SO}_2$ per litre
1.841	0.009	5.8
1.839	0.014	8.9
1.540	0.021	11.2
1.407	0.032	15.9
1.227	0.068	29.7
1.020	0.135	49.0

(Kolb, Bull. Soc. Ind. Mullhouse, 1872. 224.)

Coefficient of absorption for  $\text{H}_2\text{SO}_4$  (1.841 sp. gr. at  $15^\circ$  and 760 mm.) is 28.14 at  $17^\circ$ , and 28.86 at  $16^\circ$ . (Dunn, C. N. 43. 121.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{SO}_4$  of 1.84 sp. gr.

$t^\circ$	Sp. gr. of sat. solution	Coeff. of absorption (760 mm.)	$t^\circ$	Sp. gr. of sat. solution	Coeff. of absorption (760 mm.)
0	...	53	50	1.8186	9.5
10	1.8232	35.0	60	1.8165	7.0
20	1.8225	25.0	70	1.8140	5.5
25	1.8221	21.0	80	1.8112	4.5
30	1.8216	18.0	90	1.8080	4.0
40	1.8205	13.0	...	...	...

(Dunn; C. N. 1882. 45. 272. Calc. by Seidell, Solubilities, 1st Ed.)

Solubility of  $\text{SO}_2$  in  $\text{H}_2\text{SO}_4$  + Aq.

$t^\circ$	Sp. gr. of $\text{H}_2\text{SO}_4$ solution	Approx. $\% \text{H}_2\text{SO}_4$	Coeff. of absorption	$t^\circ$	Sp. gr. of $\text{H}_2\text{SO}_4$ solution	Approx. $\% \text{H}_2\text{SO}_4$	Coeff. of absorption
6.9	1.139	20	48.67	15.2	1.173	25	31.82
6.9	1.300	40	45.38	16.8	1.151	21	31.66
8.6	1.482	58	39.91	14.8	1.277	36	30.41
9.8	1.703	78	29.03	15.1	1.458	56	29.87
5.5	0.667	10	36.78	15.6	1.609	70	25.17
6.6	1.102	15	34.08	15.0	1.739	81	20.83

(Dunn, C. N. 1882, 45. 272; Seidell, Solubilities, 1st Ed.)

Coefficient of absorption in  $\text{H}_2\text{SO}_4$  (sp. gr. = 1.841) = 5.8; (sp. gr. = 1.839) = 8.9. (Lunge.)

Solubility in salts + Aq at  $35^\circ$ .

l = coefficient of absorption of  $\text{SO}_2$  in the given salt solution at  $35^\circ$ .  
lo = coefficient of absorption of  $\text{SO}_2$  in water at  $35^\circ$  = 22.43.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
KI	l	45.43	41.87	38.04	34.64	30.25	26.30
	l-lo	23.00	19.44	15.61	12.21	7.82	3.87
KBr	l	36.14	34.12	31.93	29.64	27.49	24.83
	l-lo	13.71	11.69	9.50	7.21	5.01	2.40
KCl	l	30.02	28.93	27.94	26.54	25.15	23.74
	l-lo	7.59	6.50	5.31	4.11	2.72	1.31
KCNS	l	42.94	38.13	35.05	32.03	28.79	25.63
	l-lo	18.51	15.70	12.62	9.60	6.36	3.20
$\text{NH}_4\text{NO}_3$	l	27.43	26.66	25.57	24.78	24.23	23.35
	l-lo	5.00	4.23	3.14	2.35	1.80	0.92
$\text{KNO}_3$	l	27.33	26.54	25.72	24.79	24.03	23.27
	l-lo	4.90	4.11	3.29	2.36	1.60	0.84

Solubility in salts + Aq at 35°.—*Continued.*l = coefficient of absorption of SO<sub>2</sub> in the given salt solution at 35°.lo = coefficient of absorption of SO<sub>2</sub> in water at 35° = 22.43.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
$\frac{1}{2}(\text{NH}_4)_2\text{SO}_4$	l	24.60	24.23	23.93	23.49	23.14	22.91
	l-lo	2.17	1.80	1.50	1.06	0.71	0.48
$\frac{1}{2}\text{CdI}_2$	l	24.30	23.99	23.71	23.38	23.06	22.75
	l-lo	1.87	1.56	1.28	0.95	0.63	0.32
$\frac{1}{2}\text{Na}_2\text{SO}_4$	l	19.27	19.79	20.20	20.81	21.35	21.88
	l-lo	-3.16	-2.64	-2.23	-1.62	-1.08	-0.55
$\frac{1}{2}\text{CdBr}_2$	l	19.17	19.70	20.60	20.81	21.46	21.88
	l-lo	-3.26	-2.73	-1.83	-1.62	-0.97	-0.55
$\frac{1}{2}\text{CdCl}_2$	l	18.68	19.23	20.02	20.55	21.23	21.73
	l-lo	-3.75	-3.20	-2.41	-1.88	-1.20	-0.70
$\frac{1}{2}\text{CdSO}_4$	l	16.25	17.41	18.31	19.42	20.43	21.45
	l-lo	-6.81	-5.02	-4.12	-3.01	-2.00	-0.98

Solubility in salts + Aq at 25°.

l = coefficient of absorption of SO<sub>2</sub> in the given solution at 25°.lo = coefficient of absorption of SO<sub>2</sub> in water at 25° = 32.76.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
KI	l	68.36	62.63	56.75	50.58	44.76	38.66
	l-lo	35.60	29.87	23.99	17.82	12.00	5.90
$\frac{1}{2}\text{CdI}_2$	l	35.77	34.98	34.74	34.16	33.76	33.27
	l-lo	3.01	2.22	1.98	1.40	1.00	0.51
NH <sub>4</sub> Br	l	52.25	49.17	46.06	42.78	39.46	36.28
	l-lo	19.49	16.41	13.30	10.02	6.70	3.52
KBr	l	52.26	48.87	44.96	42.41	39.11	35.94
	l-lo	19.00	15.71	12.70	9.15	6.35	3.18
NaBr	l	37.74	36.84	36.26	35.27	34.54	33.76
	l-lo	4.98	4.08	3.50	2.51	1.78	1.00
$\frac{1}{2}\text{CdBr}_2$	l	27.46	28.15	29.27	30.17	31.01	31.91
	l-lo	-5.30	-4.61	-3.49	-2.59	-1.75	-0.85
NH <sub>4</sub> Cl	l	42.78	41.37	39.76	38.06	36.37	34.58
	l-lo	10.02	8.61	7.00	5.30	3.61	1.80
KCl	l	42.27	40.96	39.32	37.76	36.05	34.42
	l-lo	9.51	8.20	6.56	5.00	3.29	1.66

Solubility in salts + Aq at 25°—*Continued.*l = coefficient of absorption of SO<sub>2</sub> in the given solution at 25°.l<sub>0</sub> = coefficient of absorption of SO<sub>2</sub> in water at 25° = 32.76.

Salt		3-normal	2.5-normal	2-normal	1.5-normal	1-normal	0.5-normal
NaCl	l	31.36	31.51	31.76	31.96	32.25	32.46
	l-l <sub>0</sub>	-1.40	-1.25	-1.00	-0.80	-0.51	-0.30
$\frac{1}{2}$ CdCl <sub>2</sub>	l	26.06	27.09	28.16	29.46	30.55	31.66
	l-l <sub>0</sub>	-6.70	-5.67	-4.60	-3.30	-2.21	-1.10
NH <sub>4</sub> CNS	l	61.46	57.01	52.26	47.26	42.74	37.78
	l-l <sub>0</sub>	28.70	24.25	19.50	14.50	9.98	5.02
KCNS	l	61.26	55.87	51.86	47.02	42.38	37.57
	l-l <sub>0</sub>	28.50	23.11	19.10	14.26	9.62	4.81
NaCNS	l	48.34	45.86	43.37	40.78	38.24	35.44
	l-l <sub>0</sub>	15.58	13.10	10.61	8.02	5.48	2.68
NH <sub>4</sub> NO <sub>3</sub>	l	39.14	38.01	37.27	36.28	35.07	33.96
	l-l <sub>0</sub>	6.38	5.25	4.51	3.52	2.31	1.20
KNO <sub>3</sub>	l	38.52	37.57	36.66	35.77	34.79	33.80
	l-l <sub>0</sub>	5.76	4.81	3.90	3.01	2.03	1.04
$\frac{1}{2}$ (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	l	35.96	35.47	34.95	34.34	33.82	33.35
	l-l <sub>0</sub>	3.20	2.71	2.19	1.58	1.06	0.59
$\frac{1}{2}$ K <sub>2</sub> SO <sub>4</sub>	l	...	...	...	...	33.61	33.20
	l-l <sub>0</sub>	...	...	...	...	0.85	0.48
$\frac{1}{2}$ Na <sub>2</sub> SO <sub>4</sub>	l	28.44	28.66	29.51	30.45	31.14	31.96
	l-l <sub>0</sub>	-4.32	-4.10	-3.25	-2.31	-1.62	-0.80
$\frac{1}{2}$ CdSO <sub>4</sub>	l	23.76	25.14	26.58	28.24	29.71	31.11
	l-l <sub>0</sub>	-9.00	-7.62	-6.18	-4.52	-3.05	-1.85

(Fox, Z. phys. Ch. 1902, 41. 462.)

Sol. in Cl<sub>2</sub> + Aq. Sol. in Br<sub>2</sub>. Solidification curves determined. (Van der Goot, Z. phys. Ch. 1913, 84. 419.)



Solubility of  $\text{SO}_2$  in alcohol. 1 vol. alcohol at  $t^\circ$  and 760 mm. dissolves V vols.  $\text{SO}_2$  gas at  $0^\circ$  and 760 mm.

$t^\circ$	V	$t^\circ$	V	$t^\circ$	V
0	328.62	9	201.33	17	130.61
1	311.98	10	190.31	18	124.58
2	295.97	11	179.91	19	119.17
3	280.58	12	170.13	20	114.48
4	265.81	13	160.98	21	110.22
5	251.67	14	152.45	22	106.68
6	238.16	15	144.55	23	103.77
7	225.26	16	137.27	24	101.47
8	212.98	..	...	..	...

(Bunsen's Gasometry.)

100 pts. absolute methyl alcohol dissolve 247 pts.  $\text{SO}_2$  at  $0^\circ$  and 760 mm.; 47 pts. at  $26^\circ$  and 760 mm.; 100 pts. absolute ethyl alcohol dissolve 115 pts.  $\text{SO}_2$  at  $0^\circ$  and 760 mm.; 32.3 pts. at  $26^\circ$  and 760 mm. (de Bruyn, Z. phys. Ch. 10. 783.)

Sol. in ether.

Absorbed by oil of turpentine.

Rapidly absorbed by anhydrous aldehyde in the cold, 11 pts. aldehyde absorbing 19 pts.  $\text{SO}_2$ .

Absorption coefficient of aldehyde for  $\text{SO}_2$  is 1.4 times greater than that of alcohol, and 7 times greater than that of  $\text{H}_2\text{O}$ . (Geuther and Cartmell, Proc. Roy. Soc. 10. 111.)

1 pt. camphor dissolves 0.880 pt. by weight (=308 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. glacial  $\text{HC}_2\text{H}_3\text{O}_2$  dissolves 0.961 pt. by weight (=318 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. formic acid dissolves 0.821 pt. by weight (=351 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. acetone dissolves 2.07 pts. by weight (=589 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm.; 1 pt. sulphuryl chloride dissolves 0.323 pt. by weight (=187 vols.)  $\text{SO}_2$  at  $0^\circ$  and 725 mm. (Schulze, J. pr. (2) 24. 168.)

Solubility of  $\text{SO}_2$  in  $\text{CHCl}_3$ .

C = g.  $\text{SO}_2$  in 1 cc. of the solution.

P = Pressure in mm. Hg.

$t^\circ$	C	P	$\frac{C}{P} \times 10^4$
0	0.000701	2.7	2.6
"	0.001790	5.6	3.14
"	0.006982	22.0	3.17
"	0.03097	90.2	3.43
"	0.08217	219.6	3.74
25	0.000669	5.7	1.17
"	0.001712	12.9	1.37
"	0.006723	48.0	1.40
"	0.02954	208.2	1.47
"	0.07839	488.8	1.60

(Lindner, M. 1912, 33. 645.)

Distribution of  $\text{SO}_2$  between  $\text{H}_2\text{O}$  and  $\text{CHCl}_3$  at  $20^\circ$ .

$c_1$  = g.  $\text{SO}_2$  per l. of  $\text{H}_2\text{O}$  solution.

$c_2$  = g.  $\text{SO}_2$  per l. of  $\text{CHCl}_3$  solution.

$C_1$	$C_2$	$C_1/C_2$
1.738	1.123	1.55
1.753	1.122	1.56
2.326	1.704	1.37
2.346	1.703	1.38
2.628	1.897	1.38
3.039	2.395	1.27
3.058	2.385	1.28
3.686	3.063	1.20
3.735	3.062	1.22
4.226	3.626	1.17
5.269	4.798	1.10
5.372	4.813	1.12
6.588	6.183	1.07
31.92	33.84	0.94
33.26	37.25	0.89

(McCrae, Z. anorg. 1903, 35. 12.)

Distribution of  $\text{SO}_2$  between  $\text{HCl}$  + Aq and  $\text{CHCl}_3$  at  $20^\circ$ .

$c_1$  = g.  $\text{SO}_2$  per l. of  $\text{HCl}$  + Aq solution.

$c_2$  = g.  $\text{SO}_2$  per l. of  $\text{CHCl}_3$  solution.

$\text{HCl}$  = normality of  $\text{HCl}$  + Aq used.

$\text{HCl}$	$C_1$	$C_2$	$C_1/C_2$
0.05-N	1.86	1.46	1.28
	3.076	2.830	1.08
	4.277	4.07	1.04
	5.340	5.42	0.96
0.1 -N	1.25	1.41	0.88
	1.324	1.416	0.93
	2.78	3.08	0.90
	3.86	4.08	0.94
0.2 -N	5.161	5.715	0.90
	1.268	1.509	0.84
	1.914	2.274	0.84
	2.464	3.040	0.81
0.4 -N	3.967	4.898	0.81
	1.202	1.614	0.79
	1.894	2.263	0.83

(McCrae, Z. anorg. 1903, 35. 14.)

Sulphur dioxide ammonia,  $\text{SO}_2, \text{NH}_3$ .

Very hygroscopic. Easily sol. in  $\text{H}_2\text{O}$  with decomp. (Schumann, Z. anorg. 1900, 23. 49.)

$\text{SO}_2, 2\text{NH}_3$ . Somewhat hygroscopic.

Sol. in  $\text{H}_2\text{O}$  with evolution of  $\text{NH}_3$ . (Schumann, Z. anorg. 1900, 23. 50.)

$5\text{SO}_2, 4\text{NH}_3$ . Very deliquescent.

Very sol. in  $\text{H}_2\text{O}$ . (Divers and Ogawa, Chem. Soc. 1901, 79. 1103.)

Sulphur trioxide,  $\text{SO}_3$ .

Fumes on air. Miscible with  $\text{H}_2\text{O}$ , with evolution of much heat. Sol. in  $\text{H}_2\text{SO}_4$ . De-comp. by alcohol and ether.

Exists in two modifications, one of which is liquid and miscible with  $\text{H}_2\text{SO}_4$ , while the solid form is only slowly sol. therein.

Miscible with  $\text{CS}_2$  at  $30^\circ$ , but at  $15^\circ$   $\text{CS}_2$  dissolves only  $\frac{1}{2}$  pt.  $\text{SO}_2$ , and  $\text{SO}_3$ ,  $\frac{1}{2}$  pt.  $\text{CS}_2$ . (Schultz-Sellack, Pogg. 139. 480.)

There is only one modification, the liquid, which absorbs  $\text{H}_2\text{O}$  and becomes solid. (Rebs, A. 246. 356.)

Miscible with liquid  $\text{SO}_2$ . (Schultz-Sellack.)

See also Sulphuric acid.

Sulphur heptoxide,  $\text{S}_2\text{O}_7$ .

Fumes on air. Slowly decomp. at  $0^\circ$ , instantaneously on warming. Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Berthelot, J. pr. (2) 17. 48.)

Forms compound  $\text{S}_2\text{O}_7 \cdot 2\text{H}_2\text{O}$ .

Formula is  $\text{SO}_3$ , according to Traube (B. 24. 1764), and  $\text{S}_2\text{O}_7$  is  $\text{SO}_3 + \text{SO}_4$ .

See also Marshall (Chem. Soc. 59. 771).

Traube (B. 26. 148) denies the existence of  $\text{SO}_4$ .

Sulphur oxybromide,  $\text{SOBr}_2$ .

See Thionyl bromide.

Sulphur oxychloride,  $\text{SOCl}_2$ .

See Thionyl chloride.

$\text{SO}_2\text{Cl}_2$ . See Sulphuryl chloride.

$\text{S}_2\text{O}_2\text{Cl}_2$ . See Pyrosulphuryl chloride.

$\text{HSO}_2\text{Cl}$ . See Sulphuryl hydroxyl chloride.

$\text{S}_2\text{OCl}_2$ . Decomp. by  $\text{H}_2\text{O}$  and alcohol. (Ogier, C. R. 94. 446.)

Mixture of about  $17\text{SCl}_2 + 2\text{SOCl}_2$ , and  $5\text{SO}_2\text{Cl}_2$ . (Knoll, B. 1898, 31. 2183.)

Sulphur oxytetrachloride,  $\text{S}_2\text{O}_4\text{Cl}_4$ .

Violently decomp. by  $\text{H}_2\text{O}$ , dil. acids, or alcohol. (Millon, A. ch. (3) 29. 327.)

Sol. in warm  $\text{S}_2\text{Cl}_2$ . (Carius, A. 106. 295.)

Decomp. violently with  $\text{CS}_2$ .

Sulphur oxyfluoride,  $\text{SO}_2\text{F}_2$ .

See Sulphuryl fluoride.

$\text{SOF}_2$ . See Thionyl fluoride.

Sulphur diphosphide,  $\text{P}_2\text{S}$ .

See Phosphorus monosulphide.

Sulphur tetraphosphide,  $\text{P}_4\text{S}$ .

See Phosphorus semisulphide.

Sulphuretted hydrogen,  $\text{H}_2\text{S}$ .

See Hydrogen sulphide.

Sulphuric acid,  $\text{H}_2\text{SO}_4$ .

Miscible with  $\text{H}_2\text{O}$  in all proportions.

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq.}$

Baume degrees	Sp. gr.	% $\text{H}_2\text{SO}_4$	Baume degrees	Sp. gr.	% $\text{H}_2\text{SO}_4$
66	1.842	100	66	1.844	100
60	1.725	84.22	60	1.717	82.34
55	1.618	74.32	55	1.618	74.32
50	1.524	66.45	54	1.603	72.70
45	1.466	58.02	53	1.586	71.17
40	1.375	50.41	52	1.568	69.30
35	1.315	43.21	51	1.550	68.03
30	1.260	36.52	50	1.532	66.45
25	1.210	30.12	49	1.515	64.37
20	1.162	24.01	48	1.500	62.80
15	1.114	17.39	47	1.482	61.32
10	1.076	11.73	46	1.466	59.85
5	1.023	6.60	45	1.454	58.02

(Vauquelin, A. ch. 76. 260.)

(Darcet, A. ch. (2) 1. 198.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq.}$

% $\text{H}_2\text{SO}_4$	Sp. gr. at $15^\circ$	Sp. gr. at $25^\circ$	% $\text{H}_2\text{SO}_4$	Sp. gr. at $15^\circ$	Sp. gr. at $25^\circ$
0	0.9986	0.9955	50	1.3866	1.3780
2.5	1.0115	1.0115	55	1.4347	1.4267
5	1.0284	1.0272	60	1.4880	1.4767
10	1.0659	1.0604	65	1.5402	1.5263
15	1.0998	1.0940	70	1.5946	1.5863
20	1.1378	1.1311	75	1.6534	1.6434
25	1.1767	1.1692	80	1.7092	1.6996
30	1.2164	1.2078	85	1.7602	1.7494
35	1.2562	1.2468	90	1.8050	1.7940
40	1.2976	1.2883	95	1.8318	1.8226
45	1.3409	1.3316	100	1.8406	1.8286

(Delezenne, 1833.)

Sp. gr. at  $15.56^\circ$ , and b.-pt. of  $\text{H}_2\text{SO}_4 + \text{Aq.}$

Sp. gr.	% $\text{SO}_2$	B.-pt.	Sp. gr.	% $\text{SO}_2$	B.-pt.
1.850	81	326°	1.769	67	217°
1.849	80	318	1.757	66	210
1.848	79	310	1.744	65	205
1.847	78	301	1.730	64	200
1.845	77	293	1.715	63	195
1.842	76	285	1.699	62	190
1.838	75	277	1.684	61	186
1.833	74	268	1.670	60	182
1.827	73	260	1.650	58.6	177
1.819	72	253	1.520	50	143
1.810	71	245	1.408	40	127
1.801	70	238	1.300	30	115
1.791	69	230	1.200	20	107
1.780	68	224	1.100	10	103

(Dalton, N. Syst. 2. 210.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

Sp. gr.	% $\text{SO}_2$	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{SO}_2$	% $\text{H}_2\text{SO}_4$
1.8485	81.54	100	1.5975	57.08	70
1.8460	79.90	98	1.5760	55.45	68
1.8410	78.28	96	1.5503	53.82	66
1.8336	76.65	94	1.5280	52.18	64
1.8233	75.02	92	1.5066	50.55	62
1.8115	73.39	90	1.4860	48.92	60
1.7962	71.75	88	1.4680	47.29	58
1.7774	70.12	86	1.4460	45.66	56
1.7570	68.49	84	1.4205	44.03	54
1.7360	66.86	82	1.4073	42.40	52
1.7120	65.23	80	1.3894	40.77	50
1.6870	63.60	78	1.3697	39.14	48
1.6630	61.97	76	1.3530	37.51	46
1.6415	60.34	74	1.3345	35.88	44
1.6204	58.71	72	1.3165	34.25	42

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .—Continued.

Sp. gr.	% $\text{SO}_4$	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{SO}_4$	% $\text{H}_2\text{SO}_4$
1.2999	32.61	40	1.1410	16.31	20
1.2823	30.98	38	1.1246	14.68	18
1.2654	29.35	36	1.1090	13.05	16
1.2490	27.72	34	1.0953	11.41	14
1.2334	25.09	32	1.0809	9.78	12
1.2184	24.46	30	1.0682	8.15	10
1.2032	22.83	28	1.0544	6.52	8
1.1876	21.20	26	1.0405	4.89	6
1.1706	19.57	24	1.0288	3.28	4
1.1549	17.94	22	1.0140	1.63	2

(Ure. Schw. J. 33. 444.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Degrees Baume	Sp. gr.	At $0^\circ$		At $15^\circ$	
		% $\text{SO}_4$	% $\text{H}_2\text{SO}_4$	% $\text{SO}_4$	% $\text{H}_2\text{SO}_4$
5	1.036	5.1	4.2	5.4	4.5
10	1.075	10.3	8.4	10.9	8.9
15	1.116	15.5	12.7	16.3	13.3
20	1.161	21.2	17.3	22.4	18.3
25	1.209	27.2	22.2	28.3	23.1
30	1.232	33.6	27.4	34.8	28.4
33	1.296	37.6	30.7	38.9	31.8
35	1.320	40.4	33.0	41.6	34.0
37	1.332	41.7	34.1	43.0	35.1
38	1.345	43.1	35.2	44.3	36.2
38	1.357	44.5	36.3	45.5	37.2
39	1.370	45.9	37.5	46.9	38.3
40	1.383	47.3	38.6	48.4	39.5
41	1.397	48.7	39.7	49.9	40.7
42	1.410	50.0	40.8	51.2	41.8
43	1.421	51.4	41.9	52.5	42.9
44	1.438	52.8	43.1	54.0	44.1
45	1.453	54.3	44.3	55.4	45.2
46	1.468	55.7	45.5	56.9	46.4
47	1.483	57.1	46.6	58.2	47.5
48	1.498	58.5	47.8	59.6	48.7
49	1.514	60.0	49.0	61.1	50.0
50	1.530	61.4	50.1	62.6	51.1
51	1.545	62.9	51.3	63.9	52.2
52	1.563	64.4	52.6	65.4	53.4
53	1.580	65.9	53.8	66.9	54.6
54	1.597	67.4	55.0	68.4	55.8
55	1.615	68.9	56.2	70.0	57.1
56	1.634	70.5	57.5	71.6	58.4
57	1.652	72.1	58.8	73.2	59.7
58	1.671	73.6	60.1	74.7	61.0
59	1.691	75.2	61.4	76.3	62.3
60	1.711	76.9	62.8	78.0	63.6
61	1.732	78.6	64.2	79.8	65.1
62	1.753	80.4	65.7	81.7	66.7
63	1.774	82.4	67.2	83.9	68.5
64	1.796	84.6	69.0	86.3	70.4
65	1.819	87.4	71.3	89.5	73.0
66.5	1.830	89.1	72.2	91.8	74.9
65.8	1.837	90.4	73.8	94.5	77.7
66	1.842	91.3	74.5	100.0	81.6
66.2	1.846	92.5	75.5	....	....
66.4	1.852	95.0	77.5	....	....
66.6	1.857	100.0	81.6	....	....

(Bineau. A. ch. (3) 23. 121.)

The sp. gr. found at  $t^\circ$  can be reduced to sp. gr. at  $0^\circ$  by multiplying by  $\frac{144.38}{144.38-t}$ , or by using the following table. (Bineau.)

Correction of sp. gr. for temperature, to be added for a lowering of the temp. of  $10^\circ$ , or subtracted for a corresponding increase.

Sp. gr. of acid at $0^\circ$	Corr.	Sp. gr. of acid at $0^\circ$	Corr.	Sp. gr. of acid at $0^\circ$	Corr.
1.04	0.002	1.15	0.005	1.45	0.008
1.07	0.003	1.20	0.006	1.70	0.009
1.10	0.004	1.30	0.007	1.85	0.0096

(Bineau.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ . a = %; b = sp. gr. if % is  $\text{SO}_4$ ; c = sp. gr. if % is  $\text{H}_2\text{SO}_4$ .

a	b	c	a	b	c
1	1.009	1.0064	51	1.530	1.408
2	1.017	1.013	52	1.545	1.418
3	1.025	1.019	53	1.556	1.428
4	1.034	1.0256	54	1.573	1.438
5	1.041	1.032	55	1.585	1.448
6	1.049	1.039	56	1.600	1.4586
7	1.058	1.0464	57	1.615	1.469
8	1.067	1.0536	58	1.627	1.480
9	1.076	1.061	59	1.642	1.490
10	1.085	1.068	60	1.656	1.510
11	1.095	1.0756	61	1.675	1.512
12	1.104	1.083	62	1.689	1.523
13	1.114	1.091	63	1.701	1.534
14	1.123	1.098	64	1.716	1.545
15	1.133	1.106	65	1.730	1.557
16	1.142	1.1136	66	1.742	1.578
17	1.150	1.121	67	1.755	1.580
18	1.160	1.129	68	1.770	1.592
19	1.170	1.136	69	1.781	1.604
20	1.180	1.144	70	1.792	1.615
21	1.190	1.1516	71	1.802	1.627
22	1.200	1.159	72	1.810	1.639
23	1.210	1.167	73	1.819	1.651
24	1.220	1.174	74	1.825	1.663
25	1.229	1.182	75	1.830	1.675
26	1.239	1.190	76	1.834	1.686
27	1.248	1.198	77	1.837	1.698
28	1.258	1.2066	78	1.839	1.710
29	1.268	1.215	79	1.841	1.722
30	1.278	1.223	80	1.842	1.734
31	1.288	1.231	81	...	1.745
32	1.300	1.239	82	...	1.756
33	1.310	1.2476	83	...	1.767
34	1.320	1.256	84	...	1.777
35	1.332	1.264	85	...	1.786
36	1.344	1.272	86	...	1.794
37	1.354	1.281	87	...	1.802
38	1.367	1.289	88	...	1.809
39	1.378	1.2976	89	...	1.816
40	1.390	1.306	90	...	1.822
41	1.401	1.315	91	...	1.827
42	1.415	1.324	92	...	1.831
43	1.427	1.333	93	...	1.834
44	1.440	1.342	94	...	1.8356
45	1.451	1.351	95	...	1.8376
46	1.465	1.361	96	...	1.8384
47	1.478	1.370	97	...	1.840
48	1.490	1.379	98	...	1.8406
49	1.501	1.3886	99	...	1.842
50	1.517	1.398	100	...	1.8426

(Bineau, calculated by Gerlach, Z. anal. 8. 292.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ ;  $\text{H}_2\text{O}$  at  $0^\circ = 1$ .

$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{H}_2\text{SO}_4$	Sp. gr.
1	1.006	35	1.264	68	1.592
2	1.012	36	1.272	69	1.604
3	1.018	37	1.281	70	1.615
4	1.025	38	1.290	71	1.626
5	1.032	39	1.298	72	1.638
6	1.039	40	1.307	73	1.650
7	1.046	41	1.316	74	1.662
8	1.053	42	1.324	75	1.674
9	1.061	43	1.333	76	1.684
10	1.069	44	1.342	77	1.697
11	1.076	45	1.352	78	1.710
12	1.084	46	1.361	79	1.721
13	1.091	47	1.370	80	1.732
14	1.099	48	1.379	81	1.743
15	1.106	49	1.389	82	1.753
16	1.114	50	1.399	83	1.763
17	1.122	51	1.409	84	1.773
18	1.129	52	1.418	85	1.783
19	1.137	53	1.428	86	1.792
20	1.145	54	1.438	87	1.800
21	1.153	55	1.448	88	1.807
22	1.161	56	1.459	89	1.814
23	1.168	57	1.469	90	1.820
24	1.176	58	1.480	91	1.825
25	1.184	59	1.491	92	1.8294
26	1.191	60	1.501	93	1.8339
27	1.199	61	1.512	94	1.8372
28	1.207	62	1.523	95	1.8390
29	1.215	63	1.535	96	1.8406
30	1.223	64	1.546	97	1.8410
31	1.231	65	1.558	98	1.8412
32	1.239	66	1.569	99	1.8403
33	1.247	67	1.580	100	1.8384
34	1.256	..	...	...	...

(From 1-91 % according to Kolb, calculated by Gerlach; from 92-100% according to Lunge and Naef, calculated by Gerlach, Z. anal. 27. 316.)

Sp. gr. of  $\text{H}_2\text{SO}_4$  at  $15^\circ$  compared with  $\text{H}_2\text{O}$  at  $4^\circ$  and 0 mm. pressure.

Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$
1.000	0.07	0.09	1.075	8.90	10.90
1.005	0.68	0.83	1.080	9.47	11.60
1.010	1.28	1.57	1.085	10.04	12.30
1.015	1.88	2.30	1.090	10.60	12.99
1.020	2.47	3.03	1.095	11.16	13.67
1.025	3.07	3.76	1.100	11.71	14.35
1.030	3.67	4.49	1.105	12.27	15.07
1.035	4.27	5.23	1.110	12.82	15.71
1.040	4.87	5.96	1.115	13.36	16.36
1.045	5.45	6.67	1.120	13.89	17.01
1.050	6.02	7.37	1.125	14.42	17.66
1.055	6.59	8.07	1.130	14.95	18.31
1.060	7.16	8.77	1.135	15.48	18.96
1.065	7.73	9.47	1.140	16.01	19.61
1.070	8.32	10.19	1.145	16.54	20.26

Sp. gr. of  $\text{H}_2\text{SO}_4$ , etc.—Continued.

Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$	Sp. gr.	$\text{SO}_3$	$\text{H}_2\text{SO}_4$
1.150	17.07	20.91	1.455	45.31	55.50
1.155	17.59	21.55	1.460	45.69	55.97
1.160	18.11	22.19	1.465	46.07	56.43
1.165	18.64	22.83	1.470	46.45	56.90
1.170	19.06	23.47	1.475	46.83	57.37
1.175	19.69	24.12	1.480	47.21	57.83
1.180	20.21	24.76	1.485	47.57	58.28
1.185	20.73	25.40	1.490	47.95	58.74
1.190	21.26	26.04	1.495	48.34	59.22
1.195	21.78	26.68	1.500	48.73	59.70
1.200	22.30	27.32	1.505	49.12	60.18
1.205	22.82	27.95	1.510	49.51	60.65
1.210	23.33	28.58	1.515	49.89	61.12
1.215	23.84	29.21	1.520	50.28	61.59
1.220	24.36	29.84	1.525	50.66	62.06
1.225	24.88	30.48	1.530	51.04	62.53
1.230	25.39	31.11	1.535	51.43	63.00
1.235	25.88	31.70	1.540	51.78	63.43
1.240	26.35	32.28	1.545	52.12	63.85
1.245	26.83	32.86	1.550	52.46	64.28
1.250	27.29	33.40	1.555	52.79	64.67
1.255	27.76	34.00	1.560	53.12	65.08
1.260	28.22	34.57	1.565	53.46	65.49
1.265	28.69	35.14	1.570	53.80	65.90
1.270	29.15	35.71	1.575	54.13	66.30
1.275	29.62	36.29	1.580	54.46	66.71
1.280	30.10	36.87	1.585	54.80	67.13
1.285	30.57	31.45	1.590	55.18	67.59
1.290	31.04	38.03	1.595	55.55	68.05
1.295	31.52	38.61	1.600	55.93	68.51
1.300	31.99	39.19	1.605	56.30	68.97
1.305	32.46	39.77	1.610	56.68	69.43
1.310	32.94	40.35	1.615	57.05	69.89
1.315	33.41	40.93	1.620	57.40	70.32
1.320	33.88	41.50	1.625	57.75	70.74
1.325	34.35	42.08	1.630	58.09	71.16
1.330	34.80	42.66	1.635	58.43	71.57
1.335	35.27	43.20	1.640	58.74	71.99
1.340	35.71	43.74	1.645	59.10	72.40
1.345	36.14	44.28	1.650	59.45	72.88
1.350	36.58	44.82	1.655	59.78	73.23
1.355	37.02	45.35	1.660	60.11	73.64
1.360	37.45	45.88	1.665	60.46	74.07
1.365	37.89	46.41	1.670	60.82	74.51
1.370	38.32	46.94	1.675	61.20	74.97
1.375	38.75	47.47	1.680	61.57	75.42
1.380	39.18	48.00	1.685	61.93	75.86
1.385	39.62	48.53	1.690	62.29	76.30
1.390	40.05	49.06	1.695	62.64	76.73
1.395	40.48	49.59	1.700	63.00	77.17
1.400	40.91	50.11	1.705	63.35	77.60
1.405	41.33	50.63	1.710	63.70	78.04
1.410	41.76	51.15	1.715	64.07	78.48
1.415	42.17	51.66	1.720	64.43	78.92
1.420	42.57	52.15	1.725	64.78	79.36
1.425	42.96	52.63	1.730	65.14	79.80
1.430	43.36	53.11	1.735	65.50	80.24
1.435	43.75	53.59	1.740	65.86	80.68
1.440	44.14	54.07	1.745	66.22	81.12
1.445	44.53	54.55	1.750	66.58	81.56
1.450	44.92	55.03	1.755	66.94	82.00

Sp. gr. of  $\text{H}_2\text{SO}_4$ , etc.—Continued.

Sp. gr.	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{SO}_3$	% $\text{H}_2\text{SO}_4$
1.760	67.30	82.44	1.829	75.03	91.90
1.765	67.65	82.88	1.830	75.19	92.10
1.770	68.02	83.32	1.831	75.35	92.30
1.775	68.49	83.90	1.832	75.53	92.52
1.780	68.98	84.50	1.833	75.72	92.75
1.785	69.74	85.10	1.834	75.96	93.05
1.790	69.96	85.70	1.835	76.27	93.43
1.795	70.45	86.30	1.836	76.57	93.80
1.800	70.94	86.90	1.837	76.90	94.20
1.805	71.50	87.60	1.838	77.23	94.60
1.810	72.08	88.30	1.839	77.55	95.00
1.815	72.69	89.05	1.840	78.04	95.60
1.820	73.51	90.05	1.8405	78.33	95.95
1.821	73.63	90.20	1.8415	79.19	97.00
1.822	73.80	90.40	1.8410	79.76	97.70
1.823	73.96	90.60	1.8415	80.16	98.20
1.824	74.12	90.80	1.8400	80.57	98.70
1.825	74.29	91.00	1.8400	80.98	99.20
1.826	74.49	91.25	1.8395	81.18	99.45
1.827	74.69	91.50	1.8390	81.39	99.70
1.828	74.86	91.70	1.8385	81.59	99.95

(Lunge and Isler, Zeit. angew. Ch. 9. 129.)

Sp. gr. of conc.  $\text{H}_2\text{SO}_4$  + Aq at  $15^\circ$ .

% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
100	1.8384	99.02	1.8417
99.98	1.8385	98.98	1.8418
99.96	1.8386	98.94	1.8419
99.94	1.8387	98.84	1.8420
99.92	1.8388	98.84	1.8421
99.90	1.8389	98.78	1.8422
99.88	1.8390	98.71	1.8423
99.86	1.8391	98.63	1.8424
99.84	1.8392	98.56	1.8425
99.81	1.8393	98.48	1.8426
99.78	1.8394	98.40	1.8427
99.76	1.8395	98.32	1.8428
99.73	1.8396	98.22	1.8429
99.70	1.8397	98.08	1.8430
99.67	1.8398	97.85	1.8431
99.64	1.8399	97.50	1.8432
99.61	1.8400	97.10	1.8431
95.58	1.8401	96.93	1.8430
99.55	1.8402	96.76	1.8429
99.52	1.8403	96.65	1.8428
99.49	1.8404	96.55	1.8427
99.46	1.8405	96.46	1.8426
99.43	1.8406	96.39	1.8425
99.40	1.8407	96.31	1.8424
99.37	1.8408	96.24	1.8423
99.33	1.8409	96.16	1.8422
99.29	1.8410	96.09	1.8421
99.25	1.8411	96.02	1.8420
99.22	1.8412	95.95	1.8419
99.19	1.8413	95.88	1.8418
99.16	1.8414	95.81	1.8417
99.11	1.8415	95.74	1.8416
99.06	1.8416	95.67	1.8415

Sp. gr. of conc.  $\text{H}_2\text{SO}_4$ , etc.—Continued.

% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
95.61	1.8414	93.32	1.8352
95.55	1.8413	93.29	1.8351
95.50	1.8412	93.26	1.8350
95.45	1.8411	93.23	1.8349
95.40	1.8410	93.20	1.8348
95.35	1.8409	93.17	1.8347
95.30	1.8408	93.14	1.8346
95.25	1.8407	93.12	1.8345
95.21	1.8406	93.09	1.8344
95.16	1.8405	93.06	1.8343
95.12	1.8404	93.00	1.8342
95.08	1.8403	92.98	1.8341
95.04	1.8402	92.95	1.8339
95.00	1.8401	92.93	1.8338
94.96	1.8400	92.90	1.8337
94.92	1.8399	92.87	1.8336
94.88	1.8398	92.84	1.8335
94.84	1.8397	92.82	1.8334
94.81	1.8396	92.79	1.8333
94.77	1.8395	92.77	1.8332
94.73	1.8394	92.73	1.8331
94.69	1.8393	92.71	1.8330
94.65	1.8392	92.69	1.8329
94.61	1.8391	92.66	1.8328
94.57	1.8390	92.63	1.8327
94.53	1.8389	92.61	1.8326
94.49	1.8388	92.59	1.8325
94.46	1.8387	92.56	1.8324
94.42	1.8386	92.54	1.8323
94.38	1.8385	92.52	1.8322
94.34	1.8384	92.49	1.8321
94.31	1.8383	92.46	1.8320
94.27	1.8382	92.44	1.8319
94.24	1.8381	92.41	1.8318
94.20	1.8380	92.39	1.8317
94.17	1.8379	92.37	1.8316
94.13	1.8378	92.34	1.8315
94.10	1.8377	92.32	1.8314
94.07	1.8376	92.29	1.8313
94.03	1.8375	92.27	1.8312
94.00	1.8374	92.24	1.8311
93.97	1.8373	92.22	1.8310
93.93	1.8372	92.19	1.8309
93.90	1.8371	92.17	1.8308
93.87	1.8370	92.15	1.8307
93.83	1.8369	92.12	1.8306
93.80	1.8368	92.10	1.8305
93.77	1.8367	92.07	1.8304
93.74	1.8366	92.05	1.8303
93.71	1.8365	92.02	1.8302
93.68	1.8364	92.00	1.8301
93.65	1.8363	91.98	1.8300
93.62	1.8362	91.95	1.8299
93.59	1.8361	91.93	1.8298
93.56	1.8360	91.91	1.8297
93.53	1.8359	91.88	1.8296
93.50	1.8358	91.86	1.8295
93.47	1.8357	91.84	1.8294
93.44	1.8356	91.81	1.8293
93.41	1.8355	91.78	1.8292
93.38	1.8354	91.76	1.8291
93.35	1.8353	91.74	1.8290

Sp. gr. of conc.  $\text{H}_2\text{SO}_4$ , etc.—*Continued.*

% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
91.72	1.8298	90.78	1.8244
91.70	1.8288	90.76	1.8243
91.68	1.8287	90.74	1.8242
91.65	1.8286	90.72	1.8241
91.63	1.8285	90.70	1.8240
91.61	1.8284	90.68	1.8239
91.59	1.8283	90.66	1.8238
91.56	1.8282	90.64	1.8237
91.54	1.8281	90.62	1.8236
91.52	1.8280	90.60	1.8235
91.50	1.8279	90.59	1.8234
91.47	1.8278	90.57	1.8233
91.45	1.8277	90.55	1.8232
91.43	1.8276	90.53	1.8231
91.41	1.8275	90.51	1.8230
91.39	1.8274	90.49	1.8229
91.37	1.8273	90.47	1.8228
91.35	1.8272	90.46	1.8227
91.32	1.8271	90.44	1.8226
91.30	1.8270	90.42	1.8225
91.28	1.8269	90.40	1.8224
91.26	1.8268	90.38	1.8223
91.24	1.8267	90.37	1.8222
91.22	1.8266	90.35	1.8221
91.20	1.8265	90.33	1.8220
91.18	1.8264	90.31	1.8219
91.16	1.8263	90.29	1.8218
91.14	1.8262	90.28	1.8217
91.12	1.8261	90.26	1.8216
91.10	1.8260	90.24	1.8215
91.08	1.8259	90.23	1.8214
91.06	1.8258	90.20	1.8213
91.04	1.8257	90.18	1.8212
91.02	1.8256	90.17	1.8211
91.00	1.8255	90.15	1.8210
90.98	1.8254	90.13	1.8209
90.96	1.8253	90.11	1.8208
90.94	1.8252	90.10	1.8207
90.92	1.8251	90.08	1.8206
90.90	1.8250	90.06	1.8205
90.88	1.8249	90.04	1.8204
90.86	1.8248	90.02	1.8203
90.84	1.8247	90.01	1.8202
90.82	1.8246	89.99	1.8201
90.80	1.8245	89.97	1.8200

(Richmond [calculated from Pickering, Chem. Soc. 57. 64], Jour. Soc. Ch. Ind. 9. 479.)

Sp. gr. of conc.  $\text{H}_2\text{SO}_4$ +Aq at 15°.

% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.
90	1.8185	96	1.8406
*90.20	1.8195	97	1.8410
91	1.8241	*97.70	1.8413
*91.48	1.8271	98	1.8412
92	1.8294	*98.39	1.8406
*92.83	1.8334	*98.66	1.8409
93	1.8339	99	1.8403
94	1.8372	*99.47	1.8395
*94.84	1.8387	100	1.8384
95	1.8390	*100.35	1.8411
*95.97	1.8406	...	...

\*Determined by experiment.

(Lunge and Naef, Dingl. 248. 91.)

Sp. gr. of  $\text{H}_2\text{SO}_4$ +Aq at room temp. containing:

7.875	15.503	23.429% $\text{H}_2\text{SO}_4$
1.0651	1.1305	1.2003

(Wagner, W. Ann. 1883, 18. 265.)

Sp. gr. of  $\text{H}_2\text{SO}_4$ +Aq at 25°.

Concentration of $\text{H}_2\text{SO}_4$ +Aq	Sp. gr.
1—normal	1.0303
$\frac{1}{5}$ —"	1.0154
$\frac{2}{5}$ —"	1.0074
$\frac{1}{5}$ —"	1.0035

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp. gr. of dil.  $\text{H}_2\text{SO}_4$ +Aq.

G.-equivalents $\text{H}_2\text{SO}_4$ per liter	t°	Sp. gr. t°/t°
0.005049	17.343	1.0002082
0.01009	17.360	1.0004020
0.01512	17.382	1.0005879
0.02014	17.398	1.000769
0.03014	17.419	1.001125
0.002526	18.039	1.0001065
0.005050	18.040	1.0002084
0.01006	18.040	1.0004009
0.02005	18.040	1.0007668
0.03001	18.039	1.0011208
0.04980	18.040	1.0018096
0.09864	18.048	1.003460
0.146560	18.070	1.005045
0.19354	18.060	1.006580
0.28942	18.052	1.009686
0.47466	18.055	1.015616
0.4980	17.73	1.01634
4.980	17.95	1.15234
0.005176	12.997	1.0002106
0.01035	13.020	1.000411
0.01551	13.005	1.000603
0.12648	13.031	1.004432
0.25151	13.011	1.008565
0.37672	13.007	1.012639
0.50503	12.998	1.016758

(Kohlrausch, W. Ann. 1894, 53. 22.)

Sp. gr. of $H_2SO_4$ + Aq.			
% $H_2SO_4$	79.68	60.98	35.77
Sp. gr. 20°/20°	1.7383	1.5181	1.2719
% $H_2SO_4$	10.10	4.78	
Sp. gr. 20°/20°	1.0685	1.0317	
(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 268.)			

Sp. gr. of  $N-H_2SO_4$  + Aq at 18°/4° = 1.0306.  
(Loomis, W. Ann. 1896, 60. 550.)

Sp. gr. of  $H_2SO_4$  + Aq at 19.4°, when p = percent strength of solution; d = observed density; w = volume conc. in grams per cc.  $\left(\frac{pd}{100} = w\right)$ .

p	d	w
94.10	1.8380	1.7295
84.59	1.7998	1.5223
73.08	1.6743	1.2235
61.35	1.5341	0.9412
40.72	1.3220	0.5383
31.94	1.2430	0.3970
23.77	1.1747	0.2792
14.72	1.1023	0.1623
9.802	1.0670	0.1046
4.826	1.0320	0.0498

(Barnes, J. Phys. Chem. 1898, 2. 546.)

Sp. gr. of  $H_2SO_4$  + Aq at 20°.

Normality of $H_2SO_4$ + Aq	% $H_2SO_4$	Sp. gr.
11.53	70.07	1.6129
9.01	59.26	1.4901
6.95	49.10	1.3872
4.77	36.68	1.2756
3.008	25.00	1.1791
1.002	9.25	1.0612

(Förchheimer, Z. phys. Ch. 1900, 34. 27.)

Sp. gr. of conc. and fuming  $H_2SO_4$  at 15° and 45°

% $H_2SO_4$	Total $SO_3$ %	Free $SO_3$ %	Sp. gr. at 15°	Sp. gr. at 45°
95.98	78.35	...	1.8418	...
96.68	78.92	...	1.8429	...
96.99	79.18	...	1.8431	...
97.66	79.72	...	1.8434 max.	...
98.65	80.53	...	1.8403	...
99.40	81.14	...	1.8388 min.	...
99.76	81.44	...	1.8418	...
100.00	81.63	0.0	1.8500	1.822
...	83.46	10.0	1.888	1.858
...	85.30	20.0	1.920	1.887
...	87.14	30.0	1.957	1.920
...	88.97	40.0	1.979	1.945
...	90.81	50.0	2.009	1.964 max.
...	92.65	60.0	2.020 max.	1.959
...	94.48	70.0	2.018	1.942
...	96.32	80.0	2.008	1.890
...	98.16	90.0	1.990	1.864
...	100.00	100.0	1.984	1.814

(Knietzsch, B. 1901, 34. 4102.)

Sp. gr. of fuming  $H_2SO_4$  at 35°.

Total $SO_3$ %	Free $SO_3$ %	Sp. gr.	Total $SO_3$ %	Free $SO_3$ %	Sp. gr.
81.63	0	1.8186	91.18	52	1.9749
81.99	2	1.8270	91.55	54	1.9760
82.36	4	1.8360	91.91	56	1.9772
82.73	6	1.8425	92.28	58	1.9754
83.09	8	1.8498	92.65	60	1.9738
83.46	10	1.8565	93.02	62	1.9709
83.82	12	1.8627	93.38	64	1.9672
84.20	14	1.8692	93.75	66	1.9636
84.56	16	1.8756	94.11	68	1.9600
84.92	18	1.8830	94.48	70	1.9564
85.30	20	1.8919	94.85	72	1.9502
85.66	22	1.9020	95.21	74	1.9442
86.03	24	1.9092	95.58	76	1.9379
86.40	26	1.9158	95.95	78	1.9315
86.76	28	1.9220	96.32	80	1.9251
87.14	30	1.9280	96.69	82	1.9183
87.50	32	1.9338	97.05	84	1.9115
87.87	34	1.9405	97.42	86	1.9046
88.24	36	1.9474	97.78	88	1.8980
88.60	38	1.9534	98.16	90	1.8888
88.97	40	1.9584	98.53	92	1.8800
89.33	42	1.9612	98.90	94	1.8712
89.70	44	1.9643	99.26	96	1.8605
90.07	46	1.9672	99.63	98	1.8488
90.44	48	1.9702	100.00	100	1.8370
90.81	50	1.9733	...	...	...

(Knietzsch, B. 1901, 34. 4101.)

Sp. gr. of  $H_2SO_4$  + Aq at 15°/15° in air.

Sp. gr.	% $H_2SO_4$	Sp. gr.	% $H_2SO_4$	Sp. gr.	% $H_2SO_4$
1.000	0.00	1.028	4.12	1.056	8.19
1.001	0.15	1.029	4.26	1.057	8.33
1.002	0.31	1.030	4.41	1.058	8.47
1.003	0.46	1.031	4.56	1.059	8.62
1.004	0.60	1.032	4.70	1.060	8.76
1.005	0.73	1.033	4.85	1.061	8.90
1.006	0.87	1.034	5.00	1.062	9.04
1.007	1.01	1.035	5.14	1.063	9.18
1.008	1.15	1.036	5.29	1.064	9.33
1.009	1.30	1.037	5.44	1.065	9.47
1.010	1.45	1.038	5.58	1.066	9.61
1.011	1.60	1.039	5.73	1.067	9.75
1.012	1.75	1.040	5.88	1.068	9.89
1.013	1.89	1.041	6.03	1.069	10.04
1.014	2.04	1.042	6.17	1.070	10.18
1.015	2.19	1.043	6.32	1.071	10.31
1.016	2.34	1.044	6.46	1.072	10.45
1.017	2.49	1.045	6.60	1.073	10.59
1.018	2.64	1.046	6.75	1.074	10.73
1.019	2.79	1.047	6.89	1.075	10.87
1.020	2.93	1.048	7.04	1.076	11.00
1.021	3.08	1.049	7.18	1.077	11.14
1.022	3.23	1.050	7.32	1.078	11.28
1.023	3.38	1.051	7.47	1.079	11.42
1.024	3.53	1.052	7.61	1.080	11.56
1.025	3.67	1.053	7.76	1.081	11.69
1.026	3.82	1.054	7.90	1.082	11.83
1.027	3.97	1.055	8.04	1.083	11.97

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air.—  
*Continued.*Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air.—  
*Continued.*

Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$
1.084	12.11	1.145	20.25	1.206	27.95	1.267	35.33	1.328	42.35	1.389	48.92				
1.085	12.24	1.146	20.38	1.207	28.08	1.268	35.45	1.329	42.46	1.390	49.02				
1.086	12.38	1.147	20.51	1.208	28.20	1.269	35.57	1.330	42.57	1.391	49.13				
1.087	12.52	1.148	20.64	1.209	28.32	1.270	35.68	1.331	42.68	1.392	49.23				
1.088	12.66	1.149	20.77	1.210	28.45	1.271	35.80	1.332	42.79	1.393	49.34				
1.089	12.79	1.150	20.90	1.211	28.57	1.272	35.92	1.333	42.90	1.394	49.44				
1.090	12.93	1.151	21.03	1.212	28.69	1.273	36.04	1.334	43.01	1.395	49.54				
1.091	13.07	1.152	21.16	1.213	28.82	1.274	36.15	1.335	43.12	1.396	49.65				
1.092	13.20	1.153	21.28	1.214	28.94	1.275	36.27	1.336	43.23	1.397	49.75				
1.093	13.34	1.154	21.41	1.215	29.06	1.276	36.39	1.337	43.35	1.398	49.86				
1.094	13.48	1.155	21.54	1.216	29.18	1.277	36.51	1.338	43.46	1.399	49.96				
1.095	13.61	1.156	21.67	1.217	29.31	1.278	36.62	1.339	43.57	1.400	50.06				
1.096	13.75	1.157	21.80	1.218	29.43	1.279	36.70	1.340	43.68	1.401	50.16				
1.097	13.89	1.158	21.93	1.219	29.55	1.280	36.86	1.341	43.79	1.402	50.26				
1.098	14.02	1.159	22.05	1.220	29.69	1.281	36.97	1.342	43.90	1.403	50.37				
1.099	14.16	1.160	22.18	1.221	29.80	1.282	37.09	1.343	44.01	1.404	50.47				
1.100	14.29	1.161	22.31	1.222	29.92	1.283	37.21	1.344	44.12	1.405	50.57				
1.101	14.43	1.162	22.44	1.223	30.04	1.284	37.32	1.345	44.23	1.406	50.67				
1.102	14.56	1.163	22.56	1.224	30.17	1.285	37.44	1.346	44.34	1.407	50.77				
1.103	14.70	1.164	22.69	1.225	30.29	1.286	37.56	1.347	44.45	1.408	50.88				
1.104	14.83	1.165	22.82	1.226	30.41	1.287	37.68	1.348	44.56	1.409	50.98				
1.105	14.97	1.166	22.94	1.227	30.53	1.288	37.79	1.349	44.67	1.410	51.08				
1.106	15.10	1.167	23.07	1.228	30.65	1.289	37.91	1.350	44.77	1.411	51.18				
1.107	15.24	1.168	23.20	1.229	30.78	1.290	38.03	1.351	44.88	1.412	51.28				
1.108	15.37	1.169	23.32	1.230	30.90	1.291	38.14	1.352	44.99	1.413	51.38				
1.109	15.51	1.170	23.45	1.231	31.02	1.292	38.26	1.353	45.10	1.414	51.48				
1.110	15.64	1.171	23.57	1.232	31.14	1.293	38.37	1.354	45.21	1.415	51.58				
1.111	15.78	1.172	23.71	1.233	31.26	1.294	38.49	1.355	45.32	1.416	51.68				
1.112	15.91	1.173	23.83	1.234	31.38	1.295	38.60	1.356	45.43	1.417	51.78				
1.113	16.05	1.174	23.96	1.235	31.50	1.296	38.72	1.357	45.53	1.418	51.89				
1.114	16.18	1.175	24.08	1.236	31.62	1.297	38.83	1.358	45.64	1.419	51.99				
1.115	16.31	1.176	24.21	1.237	31.75	1.298	38.95	1.359	45.75	1.420	52.09				
1.116	16.45	1.177	24.34	1.238	31.87	1.309	39.06	1.360	45.86	1.421	52.19				
1.117	16.58	1.178	24.46	1.239	31.99	1.300	39.18	1.361	45.97	1.422	52.29				
1.118	16.71	1.179	24.59	1.240	32.11	1.301	39.29	1.362	46.07	1.423	52.39				
1.119	16.84	1.180	24.71	1.241	32.23	1.302	39.41	1.363	46.18	1.424	52.49				
1.120	16.98	1.181	24.84	1.242	32.35	1.303	39.52	1.364	46.29	1.425	52.59				
1.121	17.11	1.182	24.97	1.243	32.47	1.304	39.64	1.365	46.39	1.426	52.69				
1.122	17.24	1.183	25.09	1.244	32.59	1.305	39.75	1.366	46.50	1.427	52.79				
1.123	17.37	1.184	25.22	1.245	32.71	1.306	39.86	1.367	46.61	1.428	52.89				
1.124	17.51	1.185	25.34	1.246	32.83	1.307	39.98	1.368	46.71	1.429	52.98				
1.125	17.64	1.186	25.47	1.247	32.95	1.308	40.09	1.369	46.82	1.430	53.08				
1.126	17.77	1.187	25.59	1.248	33.07	1.309	40.20	1.370	46.92	1.431	53.18				
1.127	17.90	1.188	25.72	1.249	33.19	1.310	40.32	1.371	47.03	1.432	53.28				
1.128	18.03	1.189	25.84	1.250	33.31	1.311	40.43	1.372	47.14	1.433	53.38				
1.129	18.16	1.190	25.97	1.251	33.43	1.312	40.54	1.373	47.24	1.434	53.48				
1.130	18.30	1.191	26.09	1.252	33.55	1.313	40.66	1.374	47.35	1.435	53.58				
1.131	18.43	1.192	26.22	1.253	33.67	1.314	40.77	1.375	47.45	1.436	53.68				
1.132	18.56	1.193	26.34	1.254	33.79	1.315	40.88	1.376	47.56	1.437	53.78				
1.133	18.69	1.194	26.47	1.255	33.91	1.316	40.99	1.377	47.67	1.438	53.88				
1.134	18.82	1.195	26.59	1.256	34.02	1.317	41.11	1.378	47.77	1.439	53.97				
1.135	18.95	1.196	26.71	1.257	34.14	1.318	41.22	1.379	47.88	1.440	54.07				
1.136	19.08	1.197	26.84	1.258	34.26	1.319	41.33	1.380	47.98	1.441	54.17				
1.137	19.22	1.198	26.96	1.259	34.38	1.320	41.45	1.381	48.09	1.442	54.27				
1.138	19.34	1.199	27.09	1.260	34.50	1.321	41.56	1.382	48.10	1.443	54.36				
1.139	19.47	1.200	27.21	1.261	34.62	1.322	41.67	1.383	48.30	1.444	54.46				
1.140	19.60	1.201	27.33	1.262	34.74	1.323	41.79	1.384	48.40	1.445	54.56				
1.141	19.73	1.202	27.46	1.263	34.86	1.324	41.90	1.385	48.50	1.446	54.65				
1.142	19.86	1.203	27.58	1.264	34.98	1.325	42.01	1.386	48.61	1.447	54.75				
1.143	19.99	1.204	27.71	1.265	35.09	1.326	42.12	1.387	48.71	1.448	54.85				
1.144	20.12	1.205	27.83	1.266	35.21	1.327	42.23	1.388	48.82	1.449	54.94				



Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air.—  
*Continued.*Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air.—  
*Continued.*

Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$
1.450	55.04	1.511	60.78	1.572	66.23	1.633	71.48	1.694	76.65	1.755	82.01
1.451	55.14	1.512	60.87	1.573	66.31	1.634	71.57	1.695	76.74	1.756	82.11
1.452	55.24	1.513	60.96	1.574	66.40	1.635	71.65	1.696	76.82	1.757	82.21
1.453	55.33	1.514	61.05	1.575	66.49	1.636	71.74	1.697	76.91	1.758	82.31
1.454	55.43	1.515	61.14	1.576	66.57	1.637	71.82	1.698	76.99	1.759	82.41
1.455	55.53	1.516	61.24	1.577	66.66	1.638	71.91	1.699	77.08	1.760	82.51
1.456	55.62	1.517	61.33	1.578	66.75	1.639	71.99	1.700	77.17	1.761	82.61
1.457	55.72	1.518	61.42	1.579	66.83	1.640	72.07	1.701	77.25	1.762	82.71
1.458	55.82	1.519	61.51	1.580	66.92	1.641	72.16	1.702	77.34	1.763	82.80
1.459	55.91	1.520	61.60	1.581	67.01	1.642	72.25	1.703	77.42	1.764	82.90
1.460	56.01	1.521	61.69	1.582	67.10	1.643	72.33	1.704	77.51	1.765	83.00
1.461	56.11	1.522	61.78	1.583	67.18	1.644	72.42	1.705	77.60	1.766	83.10
1.462	56.20	1.523	61.87	1.584	67.27	1.645	72.50	1.706	77.68	1.767	83.20
1.463	56.30	1.524	61.96	1.585	67.36	1.646	72.59	1.707	77.77	1.768	83.29
1.464	56.39	1.525	62.05	1.586	67.44	1.647	72.67	1.708	77.85	1.769	83.39
1.465	56.49	1.526	62.14	1.587	67.53	1.648	72.76	1.709	77.94	1.770	83.49
1.466	56.59	1.527	62.23	1.588	67.62	1.649	72.84	1.710	78.03	1.771	83.59
1.467	56.68	1.528	62.32	1.589	67.70	1.650	72.93	1.711	78.11	1.772	83.69
1.468	56.78	1.529	62.41	1.590	67.79	1.651	73.01	1.712	78.20	1.773	83.78
1.469	56.87	1.530	62.50	1.591	67.88	1.652	73.10	1.713	78.28	1.774	83.88
1.470	56.97	1.531	62.59	1.592	67.97	1.653	73.18	1.714	78.37	1.775	83.98
1.471	57.03	1.532	62.68	1.593	68.05	1.654	73.27	1.715	78.46	1.776	84.08
1.472	57.16	1.533	62.77	1.594	68.14	1.655	73.35	1.716	78.54	1.777	84.18
1.473	57.25	1.534	62.86	1.595	68.23	1.656	73.43	1.717	78.63	1.778	84.29
1.474	57.35	1.535	62.95	1.596	68.31	1.657	73.52	1.718	78.72	1.779	84.39
1.475	57.44	1.536	63.04	1.597	68.40	1.658	73.52	1.719	78.80	1.780	84.50
1.476	57.54	1.537	63.13	1.598	68.49	1.659	73.69	1.720	78.89	1.781	84.60
1.477	57.63	1.538	63.22	1.599	68.57	1.660	73.77	1.721	78.97	1.782	84.71
1.478	57.73	1.539	63.31	1.600	68.66	1.661	73.86	1.722	79.06	1.783	84.81
1.479	57.82	1.540	63.40	1.601	68.74	1.662	73.94	1.723	79.15	1.784	84.92
1.480	57.92	1.541	63.49	1.602	68.83	1.663	74.02	1.724	79.23	1.785	85.03
1.481	58.01	1.542	63.58	1.603	68.92	1.664	74.11	1.725	79.32	1.786	85.14
1.482	58.10	1.543	63.67	1.604	69.00	1.665	74.19	1.726	79.41	1.787	85.25
1.483	58.20	1.544	63.76	1.605	69.09	1.666	74.27	1.727	79.49	1.788	85.36
1.484	58.29	1.545	63.85	1.606	69.17	1.667	74.36	1.728	79.58	1.789	85.47
1.485	58.38	1.546	63.94	1.607	69.26	1.668	74.44	1.729	79.67	1.790	85.58
1.486	58.48	1.547	64.03	1.608	69.35	1.669	74.53	1.730	79.75	1.791	85.69
1.487	58.57	1.548	64.12	1.609	69.43	1.670	74.61	1.731	79.84	1.792	85.80
1.488	58.66	1.549	64.20	1.610	69.52	1.671	74.69	1.732	79.93	1.793	85.91
1.489	58.75	1.550	64.29	1.611	69.60	1.672	74.78	1.733	80.02	1.794	86.02
1.490	58.85	1.551	64.38	1.612	69.69	1.673	74.86	1.734	80.11	1.795	86.13
1.491	58.94	1.552	64.47	1.613	69.78	1.674	74.95	1.735	80.20	1.796	86.24
1.492	59.03	1.553	64.55	1.614	69.86	1.675	75.03	1.736	80.29	1.797	86.35
1.493	59.12	1.554	64.64	1.615	69.95	1.676	75.12	1.737	80.38	1.798	86.46
1.494	59.22	1.555	64.73	1.616	70.03	1.677	75.20	1.738	80.47	1.799	86.57
1.495	59.31	1.556	64.82	1.617	70.12	1.678	75.29	1.739	80.56	1.800	86.68
1.496	59.41	1.557	64.91	1.618	70.20	1.679	75.37	1.740	80.65	1.801	86.79
1.497	59.50	1.558	65.00	1.619	70.29	1.680	75.46	1.741	80.74	1.802	87.10
1.498	59.59	1.559	65.08	1.620	70.38	1.681	75.54	1.742	80.84	1.803	87.23
1.499	59.68	1.560	65.17	1.621	70.46	1.682	75.63	1.743	80.92	1.804	87.36
1.500	59.78	1.561	65.26	1.622	70.55	1.683	75.71	1.744	81.01	1.805	87.50
1.501	59.87	1.562	65.35	1.623	70.63	1.684	75.80	1.745	81.10	1.806	87.64
1.502	59.96	1.563	65.44	1.624	70.72	1.685	75.88	1.746	81.19	1.807	87.78
1.503	60.05	1.564	65.52	1.625	70.80	1.686	75.97	1.747	81.28	1.808	87.92
1.504	60.14	1.565	65.61	1.626	70.89	1.687	76.05	1.748	81.37	1.809	88.06
1.505	60.23	1.566	65.70	1.627	70.97	1.688	76.14	1.749	81.46	1.810	88.20
1.506	60.33	1.567	65.79	1.628	71.06	1.689	76.22	1.750	81.55	1.811	88.34
1.507	60.42	1.568	65.88	1.629	71.14	1.690	76.31	1.751	81.64	1.812	88.49
1.508	60.51	1.569	65.96	1.630	71.23	1.691	76.39	1.752	81.73	1.813	88.64
1.509	60.60	1.570	66.05	1.631	71.31	1.692	76.48	1.753	81.82	1.814	88.79
1.510	60.69	1.571	66.14	1.632	71.40	1.693	76.56	1.754	81.92	1.815	88.95

*Continued on page 917.*

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $t^\circ$ . Sp. gr. of  $\text{H}_2\text{O}$  at  $15^\circ = 1$ .

$\frac{\% \text{H}_2\text{SO}_4}{100}$	$0^\circ$	$10^\circ$	$15^\circ$	$20^\circ$	$25^\circ$	$30^\circ$	$40^\circ$	$50^\circ$	$60^\circ$
0	1.00074	1.00060	1.00000	0.99910	0.99794	0.99654	0.99311	0.98895	0.98418
1	1.90833	1.00773	1.00698	1.00594	1.00465	1.00312	0.99950	0.99522	0.99034
2	1.01563	1.01466	1.01381	1.01266	1.01126	1.00963	1.00585	1.00143	0.99644
3	1.02281	1.02153	1.02055	1.01928	1.01777	1.01607	1.01216	1.00761	1.00252
4	1.03001	1.02841	1.02728	1.02590	1.02428	1.02251	1.01848	1.01383	1.00865
5	1.03728	1.03533	1.03406	1.03258	1.03086	1.02902	1.02487	1.02013	1.01484
6	1.04461	1.04232	1.04092	1.03934	1.03756	1.03565	1.03138	1.02653	1.02114
7	1.05199	1.04939	1.04786	1.04618	1.04434	1.04235	1.03796	1.03302	1.02752
8	1.05942	1.05652	1.05486	1.05308	1.05116	1.04910	1.04458	1.03952	1.03393
9	1.06689	1.06370	1.06192	1.06002	1.05799	1.05585	1.05119	1.04605	1.04041
10	1.07439	1.07093	1.06903	1.06702	1.06490	1.06267	1.05787	1.05264	1.04696
11	1.08194	1.07821	1.07619	1.07408	1.07186	1.06955	1.06462	1.05930	1.05357
12	1.08954	1.08555	1.08342	1.08120	1.07890	1.07650	1.07145	1.06604	1.06027
13	1.09718	1.09294	1.09071	1.08839	1.08600	1.08352	1.07834	1.07284	1.06703
14	1.10488	1.10040	1.09805	1.09564	1.09316	1.09061	1.08530	1.07971	1.07385
15	1.11261	1.10790	1.10546	1.10295	1.10039	1.09776	1.09233	1.08666	1.08075
16	1.12040	1.11547	1.11292	1.11033	1.10768	1.10498	1.09944	1.09368	1.08772
17	1.12823	1.12309	1.12045	1.11777	1.11505	1.11228	1.10661	1.10077	1.09476
18	1.13610	1.13076	1.12803	1.12526	1.12246	1.11963	1.11385	1.10792	1.10186
19	1.14402	1.13848	1.13566	1.13282	1.12995	1.12704	1.12115	1.11514	1.10902
20	1.15199	1.14625	1.14335	1.14043	1.13748	1.13451	1.12851	1.12242	1.11625
21	1.15998	1.15407	1.15109	1.14809	1.14508	1.14205	1.13594	1.12977	1.12353
22	1.16803	1.16194	1.15888	1.15581	1.15273	1.14964	1.14343	1.13718	1.13089
23	1.17611	1.16986	1.16673	1.16359	1.16045	1.15731	1.15100	1.14467	1.13832
24	1.18424	1.17784	1.17464	1.17143	1.16823	1.16503	1.15862	1.15221	1.14579
25	1.19240	1.18586	1.18260	1.17933	1.17607	1.17282	1.16631	1.15982	1.15335
26	1.20061	1.19393	1.19060	1.18728	1.18396	1.18066	1.17406	1.16749	1.16096
27	1.20885	1.20204	1.19865	1.19527	1.19190	1.18854	1.18186	1.17522	1.16862
28	1.21710	1.21019	1.20675	1.20332	1.19990	1.19650	1.18973	1.18302	1.17635
29	1.22539	1.21838	1.21489	1.21142	1.20796	1.20452	1.19767	1.19087	1.18414
30	1.23370	1.22661	1.22308	1.21957	1.21607	1.21259	1.20566	1.19879	1.19198
31	1.24204	1.23487	1.23131	1.22776	1.22423	1.22071	1.21371	1.20677	1.19989
32	1.25038	1.24316	1.23957	1.23600	1.23244	1.22887	1.22179	1.21476	1.20779
33	1.25878	1.25151	1.24789	1.24429	1.24069	1.23712	1.22999	1.22292	1.21589
34	1.26723	1.25990	1.25626	1.25263	1.24901	1.24540	1.23822	1.23109	1.22400
35	1.27571	1.26834	1.26468	1.26102	1.25738	1.25375	1.24652	1.23933	1.23219
36	1.28424	1.27683	1.27314	1.26947	1.26580	1.26214	1.25487	1.24763	1.24045
37	1.29283	1.28538	1.28167	1.27797	1.27429	1.27061	1.26329	1.25601	1.24878
38	1.30149	1.29400	1.29027	1.28655	1.28284	1.27915	1.27179	1.26448	1.25721
39	1.31022	1.30268	1.29894	1.29520	1.29148	1.28776	1.28038	1.27304	1.26575
40	1.31901	1.31144	1.30767	1.30392	1.30018	1.29646	1.28905	1.28169	1.27440
41	1.32788	1.32027	1.31648	1.31271	1.30896	1.30522	1.29779	1.29042	1.28311
42	1.33683	1.32917	1.32537	1.32158	1.31782	1.31407	1.30662	1.29924	1.29193
43	1.34587	1.33817	1.33435	1.33054	1.32676	1.32300	1.31553	1.30813	1.30081
44	1.35501	1.34727	1.34342	1.33960	1.33580	1.33202	1.32452	1.31710	1.30976
45	1.36425	1.35647	1.35261	1.34877	1.34496	1.34116	1.33363	1.32618	1.31881
46	1.37361	1.36579	1.36191	1.35805	1.35422	1.35040	1.34284	1.33536	1.32797
47	1.38308	1.37522	1.37132	1.36744	1.36359	1.35975	1.35215	1.34464	1.33721
48	1.39267	1.38476	1.38084	1.37694	1.37306	1.36921	1.36157	1.35401	1.34655
49	1.40238	1.39441	1.39047	1.38654	1.38264	1.37877	1.37108	1.36349	1.35600
50	1.41219	1.40418	1.40021	1.39627	1.39235	1.38845	1.38073	1.37310	1.36566
51	1.42214	1.41407	1.41007	1.40610	1.40215	1.39823	1.39047	1.38280	1.37524
52	1.43220	1.42408	1.42005	1.41605	1.41208	1.40814	1.40033	1.39262	1.38502

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq. at } t^\circ$ . Sp. gr. of  $\text{H}_2\text{O at } 15^\circ = 1$  *Continued*

$\frac{\% \text{H}_2\text{SO}_4}{100}$	0°	10°	15°	20°	25°	30°	40°	50°	60°
53	1.44239	1.43420	1.43014	1.42611	1.42211	1.41814	1.41028	1.40254	1.39490
54	1.45269	1.44443	1.44034	1.43628	1.43225	1.42825	1.42034	1.41255	1.40488
55	1.46311	1.45477	1.45065	1.44656	1.44250	1.43847	1.43051	1.42268	1.41497
56	1.47364	1.46523	1.46107	1.45695	1.45285	1.44880	1.44078	1.43290	1.42515
57	1.48427	1.47578	1.47169	1.46743	1.46331	1.45922	1.45115	1.44322	1.43542
58	1.49499	1.48643	1.48221	1.47802	1.47387	1.46975	1.46162	1.45364	1.44579
59	1.50583	1.49719	1.49292	1.48870	1.48452	1.48037	1.47218	1.46415	1.45626
60	1.51676	1.50804	1.50374	1.49949	1.49527	1.49109	1.48285	1.47476	1.46683
61	1.52778	1.51899	1.51465	1.51036	1.50611	1.50190	1.49360	1.48546	1.47748
62	1.53889	1.53002	1.52564	1.52132	1.51703	1.51278	1.50442	1.49622	1.48819
63	1.55008	1.54113	1.53672	1.53236	1.52804	1.52376	1.51533	1.50708	1.49900
64	1.56135	1.55233	1.54788	1.54348	1.53913	1.53481	1.52632	1.51801	1.50988
65	1.57270	1.56360	1.55912	1.55469	1.55030	1.54595	1.53740	1.52903	1.52084
66	1.58414	1.57496	1.57044	1.56597	1.56154	1.55716	1.54854	1.54011	1.53187
67	1.59565	1.58640	1.58184	1.57733	1.57287	1.56846	1.55978	1.55128	1.54298
68	1.60724	1.59792	1.59332	1.58878	1.58427	1.57981	1.57104	1.56246	1.55408
69	1.61892	1.60961	1.60488	1.60030	1.59577	1.59129	1.58247	1.57384	1.56541
70	1.63068	1.62118	1.61651	1.61189	1.60732	1.60280	1.59391	1.58521	1.57672
71	1.64251	1.63293	1.62821	1.62355	1.61894	1.61437	1.60540	1.59663	1.58806
72	1.65439	1.64473	1.63997	1.63527	1.63062	1.62601	1.61696	1.60811	1.59937
73	1.66633	1.65658	1.65178	1.64704	1.64234	1.63769	1.62855	1.61961	1.61087
74	1.67831	1.66847	1.66362	1.65883	1.65408	1.64939	1.64015	1.63111	1.62227
75	1.69030	1.68037	1.67547	1.67063	1.66584	1.66109	1.65175	1.64280	1.63366
76	1.70228	1.69225	1.68731	1.68242	1.67757	1.67278	1.66332	1.65405	1.64498
77	1.71424	1.70411	1.69911	1.69416	1.68926	1.68439	1.67481	1.66540	1.65617
78	1.72615	1.71589	1.71083	1.70582	1.70085	1.69591	1.68616	1.67658	1.66717
79	1.73798	1.72758	1.72243	1.71735	1.71231	1.70731	1.69741	1.68767	1.67809
80	1.74970	1.73909	1.73386	1.72868	1.72356	1.71847	1.70842	1.69854	1.68881
81	1.76120	1.75038	1.74504	1.73979	1.73458	1.72942	1.71921	1.70916	1.69930
82	1.77244	1.76140	1.75595	1.75057	1.74524	1.73998	1.72962	1.71945	1.70950
83	1.78312	1.77193	1.76642	1.76097	1.75557	1.75022	1.73972	1.72943	1.71937
84	1.79316	1.78191	1.77636	1.77087	1.76543	1.76006	1.74943	1.73902	1.72883
85	1.80250	1.79123	1.78567	1.78016	1.77470	1.76929	1.75863	1.74816	1.73789
86	1.81108	1.79982	1.79428	1.78878	1.78331	1.77789	1.76721	1.75674	1.74642
87	1.81887	1.80767	1.80214	1.79666	1.79123	1.78584	1.77519	1.76473	1.75445
88	1.82589	1.81476	1.80926	1.80381	1.79839	1.79302	1.78242	1.77199	1.76176
89	1.83216	1.82111	1.81564	1.81022	1.80484	1.79950	1.78895	1.77856	1.76834
90	1.83771	1.82677	1.82135	1.81597	1.81063	1.80532	1.79483	1.78448	1.77429
91	1.84263	1.83179	1.82642	1.82109	1.81580	1.81054	1.80013	1.78985	1.77972
92	1.84691	1.83619	1.83088	1.82561	1.82037	1.81516	1.80487	1.79471	1.78470
93	1.85059	1.83997	1.83471	1.82950	1.82432	1.81918	1.80902	1.79900	1.78914
94	1.85363	1.84311	1.83790	1.83275	1.82763	1.82255	1.81253	1.80266	1.79296
95	1.85598	1.84555	1.84040	1.83526	1.83022	1.82520	1.81528	1.80553	1.79595
96	1.85765	1.84729	1.84217	1.83709	1.83207	1.82708	1.81724	1.80758	1.79809
97	1.85854	1.84816	1.84305	1.83798	1.83297	1.82800	1.81822	1.80863	1.79924
98	1.85836	1.84789	1.84275	1.83766	1.83264	1.82767	1.81792	1.80840	1.79912
99	1.85671	1.84612	1.84093	1.83581	1.83076	1.82578	1.81604	1.80658	1.79741
100	(1.85330)	(1.84255)	(1.83729)	(1.83213)	(1.82705)	(1.82205)	(1.81231)	(1.80288)	(1.79381)

Auszug aus Band 5 der wissenschaftlichen Abhandlungen der Normaleichungskommission  
 Berlin 1904, P. 257. Springer's publication.

(Domke, Z. anorg. 1905, 43. 176.)

Sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $15^\circ/15^\circ$  in air.—  
Continued from page 915.

Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$	Sp. gr.	% $\text{H}_2\text{SO}_4$
1.816	89.11	1.828	91.30	1.840	94.57
1.817	89.27	1.829	91.52	1.841	94.96
1.818	89.44	1.830	91.74	1.842	95.40
1.819	89.61	1.831	91.98	1.843	96.02
1.820	89.79	1.832	92.22	1.844	96.93
1.821	89.97	1.833	92.46	1.8442	97.50
1.822	90.15	1.834	92.71	1.844	99.08
1.823	90.33	1.835	92.98	1.843	99.84
1.824	90.51	1.836	93.26	1.842	99.29
1.825	90.70	1.837	93.56	1.841	98.61
1.826	90.90	1.838	93.87	1.840	98.88
1.827	91.10	1.839	94.20	1.8394	100.00

(Lunge, calculated by Marshall, J. Soc. Chem. Ind. 1902, 21. 1509.)

Sp. gr. at  $20^\circ$  of  $\text{H}_2\text{SO}_4 + \text{Aq}$  containing  
M g. mols.  $\text{H}_2\text{SO}_4$  per liter.

M.	0.01	0.025	0.05
Sp. gr.	1.000719	1.001907	1.003551
M.	0.075	0.10	0.25
Sp. gr.	1.005152	1.00677	1.01618
M.	0.50	0.75	1.0
Sp. gr.	1.03218	1.04760	1.06307
M.	1.5	2.0	
Sp. gr.	1.09345	1.12316	

(Jones and Pearce, Am. Ch. J. 1907, 38. 733.)

Boiling-point of  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

% $\text{H}_2\text{SO}_4$	B.-pt.	% $\text{H}_2\text{SO}_4$	B.-pt.
5	101.0°	70	170.0°
10	102.0	72	174.5
15	105.5	74	180.5
20	105.0	76	189.0
25	106.5	78	199.0
30	108.0	80	207.0
35	110.0	82	218.5
40	114.0	84	227.0
45	118.5	86	238.5
50	124.0	88	251.5
53	128.5	90	262.5
56	133.0	91	268.0
60	141.5	92	274.5
62.5	147.0	93	281.5
65	153.5	94	289.5
67.5	161.0	95	295.0

(Lunge, B. 11. 370.)

Freezing- and melting-points of  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Sp. gr. at $15^\circ$	F.-pt.	M.-pt.
1.671	liq. at $-20^\circ$	...
1.691	"	...
1.712	"	...
1.727	$-7.5$	$-7.5$
1.732	$-8.5$	$-8.5$
1.749	$-0.2$	$+4.5$
1.767	$+1.6$	$+6.5$
1.790	$+4.5$	$+8.0$
1.807	$-9.0$	$-6.0$
1.822	liq. at $-20^\circ$	...
1.842	"	...

(Lunge, B. 15. 2644.)

Effect of impurities on sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

The figures show the increase in sp. gr. of  $\text{H}_2\text{SO}_4 + \text{Aq}$  caused by adding 0.1% of an impurity to acid of different strengths.

Salt	100 %	98 %	94 %	80 %	70 %
$\text{Na}_2\text{SO}_4$	0.0011	0.0010	0.0007	0.0008	0.0007
$\text{CaSO}_4$	0.0012	0.0011	0.0009	0.0007	0.0006
$\text{Al}_2(\text{SO}_4)_3$	insol.	insol.	insol.	0.00127	0.0011
$\text{Fe}_2(\text{SO}_4)_3$	"	"	0.00067	0.0008	0.0007
$\text{PbSO}_4$	0.0017	0.0014	0.0015	insol.	insol.
$\text{MgSO}_4$	0.0011	0.0010	0.0012	0.0009	0.0009
$\text{As}_2\text{O}_3$	"	0.0013	"	0.0010	"
$\text{HSNO}_2$	0.00029	0.00027	"	0.00023	"

(Marshall, J. Soc. Chem. Ind. 1902, 21. 1508.)

Sp. gr. of mixtures of  $\text{H}_2\text{SO}_4$  (96.5%) and  
 $\text{HNO}_3$  (94%) at  $18^\circ/18^\circ$  in air.

% $\text{HNO}_3$ in mixture	Sp. gr.	% $\text{HNO}_3$ in mixture	Sp. gr.
0.00	1.8437	22.51	1.8215
0.57	1.8456	25.56	1.8112
1.05	1.8476	27.29	1.8053
4.67	1.8586	32.53	1.7863
7.17	1.8618	37.03	1.7700
7.37	1.8620	39.49	1.7601
7.75	1.8619	57.78	1.6879
9.10	1.8605	72.89	1.6227
11.33	1.8557	90.76	1.5408
12.71	1.8520	98.19	1.5080
16.52	1.8414	100.00	1.5009

(Marshall, J. Soc. Chem. Ind. 1902, 21. 1508.)

Miscible with alcohol, with evolution of heat and formation of ethylsulphuric acid.  
 $+\text{H}_2\text{O} = \text{H}_2\text{SO}_4$ , also called tetrahydroxyl sulphuric acid. (Marignac, A. ch. (3) 39. 184.)

Mpt.  $8.35^\circ$ . (Pickering.)

$+2\text{H}_2\text{O} = \text{H}_2\text{SO}_4$ , also called perhydroxyl sulphuric acid.

Mpt.  $-38.9^\circ$ . (Biron, J. Russ. Phys. Chem. Soc. 1899, 31. 517.)

$+3\text{H}_2\text{O}$ . (Pickering, Chem. Soc., 1890, 57. 331.)

+4H<sub>2</sub>O. Mpt. -75°. (Pickering, Chem. Soc. 1890, 57. 331.)

Sp. gr. and fr. pt. of hydrates of H<sub>2</sub>SO<sub>4</sub>.

Hydrate	% H <sub>2</sub> SO <sub>4</sub>	Sp. gr. of the liquid	Fr.-pt.
H <sub>2</sub> SO <sub>4</sub> (pure)	100	1.842	+10.5
H <sub>2</sub> SO <sub>4</sub> +H <sub>2</sub> O	84.48	1.777	+3.5
H <sub>2</sub> SO <sub>4</sub> +2H <sub>2</sub> O	73.08	1.650	-70.0
H <sub>2</sub> SO <sub>4</sub> +4H <sub>2</sub> O	57.65	1.476	-40.0
H <sub>2</sub> SO <sub>4</sub> +6H <sub>2</sub> O	47.57	1.376	-50.0
H <sub>2</sub> SO <sub>4</sub> +8H <sub>2</sub> O	40.50	1.311	-65.0
H <sub>2</sub> SO <sub>4</sub> +10H <sub>2</sub> O	35.25	1.268	-88.0
H <sub>2</sub> SO <sub>4</sub> +11H <sub>2</sub> O	33.11	1.249	-75.0
H <sub>2</sub> SO <sub>4</sub> +12H <sub>2</sub> O	31.21	1.233	-55.0
H <sub>2</sub> SO <sub>4</sub> +13H <sub>2</sub> O	29.52	1.219	-45.0
H <sub>2</sub> SO <sub>4</sub> +14H <sub>2</sub> O	28.00	1.207	-40.0
H <sub>2</sub> SO <sub>4</sub> +15H <sub>2</sub> O	26.63	1.196	-34.0
H <sub>2</sub> SO <sub>4</sub> +16H <sub>2</sub> O	25.39	1.187	-25.6
H <sub>2</sub> SO <sub>4</sub> +18H <sub>2</sub> O	23.22	1.170	-19.0
H <sub>2</sub> SO <sub>4</sub> +20H <sub>2</sub> O	21.40	1.157	-17.0
H <sub>2</sub> SO <sub>4</sub> +25H <sub>2</sub> O	17.88	1.129	-8.5
H <sub>2</sub> SO <sub>4</sub> +50H <sub>2</sub> O	9.82	1.067	-3.5
H <sub>2</sub> SO <sub>4</sub> +75H <sub>2</sub> O	6.77	1.045	0.0
H <sub>2</sub> SO <sub>4</sub> +100H <sub>2</sub> O	5.16	1.032	+2.5
H <sub>2</sub> SO <sub>4</sub> +300H <sub>2</sub> O	1.78	1.007	+4.5
H <sub>2</sub> SO <sub>4</sub> +1000H <sub>2</sub> O	0.54	1.001	+0.5

(Pictet, C. R. 1894, 119. 645.)

### Sulphuric acid, anhydrous, SO<sub>3</sub>.

See Sulphur trioxide.

### Disulphuric (Pyrosulphuric) acid, H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.

Very deliquescent. Miscible with H<sub>2</sub>O. Sol. in fuming H<sub>2</sub>SO<sub>4</sub>. Miscible in liquid SO<sub>2</sub>. (Schultz-Sellack.)

H<sub>2</sub>S<sub>2</sub>O<sub>7</sub>, 2H<sub>2</sub>SO<sub>4</sub>. Fumes on air. (Jacquelin, A. ch. (3) 30. 343.)

### Tetrasulphuric acid, H<sub>2</sub>S<sub>4</sub>O<sub>11</sub>.

Fumes on air. (Weber, Pogg. 159. 313.)

### Sulphates.

Most sulphates are easily sol. in H<sub>2</sub>O; but Ag<sub>2</sub>SO<sub>4</sub>, Hg<sub>2</sub>SO<sub>4</sub>, and CaSO<sub>4</sub> are only sl. sol., while BaSO<sub>4</sub>, SrSO<sub>4</sub>, and PbSO<sub>4</sub> are nearly insol. therein. All sulphates are sol. in conc. H<sub>2</sub>SO<sub>4</sub>. Basic sulphates are insol. in H<sub>2</sub>O. Most sulphates are insol. in alcohol.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 823.)

### Aluminum sulphate, basic, 2Al<sub>2</sub>O<sub>3</sub>.SO<sub>3</sub>+5H<sub>2</sub>O.

Slowly sol. in 10 mols. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Schlumberger, Bull. Soc. 1895, (3) 13. 41.)

+7H<sub>2</sub>O. Easily sol. in 8 mols. dil. HCl + Aq. or in 10 mols. 10% acetic acid in 24 hours. (Schlumberger.)

+10H<sub>2</sub>O. Insol. in H<sub>2</sub>O; easily sol. in cold dil. mineral acids, and HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Crum, A. 89. 174.)

### Min. Felsöbanyite.

+15H<sub>2</sub>O. Min. Paraluminite.

8Al<sub>2</sub>O<sub>3</sub>, 5SO<sub>3</sub>+25H<sub>2</sub>O. Insol. in H<sub>2</sub>O; sol. in dil. acids. (Löwe, J. pr. 79. 428.)

5Al<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+20H<sub>2</sub>O. Easily sol. in acids. (Debray, Bull. Soc. (2) 7. 9.)

3Al<sub>2</sub>O<sub>3</sub>, 2SO<sub>3</sub>+9H<sub>2</sub>O. Nearly insol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Bayer, Dingl. 263. 211.)

+20H<sub>2</sub>O. Ppt.

4Al<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+36H<sub>2</sub>O. Insol. in H<sub>2</sub>O. Easily sol. in dil. mineral acids, and hot HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. (Debray, Bull. Soc. (2) 7. 1.)

Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>+6H<sub>2</sub>O = (AlO)<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O. Insol. in H<sub>2</sub>O or HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> + Aq. Sl. sol. in hot HCl, easily sol. in warm KOH + Aq. (Böttger, A. 244. 225.)

+9H<sub>2</sub>O. (Athanasesco, C. R. 103. 27.)

### Min. Aluminite.

[Al<sub>2</sub>(OH)<sub>5</sub>SO<sub>4</sub>+2H<sub>2</sub>O.

Sol. in HCl + Aq. in the cold with decomp. Very unstable. (Schlumberger, Bull. Soc. 1895, (3) 13. 60.)

3Al<sub>2</sub>O<sub>3</sub>, 4SO<sub>3</sub>+9H<sub>2</sub>O. (Athanasesco, C. R. 103. 271.)

+30H<sub>2</sub>O. Sol. in 144 pts. cold, and 30.8 pts. boiling H<sub>2</sub>O. Easily sol. in HCl, and HNO<sub>3</sub> + Aq. (Rammelsberg, Pogg. 43. 583.)

2Al<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>. Decomp. by H<sub>2</sub>O into 3Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Maus.)

Al<sub>2</sub>O<sub>3</sub>, 2SO<sub>3</sub>=Al<sub>2</sub>O(SO<sub>4</sub>)<sub>2</sub>.

### Min. Alumaine.

+H<sub>2</sub>O. Sol. in small quantity of H<sub>2</sub>O, but decomp. by a large quantity into (AlO)<sub>2</sub>SO<sub>4</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Maus, Pogg. 11. 80.)

+12H<sub>2</sub>O. Easily sol. in hot or cold H<sub>2</sub>O. Sat. solution contains 45% salt at 15°, which crystallises unchanged on evaporating. (Marguerite, C. R. 90. 354.)

Above basic compounds are mixtures. (Pickering, C. N. 45. 121, 133, 146.)

### Aluminum sulphate, Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

100 pts. H<sub>2</sub>O dissolve (a) pts. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, and (b) pts. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+18H<sub>2</sub>O at:

	0°	10°	20°	30°	40°	50°
a	31.3	33.5	36.15	40.36	45.73	52.13
b	86.85	95.8	107.35	127.6	167.6	201.4

	60°	70°	80°	90°	100°
a	59.09	66.23	73.14	80.83	96.11
b	262.6	348.2	467.3	678.8	1132.

(Poggiale, A. ch. (3) 8. 467.)

See also +18H<sub>2</sub>O.

Sp. gr. of Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + Aq.

%	Sp. gr. at			
	15°	25°	35°	45°
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>				
5	1.0569	1.0503	1.045	1.0356
10	1.1071	1.1022	1.096	1.085
15	1.1574	1.1522	1.146	1.1346
20	1.2074	1.2004	1.192	1.1801
25	1.2572	1.2487	1.2407	1.2295

(Reuss, B. 17. 2888.)

Sp. gr. of  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at  $15^\circ$  containing:  
 10 20 30%  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ ,  
 1.0635 1.1105 1.1710  
 40 50%  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ .  
 1.2355 1.3050

Sp. gr. of sat. solution = 1.34.  
 (Gerlach, Z. anal. 28. 493.)

Sp. gr. of  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$ .

Strength of $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$	Sp. gr.
1 normal	1.0550
$\frac{1}{2}$ "	1.0278
$\frac{1}{4}$ "	1.0138
$\frac{1}{8}$ "	1.0068

(Wagner, Z. phys. Ch. 1890, 5. 35.)

100 pts. of a mixture of 1 vol.  $\text{H}_2\text{SO}_4 + 2$  vols.  $\text{H}_2\text{O}$  dissolve only 6.45 pts.  $\text{Al}_2(\text{SO}_4)_3$ . (Baud, C. R. 1903, 137. 494.)

$\text{Al}_2(\text{SO}_4)_3$  is completely pptd. from  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  by an excess of glacial  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persson, A. ch. (2) 63. 444.)

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + (\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ .  
 See under  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4$ .

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + \text{K}_2\text{Al}_2(\text{SO}_4)_4$ . See under  $\text{K}_2\text{Al}_2(\text{SO}_4)_4$ .

Solubility in  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  at  $25^\circ$ .

100 g. of the solution contain

g. $\text{Al}_2(\text{SO}_4)_3$	g. $\text{Fe}_2(\text{SO}_4)_3$
27.82	0
26.01	6.064
24.21	9.819
21.64	13.02
15.22	23.28
*10.70	31.91
10.23	31.90

\*Solution sat. with respect to both salts.  
 (Wirth and Bakke, Z. anorg. 1914, 87. 48.)  
 See also under  $\text{Fe}_2(\text{SO}_4)_3$ .

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + \text{Li}_2\text{SO}_4$  at  $30^\circ$ .

Composition of				Solid phase
Solution		Residue		
% Li <sub>2</sub> SO <sub>4</sub>	% Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	% Li <sub>2</sub> SO <sub>4</sub>	% Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	
25.1	0	...	...	Li <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O
21.93	5.34	...	...	"
16.10	14.89	63.70	4.02	"
13.63	20.76	14.72	31.17	Li <sub>2</sub> SO <sub>4</sub> , H <sub>2</sub> O + Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , 18H <sub>2</sub> O
13.24	21.71	61.24	7.22	Li <sub>2</sub> SO <sub>4</sub> , 4H <sub>2</sub> O
11.73	22.08	6.92	33.54	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> , 18H <sub>2</sub> O
6.75	24.34	3.77	37.06	"
3.44	26.12	...	...	"
0.00	28.0	...	...	"

(Schreinemakers and de Waal, Ch. Weekbl. 1906, 3. 539.)

100 g. of sat. solution of  $\text{Al}_2(\text{SO}_4)_3$  in glycol contain 14.4 g.  $\text{Al}_2(\text{SO}_4)_3$ . (de Coninck, Bull. Ac. Roy. Belg. 1906. 359.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone. (Naumann, B. 1904, 37. 4328.)

+  $6\text{H}_2\text{O}$ . Very slowly sol. in cold, completely sol. in hot  $\text{H}_2\text{O}$ .

+  $8\text{H}_2\text{O}$ . (Margueritte-Delarcharabonny, C. R. 112. 229.)

+  $10\text{H}_2\text{O}$ . Deliquescent. (v. Hauer, W. A. B. 13. 449.)

+  $16\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Baud, C. R. 1903, 137. 494.)

+  $17\text{H}_2\text{O}$ . (Gawalowaki, C. C. 1885. 721.)

+  $18\text{H}_2\text{O}$ . Permanent. (Berselius.)

100 g. of the aqueous solution contain 27.82 g.  $\text{Al}_2(\text{SO}_4)_3$  at  $25^\circ$ . (Wirth, Z. anorg. 1913, 79. 361.)

Solubility of  $\text{Al}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4 + \text{Aq}$ % $\text{H}_2\text{SO}_4$	100 g. of the solution contain g. $\text{Al}_2(\text{SO}_4)_3$
0	27.82
5.23	29.21
9.90	26.21
18.70	20.44
25.50	15.40
40.70	5.07
52.25	1.216
63.70	1.243
73.64	2.915

(Wirth, Z. anorg. 1913, 79. 361.)

Hydrous salt is scarcely sol. in alcohol. (Berselius.)

Min. *Alumogen*.

+  $27\text{H}_2\text{O}$ . Efflorescent. (Margueritte-Delarcharabonny, C. R. 99. 800.)

Aluminum sulphate, acid,  $\text{Al}_2\text{O}_3, 4\text{SO}_3 + 4\text{H}_2\text{O}$ .

Extremely slowly sol. in cold, more rapidly in hot  $\text{H}_2\text{O}$ . (Baud, C. R. 1903, 137. 493.)

$\text{Al}_2\text{O}_3, 6\text{SO}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; solution soon decomp. into  $\text{Al}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4$ . (Silberberger, M. 1904, 25. 221.)

Aluminum ammonium sulphate (Ammonia alum),  $(\text{NH}_4)_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 2.9 pts. anhydrous salt at  $0^\circ$ ; 207.7 pts. anhydrous salt at  $110.6^\circ$ . (Mulder.)

100 pts.  $\text{H}_2\text{O}$  dissolve 8.74 pts. anhydrous salt at  $17.5^\circ$ . (Pohl, W. A. B. 6. 597.)

100 pts. H<sub>2</sub>O at t° dissolve pts.  
(NH<sub>4</sub>)<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.

t°	Pts. (NH <sub>4</sub> ) <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub>	Pts. (NH <sub>4</sub> ) <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> + 24H <sub>2</sub> O
0	2.10	3.90
10	4.99	9.52
20	7.74	15.13
30	10.94	22.01
40	14.88	30.92
50	20.09	44.11
60	26.70	66.65
70	35.11	90.67
80	45.66	134.47
90	58.68	209.31
100	74.53	357.48

(Poggiale, A. ch. (3) 8. 467.)

According to Locke (Am. Ch. J. 1901, 26. 174), Poggiale's tables for NH<sub>4</sub> and K alums are evidently transposed, and the above data are applied by Poggiale to K alum.

1 l. H<sub>2</sub>O dissolves 91.9 g. anhydrous, or 191.9 g. hydrated salt, or 0.387 mols. anhydrous salt at 25°. (Locke, Am. Ch. J. 1901, 26. 175.)

Solubility in H<sub>2</sub>O at t°.

t°	G. (NH <sub>4</sub> ) <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per 100 g. H <sub>2</sub> O	G. (NH <sub>4</sub> ) <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> + 24H <sub>2</sub> O per 100 g. H <sub>2</sub> O	G. mol. (NH <sub>4</sub> ) <sub>2</sub> Al <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> per 100 g. H <sub>2</sub> O
0	2.10	3.90	0.0044
5	3.50	6.91	0.0074
10	4.99	9.52	0.0105
15	6.25	12.66	0.0132
20	7.74	15.13	0.0163
25	9.19	19.19	0.0194
30	10.94	22.01	0.0231
40	14.88	30.92	0.0314
50	20.10	44.10	0.0424
60	26.70	66.65	0.0569
95	109.7	00	0.2312

(Mulder, Poggiale, Locke; Marino, Gazz. ch. it. 1905, 35. II, 351; Berkeley, Trans. Roy. Soc. 1904, 203. A, 214, calc. by Seidell, Solubilities.)

B.-pt. of sat. solution is 110.6°.

M.-pt. of (NH<sub>4</sub>)<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> + 24H<sub>2</sub>O = 92°. (Tilden, Chem. Soc. 45. 409.); = 95°. (Locke, l. c.)

Sp. gr. of aqueous solution at 15° containing:

3%      6%      9%  
1.0423   1.0141   1.0282 hydrous salt.

(Gerlach, Z. anal. 23. 495.)

Solubility of NH<sub>4</sub> alum in presence of  
(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Mixture used	100 g. sat. solution contains	
	g. (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	g. Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
Sat. NH <sub>4</sub> alum at 18.5°	1.42	3.69
20 cc. above sol- ution + 6 g. cryst. Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	0.45	16.09
20 cc. above sol- ution + 4g. (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	20.81	0.29

(Rüdorff, 1885, B. 18. 1160.)

Insol. in alcohol. (Mulder.)

Solubility of Al(NH<sub>4</sub>)(SO<sub>4</sub>)<sub>2</sub> + 12H<sub>2</sub>O in a mixture of 93.3 g. H<sub>2</sub>O and 23.33 g. glycerine = 6.15 g. (Dunlop, Pharm. J. 1910, 88. 6.)

Solubility in 93.3 g. H<sub>2</sub>O + 23.3 g. glycerine + 3.9 g. phenol = 5.59 g. Al(NH<sub>4</sub>)(SO<sub>4</sub>)<sub>2</sub> + 12H<sub>2</sub>O. (Dunlop.)

Min. *Tschermigite*.

Aluminum ammonium chromium sulphate,  
Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> +  
48H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; decomp. by boiling. (Vohl, A. 94. 71.)

Aluminum caesium sulphate, Al<sub>2</sub>Cs<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> +  
24H<sub>2</sub>O.

100 pts. H<sub>2</sub>O at 17° dissolve 0.619 pt. caesium alum. (Redtenbacher, J. pr. 94. 442.)

Solubility in 100 pts. H<sub>2</sub>O at t° (calculated for salt dried at 130°).

t°	Pts. alum	t°	Pts. alum	t°	Pts. alum
0	0.19	25	0.49	65	2.38
10	0.29	35	0.69	80	5.29
17	0.38	50	1.235	..	...

(Setterberg, A. 211. 104.)

Solubility in H<sub>2</sub>O.

t°	Pts. anhydrous salt per litre	G. mols. anhydrous salt per litre
25	4.7	0.013
30	5.89	0.0167
35	7.29	0.0207
40	9.00	0.0256

(Locke, Am. Ch. J. 1901, 26. 180.)

Solubility of  $\text{Al}_2\text{C}_2(\text{SO}_4)_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
(G.  $\text{Al}_2\text{C}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$  in 100 g. solution.)

$t^\circ$	% salt	$t^\circ$	% salt
0	0.21	75	4.12
15	0.35	80	5.21
30	0.60	90	9.50
45	1.04	100.4	18.60
60	1.96		

(Berkeley, Trans. Roy. Soc. 1904, 203. A, 214.)

Solubility in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	$\text{G. AlC}_2(\text{SO}_4)_4$	$t^\circ$	$\text{G. AlC}_2(\text{SO}_4)_4$	$t^\circ$	$\text{G. AlC}_2(\text{SO}_4)_4$	$t^\circ$	$\text{G. AlC}_2(\text{SO}_4)_4$
0	0.19	26	0.50	52	1.45	78	5.15
1	0.20	27	0.51	53	1.51	79	5.40
2	0.21	28	0.52	54	1.58	80	5.78
3	0.22	29	0.55	55	1.65	81	6.05
4	0.23	30	0.57	56	1.71	82	6.4
5	0.24	31	0.59	57	1.77	83	6.7
6	0.25	32	0.60	58	1.86	84	7.0
7	0.26	33	0.62	59	1.92	85	7.4
8	0.27	34	0.65	60	2.06	86	7.7
9	0.28	35	0.69	61	2.14	87	8.0
10	0.29	36	0.72	62	2.25	88	8.3
11	0.30	37	0.75	63	2.37	89	8.6
12	0.31	38	0.77	64	2.50	90	8.8
13	0.32	39	0.80	65	2.65	91	9.0
14	0.34	40	0.85	66	2.78	92	9.2
15	0.35	41	0.87	67	2.96	93	9.5
16	0.36	42	0.91	68	3.13	94	9.9
17	0.38	43	0.96	69	3.34	95	10.1
18	0.39	44	1.01	70	3.50	96	10.4
19	0.40	45	1.06	71	3.67	97	10.8
20	0.41	46	1.10	72	3.85	98	11.1
21	0.42	47	1.17	73	4.07	99	11.5
22	0.43	48	1.21	74	4.30	100	12.0
23	0.45	49	1.27	75	4.50	...	...
24	0.47	50	1.30	76	4.72	...	...
25	0.49	51	1.39	77	4.95	...	...

Values from 0-7° obtained by interpolation using Setterberg's values for 0° (A. 1882, 211. 100).

From 80-100° they were calculated by extrapolation.

(Hart and Huselton, J. Am. Chem. Soc. 1914, 36. 2084.)

Melts in crystal  $\text{H}_2\text{O}$  at 106° (Tilden, Chem. Soc. 45. 409); at 120.5° (Erdmann); at 122° (Locke.)

**Aluminum calcium sulphate, basic,  $\text{Al}_2\text{O}_3$ ,  $6\text{CaO}$ ,  $3\text{SO}_3 + 32\text{H}_2\text{O}$ .**

Min. *Ettringite*. Mostly sol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl} + \text{Aq}$ .

**Aluminum chromium sulphate,  $\text{Al}_2\text{Cr}_2(\text{SO}_4)_4$ .**

Insol. in  $\text{H}_2\text{O}$ .

$\text{Al}_2\text{Cr}_2(\text{SO}_4)_4 \cdot \text{H}_2\text{SO}_4$ . Insol. in  $\text{H}_2\text{O}$ . (Étard C. R. 86. 1400.)

**Aluminum chromium potassium sulphate,**

$\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Cr}_2(\text{SO}_4)_3$ ,  $2\text{K}_2\text{SO}_4 + 48\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. on boiling. (Vohl.)

**Aluminum copper sulphate,  $2\text{Al}_2\text{O}_3$ ,  $9\text{CuO}$ ,  $3\text{SO}_3 + 21\text{H}_2\text{O}$ .**

Min. *Cyanotrichite*. (Percy, Phil. Mag. (3) 36. 103.)

**Aluminum hydroxylamine sulphate,**

$\text{Al}_2(\text{SO}_4)_3$ ,  $(\text{NH}_2\text{OH})_2\text{SO}_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Meyerinh, B. 10. 1946.)

**Aluminum iron (ferrous) sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{FeSO}_4 + 24\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Klawer, A. 14. 261.)

Min. *Halotrichite*.

$\text{Al}_2(\text{SO}_4)_3$ ,  $2\text{FeSO}_4 + 27\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Berthier.)

$\text{Al}_2\text{O}_3$ ,  $2\text{SO}_3$ ,  $6\text{FeSO}_4$ . Easily sol. in  $\text{H}_2\text{O}$ . (Phillips.)

$\text{Al}_2(\text{SO}_4)_3$ ,  $2\text{FeSO}_4$ ,  $\text{H}_2\text{SO}_4$ . Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

**Aluminum iron (ferric) sulphate,  $\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Fe}_2(\text{SO}_4)_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 86. 1399.)

$\text{Al}_2(\text{SO}_4)_3$ ,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4$ . As above (Étard.)

See  $\text{Al}_2(\text{SO}_4)_3 + \text{Fe}_2(\text{SO}_4)_3$ , under  $\text{Al}_2(\text{SO}_4)_3$  and  $\text{Fe}_2(\text{SO}_4)_3$ .

**Aluminum ferrous potassium sulphate,**

$\text{Al}_2(\text{SO}_4)_3$ ,  $12\text{FeSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 24\text{H}_2\text{O}$ .

Permanent. Sl. sol. in  $\text{H}_2\text{O}$ . (Dufrenoy.)

**Aluminum lead sulphate,  $\text{Al}_2\text{Pb}_2(\text{SO}_4)_4 + 20\text{H}_2\text{O}$ .**

Permanent; insol. in  $\text{H}_2\text{O}$ . (G. H. Bailey J. Chem. Soc. Ind. 6. 415.)

**Aluminum lithium sulphate,  $\text{Li}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

Sol. in 24 pts. cold, and 0.87 pt. hot  $\text{H}_2\text{O}$ .

(Kralovansky, Schw. J. 54. 349.)

Does not exist. (Rammelsberg, J. B. 1847-48. 394; Arfvedson; Gmelin.)

**Aluminum lithium potassium sulphate (?).**

Sol. in  $\text{H}_2\text{O}$ , from which it crystallises on cooling. (Joas, J. pr. 1. 142.)

**Aluminum magnesium sulphate,  $\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$ .**

Min. *Pickeringite*.

$2\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 22\text{H}_2\text{O}$ . Min. *Picraluminite*.

$3\text{MgSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3 + 36\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Klawer, A. 14. 264.)



**Aluminum magnesium manganous sulphate,**  $\text{Al}_2(\text{SO}_4)_3, \text{MgSO}_4, \text{MnSO}_4 + 25\text{H}_2\text{O}$ .

As sol. in  $\text{H}_2\text{O}$  as K alum. (Kane.) Very sol. in  $\text{H}_2\text{O}$ . (Smith, Sill. Am. J. (2) 18. 379.) Min. *Bojemanite*.

**Aluminum manganous sulphate,**  $\text{Al}_2(\text{SO}_4)_3, \text{MnSO}_4 + 25\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Berselius.) +  $24\text{H}_2\text{O}$ . Min. *Apjohnite*.

**Aluminum manganic sulphate,**  $2\text{Al}_2(\text{SO}_4)_3, \text{Mn}_2(\text{SO}_4)_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 86. 1399.)

**Aluminum nickel sulphate,**  $\text{Al}_2(\text{SO}_4)_3, 2\text{NiSO}_4, \text{H}_2\text{SO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. (Étard, C. R. 87. 602.)

**Aluminum potassium sulphate, basic,**  $3(\text{Al}_2\text{O}_3, \text{SO}_3), \text{K}_2\text{SO}_4 + 6\text{H}_2\text{O} = \text{K}_2\text{SO}_4, 3\text{Al}_2(\text{SO}_4)_3(\text{OH})_4$ .

Min. *Alumite*. Insol. in  $\text{H}_2\text{O}$ . Insol. in conc.  $\text{HCl} + \text{Aq}$ .

Sol. in boiling  $\text{H}_2\text{SO}_4$  of 1.845 sp. gr., but more easily in a mixture of 12 g.  $\text{H}_2\text{SO}_4$  and 1.5 g.  $\text{H}_2\text{O}$ , and also in weaker acids, if heated to  $210^\circ$ . (Mitscherlich, J. pr. 81. 108.)

+  $9\text{H}_2\text{O}$ . Min. *Lévigite*. Sl. sol. in boiling  $\text{HCl} + \text{Aq}$ . (Mitscherlich, J. pr. 83. 455.)

Nearly insol. in  $\text{HCl}$  or conc.  $\text{HNO}_3 + \text{Aq}$ , but sol. in a mixture of 1 pt.  $\text{H}_2\text{SO}_4$  and 1 pt.  $\text{H}_2\text{O}$ . (Debray, Bull. Soc. (2) 7. 9.)

$\text{Al}_2\text{O}_3(\text{SO}_4)_3, \text{K}_2\text{SO}_4$ . Sol. in  $\text{H}_2\text{O}$ , but decomp. by heating.

*With varying composition.* Precipitates. Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in cold, gradually in hot acids. (Bley, J. pr. 39. 17.) Very difficultly sol. in warm conc.  $\text{HCl} + \text{Aq}$ , but easily sol. in  $\text{KOH} + \text{Aq}$ . (Naumann, B. 8. 1630.)

**Aluminum potassium sulphate (Potash alum),**  $\text{KAl}(\text{SO}_4)_2 + 12\text{H}_2\text{O}$  or  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 = \text{K}_2\text{SO}_4, \text{Al}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with absorption of heat.

When 100 pts.  $\text{H}_2\text{O}$  at  $10.8^\circ$  are mixed with 14 pts. alum, the temp. is lowered  $1.4^\circ$ . (Rüddorf, B. 2. 68.)

Burnt alum is very slowly sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve P pts.  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

$t^\circ$	P	$t^\circ$	P
12.5	7.6	50.0	46.7
21.25	10.4	62.5	230.0
25.0	22.0	75.0	920.0
37.5	44.1	87.5	1566.6

(Brandes, 1832.)

Sol. in 18 pts. cold, and 1.6 pts. boiling  $\text{H}_2\text{O}$  (Fourcroy); in 14.12 pts. cold, and 0.75 pt. boiling  $\text{H}_2\text{O}$  (Bergmann); in 15 pts. cold, and 0.75 pt. boiling  $\text{H}_2\text{O}$  (Dumas); in 11.7 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abt).

100 pts.  $\text{H}_2\text{O}$  dissolve 14.79 pts. alum at  $15.56^\circ$ , and 133.33 pts. at  $100^\circ$ . (Ure's Dict.)

$\text{K}_2\text{Al}_2(\text{SO}_4)_4 + \text{Aq}$  sat. at  $15^\circ$  contains 10.939 pts. alum in every 100 pts.  $\text{H}_2\text{O}$ . (Michel and Krafft.)

$\text{K}_2\text{Al}_2(\text{SO}_4)_4 + \text{Aq}$  sat. in cold contains 5.2% alum (Fourcroy), 6.7% (Boerhave).

100 pts.  $\text{H}_2\text{O}$  dissolve (a) pts. anhydrous alum, and (b) pts. crystallised at  $t^\circ$ .

	0°	10°	20°	30°	40°	50°
a	2.62	4.50	6.57	9.05	12.35	15.9
b	5.22	9.16	13.66	19.29	27.3	36.5

	60°	70°	80°	90°	100°
a	21.1	26.95	35.2	50.3	70.83
b	51.3	71.97	103.1	187.8	421.9

(Poggiale, A. ch. (3) 8. 467.)

According to Locke (Am. Ch. J. 1901, 28. 174), Poggiale's tables for  $\text{NH}_4$  and K alums are evidently transposed, and the above date are applied by Poggiale to  $\text{NH}_4$  alum.

100 pts.  $\text{H}_2\text{O}$  dissolve  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$  corresponding to pts. anhydrous  $\text{K}_2\text{Al}_2(\text{SO}_4)_4$ .

Temp.	Pts. $\text{K}_2\text{Al}_2(\text{SO}_4)_4$	Temp.	Pts. $\text{K}_2\text{Al}_2(\text{SO}_4)_4$
0	3.0	60	25
5	3.5	70	40
10	4.0	80	71
15	5.0	90	109
20	5.9	92.5	119.5
30	7.9	100	154
40	11.7	110	200
50	17.0	111.9	210.6

(Mulder, Scheik. Verhandel. 1864. 90.)

100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$  dissolve 13.5 pts.  $\text{K}_2\text{Al}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ , or 7.36 pts.  $\text{K}_2\text{Al}_2(\text{SO}_4)_4$ . (Redtenbacher, J. pr. 94. 442.)

Forms supersaturated solutions very easily. Supersat. solutions are brought to crystallisation by addition of a crystal of alum or an isomorphous substance, as chrome or iron alum. Other substances as  $\text{NaCl}$ , etc. have no action. (Thomson, Chem. Soc. 35. 199.)

1 l.  $\text{H}_2\text{O}$  dissolves 72.3 g. anhydrous, or 138.4 g. hydrated salt, or 0.28 g. mol. of anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 28. 175.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
(g. alum in 1000 g.  $\text{H}_2\text{O}$ .)

$t^\circ$	g. alum	$t^\circ$	g. alum
0	57.0	75	1280.9
5	76.3	76	1412.1
10	84.9	77	1517.9
15	103.6	78	1680.1
20	120.3	79	1775.2
25	131.3	80	1950.0
30	184.9	82	2273.5
36	204.3	84	2661.5
40	250.0	84.6	2816.0
45	290.2	85.1	3166.6
50	367.8	85.3	3337.2
55	457.7	85.6	3372.2
60	585.4	86	3997.8
65	708.4	87	4825.4
70	943.8	88	6639.6

(Marino, Gazz. ch. it. 1905, 35. (2) 351.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g. $K_2Al_2(SO_4)_4$ per 100 g. $H_2O$	g. $K_2Al_2(SO_4)_4 + 24H_2O$ per 100 g. $H_2O$	g. mol. $K_2Al_2(SO_4)_4$ per 100 g. $H_2O$
0	3.0	5.65	0.0058
5	3.5	6.62	0.0068
10	4.0	7.60	0.0077
15	5.0	9.59	0.0097
20	5.9	11.40	0.0114
25	7.23	14.14	0.0140
30	8.39	16.58	0.0162
40	11.70	23.83	0.0227
50	17.00	36.40	0.0329
60	24.75	57.35	0.0479
70	40.00	110.5	0.0774
80	71.0	321.3	0.01374
90	109.0	2,275.0	0.2110
92.5	119.0	$\infty$	0.2318

(Mulder, Poggiale, Locke; Marino, Gazz. ch. it. 1905, **35**, (2) 351; and Berkeley, Proc. Roy. Soc. 1904, **203**, A, 214, calc. by Seidell, Solubilities, 1st Ed.)

M.-pt. of  $K_2Al_2(SO_4)_4 + 24H_2O = 84.5^\circ$  (Tilden, Chem. Soc. **45**, 409.);  $= 92.5^\circ$  (Erdmann);  $= 91^\circ$  (Locke).

Sp. gr. of sat.  $K_2Al_2(SO_4)_4 + Aq$  at  $8^\circ = 1.045$  (Anthon); at  $15^\circ = 1.0488$  (Michel and Krafft); at  $15^\circ = 1.0456$  (Stolba).

Sp. gr. of  $K_2Al_2(SO_4)_4 + Aq$  at  $15^\circ$  containing 5%  $K_2Al_2(SO_4)_4 = 1.0477$ . (Kohlrausch, W. Ann. **1879**, 1.)

Sp. gr. of  $K_2Al_2(SO_4)_4 + Aq$  at  $15^\circ$ . a = pts.  $K_2Al_2(SO_4)_4 + 24H_2O$  in 100 pts. solution; b = pts.  $K_2Al_2(SO_4)_4$  in 100 pts. solution; c = pts.  $K_2Al_2(SO_4)_4$  for 100 pts.  $H_2O$ .

a	b	c	Sp. gr.
4	2.1792	2.2277	1.0210
8	4.3584	4.5570	1.0420
12	6.5376	6.9950	1.0641
13	7.083	7.622	1.0690

(Gerlach, Z. anal. **27**, 280.)

Saturated solution boils at  $111.9^\circ$ , and contains 210.6 pts.  $K_2Al_2(SO_4)_4 + 24H_2O$  to 100 pts.  $H_2O$ . (Mulder.)

100 pts.  $H_2O$  contain 52 pts.  $K_2Al_2(SO_4)_4$ , and boils at  $104.5^\circ$ . (Griffiths.) Crust forms at  $108.3^\circ$ , when the solution contains 114.2 pts.  $K_2Al_2(SO_4)_4$  to 100 pts.  $H_2O$ . (Gerlach, Z. anal. **28**, 426.)

B.-pt. of  $K_2Al_2(SO_4)_4 + Aq$  containing pts.  $K_2Al_2(SO_4)_4$  to 100 pts.  $H_2O$ .

B.-pt.	Pts. $K_2Al_2(SO_4)_4$	B.-pt.	Pts. $K_2Al_2(SO_4)_4$
100.5°	17.0	104.0°	83.9
101.0	30.2	104.5	90.7
101.5	41.8	105.0	97.6
102.0	51.6	105.5	103.9
102.5	60.4	106.0	110.5
103.0	68.7	106.5	116.9
103.5	76.7	106.7	120.55

(Gerlach, Z. anal. **26**, 435.)

$K_2Al_2(SO_4)_4 + Al_2(SO_4)_3$ .

$K_2Al_2(SO_4)_4$  is nearly insol. in sat.  $Al_2(SO_4)_3 + Aq$ . (Crum, A. **89**, 156.)

Solubility in  $Al_2(SO_4)_3 + Aq$ . Solid Phase =  $K$  alum +  $Al_2(SO_4)_3$ .

$t^\circ$	g. $Al_2(SO_4)_3 + 18H_2O$ in 1000 g. $H_2O$	g. $K_2SO_4$ in 1000 g. $H_2O$
0	234.73	23.45
20	824.25	30.85
35	911.02	35.29
50	1,243.21	59.55
65	1,598.00	119.43
77	1,872.11	183.80

(Marino, Gazz. ch. it. 1905, **35**, (2) 351.)

Solubility is decreased by presence of Na alum. (Venable, C. N. **1879**, **40**, 198.)

Nearly completed pptd. from sat. aq. solution by addition of Fe or Cr alum. (v. Hauer, J. B. **1866**, 59.)

$K_2Al_2(SO_4)_4 + MgSO_4$ .

$K_2Al_2(SO_4)_4 + Aq$  sat. at  $10^\circ$ , and then sat. with  $MgSO_4$  at  $9^\circ$ , contains for 100 pts.  $H_2O$ —

	At $10^\circ$	At $9^\circ$
Alum (anhydrous)	4.0	2.7
$MgSO_4$	...	31.2
		33.9

(Mulder.)

$K_2Al_2(SO_4)_4 + K_2SO_4$ .

$K_2Al_2(SO_4)_4 + Aq$  at  $10^\circ$ , and then sat. with  $K_2SO_4$  at same temp., contains for 100 pts.  $H_2O$ —

	At $10^\circ$	At $9^\circ$
Alum (anhydrous)	4.0	0.86
$K_2SO_4$	...	9.16
		10.20

(Mulder.)

Solubility in  $K_2SO_4 + Aq.$  Solid phase =  $K \text{ alum} + K_2SO_4.$

$t^\circ$	$\frac{g. Al_2(SO_4)_3 + 18H_2O}{in 1000 g. H_2O}$	$\frac{g. K_2SO_4}{in 1000 g. H_2O}$	$t^\circ$	$\frac{g. Al_2(SO_4)_3 + 18H_2O}{in 1000 g. H_2O}$	$\frac{g. K_2SO_4}{in 1000 g. H_2O}$
0.	5.06	75.83	40	73.88	163.10
0.5	8.658	75.18	50	126.00	195.40
5.	16.07	85.78	60	249.70	238.80
10	18.52	96.50	70	529.01	323.74
15	20.56	109.30	80	1,044.04	517.27
30	39.60	147.80	..	...	...

(Marino, *l. c.*)



$K_2Al_2(SO_4)_4 + Aq$  sat. at  $10^\circ$ , and then sat. with  $Na_2SO_4$  at  $9^\circ$ , contains for 100 pts.  $H_2O$ —

	At $10^\circ$		At $9^\circ$
Alum (anhydrous)	4.0	4.1	...
$Na_2SO_4$	...	8.8	8.4
		12.9	

(Mulder.)

Solubility of  $K_2Al_2(SO_4)_4 + Ti_2Al_2(SO_4)_4$  in  $H_2O$  at  $25^\circ$ .

$\frac{G. K_2Al_2(SO_4)_4}{per l.}$	$\frac{G. Ti_2Al_2(SO_4)_4}{per l.}$	Solid phase Mol. % $K_2Al_2(SO_4)_4$	Sp. gr.
69.90	0.00	100	1.0591
74.56	0.48	99.61	1.0601
67.90	1.72	98.48	1.0598
65.30	4.52	95.45	1.0603
64.95	9.60	91.73	1.0605
53.23	18.44	82.54	1.0609
45.32	24.60	75.12	1.0609
38.02	32.48	65.73	1.0611
34.54	35.59	61.36	1.0611
28.35	42.99	51.93	1.0623
10.94	66.12	21.34	1.0654
0.00	75.46	0.00	1.0674

(Foch, *Z. Kryst. Min.* 1897, **28**, 397.)

Insol. in alcohol of 0.905 sp. gr. or less. (Anthon, *J. pr.* **14**, 125.)

Insol. in acetone. (Naumann, *B.* 1904, **37**, 4328.)

Insol. in methyl acetate. (Naumann, *B.* 1909, **42**, 3790.)

Solubility in  $H_2O$  is increased by glycerine. (Dunlop, *Pharm. J.* 1910, **31**, 6.)

Min. *Kalinile*.

+ $8H_2O$ . Stable in dry air. (Marino, *l. c.*)  
+ $14H_2O$ . Converted into ord. alum in air. (Marino.)

Aluminum rubidium sulphate,  $Al_2Rb_2(SO_4)_4 + 24H_2O$ .

100 pts.  $H_2O$  dissolve 2.27 pts. at  $17^\circ$ ; very sol. in hot  $H_2O$ . (Redtenbacher, *J. pr.* **94**, 442.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$  (calculated for salt dried at  $130^\circ$ ).

$t^\circ$	Pts. alum	$t^\circ$	Pts. alum	$t^\circ$	Pts. alum
0	0.71	25	1.85	65	9.63
10	1.09	35	2.67	80	21.60
17	1.42	50	4.98	..	..

(Setterberg, *A.* **211**, 104)

Solubility in  $H_2O$ .

$t^\circ$	Pts. per litre	G. mols. anhydrous salt per litre
25	18.1	0.059
30	21.9	0.072
35	26.6	0.087
40	32.2	0.106

(Locke, *Am. Ch. J.* 1901, **28**, 180.)

Melts in crystal  $H_2O$  at  $99^\circ$  (Tilden, *Chem. Soc.* **45**, 409); at  $105^\circ$  (Erdmann); at  $109^\circ$  (Locke.)

Aluminum silver sulphate,  $Al_2Ag_2(SO_4)_4 + 24H_2O$ .

Decomp. by  $H_2O$ . (Church and Northcote, *C. N.* **9**, 155.)

Aluminum sodium sulphate,  $Al_2Na_2(SO_4)_4 + 24H_2O$ .

Very sl. efflorescent.

Sol. in 2.14 pts.  $H_2O$  at  $13^\circ$ , or 100 pts.  $H_2O$  dissolve 46.7 pts. soda alum. Sol. in 1 pt. boiling  $H_2O$ . (Zellner, *Schw. J.* **36**, 183.)

100 pts.  $H_2O$  dissolve 110 pts. at  $15.5^\circ$ , and form a liquid of 1.296 sp. gr. (Ure.)

100 pts.  $H_2O$  dissolve 51 pts. soda alum at  $16^\circ$ . (Augé, *C. R.* **110**, 1139.)

100 pts.  $H_2O$  dissolve 110 pts. soda alum at  $0^\circ$ . (Tilden, *Chem. Soc.* **45**, 409.)

100 g.  $H_2O$  dissolve at:

$10^\circ$   $15^\circ$   $20^\circ$   $25^\circ$   $30^\circ$   
36.7 38.7 40.9 43.145.8 g. anhydrous salt.

(Smith, *J. Am. Chem. Soc.* 1909, **31**, 247.)

M.-pt. of  $Na_2Al_2(SO_4)_4 + 24H_2O = 61^\circ$ . (Tilden, *Chem. Soc.* **45**, 409.);  $= 63^\circ$ . (Locke, *Am. Ch. J.* 1901, **28**, 183.)

Insol. in absolute alcohol. (Zellner.)

Min. *Mendosite*. Digitized by Google

**Aluminum thallous sulphate,  $TlAl(SO_4)_3$ .**

0.177 g. mols. of anhydrous salt are sol. in 1 l.  $H_2O$  at  $25^\circ$ ; or 1 l.  $H_2O$  dissolves 75 g. of the anhydrous, or 117.8 g. of the hydrated salt at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 28. 175.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	G. $Al_2Tl_2(SO_4)_4$ in 100 g. $H_2O$	G. $Al_2Tl_2(SO_4)_4$ + $24H_2O$ in 100 g. $H_2O$
0	3.15	4.84
5	3.80	5.86
10	4.60	7.12
20	6.40	10.00
25	7.60	11.95
30	9.38	14.89
40	14.40	23.57
50	22.50	38.41
60	35.36	65.19

(Seidell, Solubilities, 1st Ed., p. 15.)

$3Al_2(SO_4)_3, Tl_2SO_4 + 96H_2O$ . Sol. in  $H_2O$ . (Lamy.)

**Aluminum zinc sulphate,  $Al_2(SO_4)_3, ZnSO_4 + 24H_2O$ .**  
Sol. in  $H_2O$ . (Kane.)

**Aluminum sulphate chromium chloride,**  
 $Al(OH_2)_2(SO_4)_2, CrCl_3(OH_2)_4 + 2H_2O$ .  
(Werner, B. 1906, 39. 337.)

**Aluminum sulphate sodium fluoride.**

Decomp. by  $H_2O$ . (Weber, Dingl. 263. 112.)

**Ammonium sulphate,  $(NH_4)_2SO_4$ .**

Sol. in  $H_2O$  with absorption of heat.  
75 pts.  $(NH_4)_2SO_4$  mixed with 100 pts.  $H_2O$  lower the temperature from  $13.2^\circ$  to  $6.8^\circ$ , that is,  $6.4^\circ$  (Rüdorff, B. 2. 68.)

Sol. in 1.31 pts.  $H_2O$  at  $19^\circ$ . (Schiff, A 109. 326.)  
Sol. in 2 pts.  $H_2O$  at  $18.75^\circ$ . (Abl.)  
Sol. in 2 pts.  $H_2O$  at  $15.6^\circ$ , and in 1 pt. boiling  $H_2O$ . (Fourcroy.)  
100 pts.  $H_2O$  at  $62.6^\circ$  dissolve 78 pts.  $(NH_4)_2SO_4$ . (Wenzel.)  
100 pts.  $H_2O$  at  $15^\circ$  dissolve 66.739 pts.  $(NH_4)_2SO_4$ . (Michel and Kraft.)

Sol. in 1.3 pts. cold  $H_2O$ . (Vogel, N. Rep. Pharm. 10. 9.)

Sol. in 1.37 pts. cold  $H_2O$  at  $10^\circ$ . (Mulder, J. B. 1866. 67.)

Sol. in 1.34 pts.  $H_2O$  at  $16-17^\circ$ . (v. Hauer, W. A. B. 53, 2. 221.)

100 pts.  $H_2O$  dissolve at:

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
71.00	73.65	76.30	78.95 pts. $(NH_4)_2SO_4$ ,
$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
81.60	84.25	86.90	89.55 pts. $(NH_4)_2SO_4$ ,
$80^\circ$	$90^\circ$	$100^\circ$	
92.20	94.85	97.50 pts. $(NH_4)_2SO_4$ .	

(Alluard, C. R. 59. 500.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $(NH_4)_2SO_4$	$t^\circ$	Pts. $(NH_4)_2SO_4$	$t^\circ$	Pts. $(NH_4)_2SO_4$
0	70.6	37	80.1	74	93.1
1	70.9	38	80.4	75	93.4
2	71.1	39	80.7	76	93.8
3	71.4	40	81.0	77	94.2
4	71.6	41	81.3	78	94.5
5	71.8	42	81.7	79	94.9
6	72.1	43	82.0	80	95.3
7	72.3	44	82.3	81	95.6
8	72.5	45	82.7	82	96.0
9	72.8	46	83.0	83	96.4
10	73.0	47	83.3	84	96.8
11	73.2	48	83.7	85	97.2
12	73.5	49	84.0	86	97.6
13	73.7	50	84.4	87	98.0
14	74.0	51	84.7	88	98.4
15	74.2	52	85.1	89	98.8
16	74.4	53	85.5	90	99.2
17	74.7	54	85.8	91	99.6
18	74.9	55	86.2	92	100.0
19	75.1	56	86.6	93	100.4
20	75.4	57	86.9	94	100.8
21	75.7	58	87.3	95	101.2
22	75.9	59	87.7	96	101.6
23	76.2	60	88.0	97	102.1
24	76.4	61	88.4	98	102.5
25	76.7	62	88.7	99	102.9
26	76.9	63	89.1	100	103.3
27	77.2	64	89.5	101	103.8
28	77.5	65	89.9	102	104.2
29	77.8	66	90.2	103	104.6
30	78.0	67	90.6	104	105.1
31	78.3	68	90.9	105	105.5
32	78.6	69	91.3	106	106.0
33	78.9	70	91.6	107	106.5
34	79.2	71	92.0	108	107.0
35	79.5	72	92.4	108.9	107.5
36	79.8	73	92.7	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. 1864. 60.)

100 g.  $(NH_4)_2SO_4 + Aq$  contain 41.4 g.  $(NH_4)_2SO_4$  at  $0^\circ$ . (de Waal, Dissert. 1910); 44.27 g. at  $30^\circ$ . (Schreinemakers, Z. phys. Ch. 71. 110); 47.81 g. at  $70^\circ$ . (de Waal.)  
 $(NH_4)_2SO_4 + Aq$  sat. at  $15^\circ$  has sp. gr. 1.248. (Michel and Kraft, A. ch. (3) 41. 471.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
1	1.0057	18	1.1035	35	1.2004
2	1.0115	19	1.1092	36	1.2060
3	1.0172	20	1.1149	37	1.2116
4	1.0230	21	1.1207	38	1.2172
5	1.0287	22	1.1265	39	1.2228
6	1.0345	23	1.1323	40	1.2284
7	1.0403	24	1.1381	41	1.2343
8	1.0460	25	1.1439	42	1.2402
9	1.0518	26	1.1496	43	1.2462
10	1.0575	27	1.1554	44	1.2522
11	1.0632	28	1.1612	45	1.2583
12	1.0690	29	1.1670	46	1.2644
13	1.0747	30	1.1724	47	1.2705
14	1.0805	31	1.1780	48	1.2766
15	1.0862	32	1.1836	49	1.2828
16	1.0920	33	1.1892	50	1.2890
17	1.0977	34	1.1948	..	...

(Schiff, calculated by Gerlach, Z. anal. 8. 280.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
5	1.0292	20	1.1160	31	1.1787
10	1.0581	30	1.1730		

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $15^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
3	1.0181	10	1.0600	30	1.1773
6	1.0359	20	1.1190	40	1.2352

(Gerlach, Z. anal. 28. 493.)

Sp. gr. of sat. solution = 1.248. (Gerlach.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ .

$\frac{1}{2}(\text{NH}_4)_2\text{SO}_4$ g. mol. in 1000 g. of solution	Sp. gr. $16^\circ/16^\circ$
0	1.000000
0.5514	1.000347
1.1251	1.000704
2.3114	1.001436
4.5840	1.002823
10.0893	1.006093
20.0138	1.012023
40.5236	1.024117
56.8536	1.033690

(Dijken, Z. phys. Ch. 1897, 24. 107.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .

Normality of $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$	% $(\text{NH}_4)_2\text{SO}_4$	Sp. gr.
3.75	40.28	1.2289
2.964	32.99	1.1858
1.978	23.01	1.1319
0.876	10.88	1.0626
0.492	6.275	1.0352

(Forchheimer, Z. phys. Ch. 1900, 24. 22.)

Sp. gr. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .

Solution	Sp. gr.	weight of 10 ccm. of the solution	% $(\text{NH}_4)_2\text{SO}_4$
sat.	1.248	12.5062 g.	53.2
$\frac{3}{4}$ "	1.196	11.9034 "	39.9
$\frac{1}{2}$ "	1.139	11.3377 "	26.6
$\frac{1}{4}$ "	1.077	10.7232 "	13.3
$\frac{1}{8}$ "	1.039	...	6.65

(Wiener, Z. phys. Chem. 1911, 71. 120.)

B.-pt. of sat. solution: crust formed at  $106.2^\circ$ , solution containing 88.2 pts.  $(\text{NH}_4)_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp. observed,  $108.2^\circ$ . (Gerlach, Z. anal. 28. 426.)

B.-pt. of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  containing pts.  $(\text{NH}_4)_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $(\text{NH}_4)_2\text{SO}_4$	B.-pt.	Pts. $(\text{NH}_4)_2\text{SO}_4$
100.5°	7.8	105.0°	71.8
101.0	15.4	105.5	78.7
101.5	22.8	106.0	85.5
102.0	30.1	106.5	92.3
102.5	37.2	107.0	99.1
103.0	44.2	107.5	105.9
103.5	51.1	108.0	112.6
104.0	58.0	108.2	115.3
104.5	64.9	...	...

(Gerlach, Z. anal. 28. 431.)

Sol. with decomp. in  $\text{HCl} + \text{Aq}$ .

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

100 g. of the solution contain		Solid phase
Mol. $\text{H}_2\text{SO}_4$	Mol. $(\text{NH}_4)_2\text{SO}_4$	
0.00	2.28	$(\text{NH}_4)_2\text{SO}_4$
0.24	3.25	
0.47	3.19	
0.97	3.15	
1.19	3.15	
1.43	3.22	$(\text{NH}_4)_2\text{H}(\text{SO}_4)_2$
1.72	3.18	
2.20	3.02	
2.60	2.97	
2.71	3.00	
2.82	3.03	
2.96	3.10	
3.20	3.19	
3.32	3.25	
3.47	3.32	
3.54	3.20	$(\text{NH}_4)\text{HSO}_4$
3.76	2.84	
4.22	2.26	
5.09	1.44	

(D'Ans, Z. anorg. 1909, 65. 229.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution			Solid phase
% by wt. $\text{H}_2\text{SO}_4$	% by wt. $(\text{NH}_4)_2\text{SO}_4$	% by wt. $\text{H}_2\text{O}$	
10.63	43.59	45.79	$(\text{NH}_4)_2\text{SO}_4$
10.70	43.25	46.05	"
13.18	44.10	42.72	$(\text{NH}_4)_2\text{SO}_4 + 3(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$
16.67	42.06	41.27	$3(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{SO}_4$
25.82	41.15	33.03	"
27.33	41.16	31.51	"
32.32	44.63	22.26	"
33.12	45.50	21.83	"
33.84	45.52	20.64	$(\text{NH}_4)\text{HSO}_4$
33.96	45.31	20.73	"
38.51	35.37	26.12	"
42.12	30.10	27.78	"
45.80	24.88	29.32	"
45.77	24.30	29.93	"
56.55	16.98	26.37	"
62.43	20.41	17.16	"
62.46	24.40	13.14	"
63.12	24.20	12.68	"
62.57	27.67	9.76	"
62.83	29.75	8.42	"
62.56	30.26	7.28	"
62.67	31.86	5.47	"
62.59	33.70	3.71	"
61.63	36.75	1.72	"
62.23	36.95	0.82	"

(Van Dorp, Z. phys. Ch. 1910, 73. 285.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution		Solid phase
Mol. $\text{SO}_3$	Mol. $(\text{NH}_4)_2\text{SO}_4$	
4.29	2.17	$(\text{NH}_4)\text{HSO}_4$
4.57	1.83	
4.85	1.60	
5.25	1.36	
5.66	1.22	
6.16	1.28	$(\text{NH}_4)\text{HSO}_4$
6.47	1.55	
6.51	1.95	
6.50	2.37	$(\text{NH}_4)\text{HSO}_4 + (\text{NH}_4)\text{H}_2(\text{SO}_4)_2$
6.43	2.50	
7.28	1.64	
7.99	1.38	$(\text{NH}_4)\text{H}_2(\text{SO}_4)_2$
(7.60)	(1.74)	
(8.00)	(1.42)	$(\text{NH}_4)\text{HSO}_4$
9.02	0.96	
9.21	0.832	
9.60	0.977	$(\text{NH}_4)\text{HSO}_4$
9.68	1.00	
9.67	1.26	
10.43	0.894	$(\text{NH}_4)\text{HSO}_4 + ?$

(D'Ans, Z. anorg. 1913, 80. 241.)

Very easily sol., even in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Girard, Bull. Soc. (2) 43. 522.)Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $25^\circ$ .

In 1000 g. of the solution	
Mol. $(\text{NH}_4)_2\text{SO}_4$	Mol. $\text{NH}_3$
3.28	0
2.60	1.02
2.13	1.95
1.59	3.44
1.16	5.35
0.78	7.13
0	9.47

(D'Ans and Schreiner, Z. anorg. 1910, 67. 438.)

100 pts.  $\text{H}_2\text{O}$  dissolve 46.5 pts.  $(\text{NH}_4)_2\text{SO}_4$  and 26.8 pts.  $\text{NH}_4\text{Cl}$  at  $21.5^\circ$ .Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ .

% $\text{NH}_4\text{Cl}$	% $(\text{NH}_4)_2\text{SO}_4$	Solid phase
0	44	$(\text{NH}_4)_2\text{SO}_4$
6.86	36.15	"
14.62	28.6	"
17.60	25.69	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{Cl}$
17.93	25.81	"
19.07	23.22	$\text{NH}_4\text{Cl}$
19.97	21.3	"
22.3	16.33	"
24.06	12.72	"
29.5	0	"

(Schreinemakers, Arch. Néer. Sc. 1910, (2) 15. 92.)

See also under  $\text{NH}_4\text{Cl}$ .

$(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$  in  $\text{H}_2\text{O}$  at  $16^\circ$ .

Solution	% $\text{CuSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$
Both salts in excess	8.55	7.12
15 cc. sat. sol. + 3 g. $(\text{NH}_4)_2\text{SO}_4$	1.77	18.16
15 cc. sat. sol. + 3 g. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	15.85	5.65

(Rüdorff, B. 6. 482.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{CuSO}_4$  in  $\text{H}_2\text{O}$  at  $30^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	% $\text{CuSO}_4$	Solid phase
0	20.32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
2.45	20.19	"
5.79	20.53	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
6.98	16.77	$\text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
8.19	13.65	"
9.33	11.03	"
17.53	4.05	"
29.27	1.57	"
38.32	0.77	"
43.29	0.49	$\text{CuSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$
44	0	$(\text{NH}_4)_2\text{SO}_4$

(Schreinemakers, Arch. Néer. Sc. 1910, 15. 12.)

See also under  $\text{CuSO}_4$ .

$(\text{NH}_4)_2\text{SO}_4 + \text{FeSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{FeSO}_4$  in  $\text{H}_2\text{O} + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $\text{FeSO}_4$	% by wt. $(\text{NH}_4)_2\text{SO}_4$	
24.90	0	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
25.24	5.24	"
25.22	5.93	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O} + \text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
25.26	5.89	"
23.59	6.44	$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
17.64	8.90	"
13.13	11.45	"
7.95	16.29	"
5.70	19.64	"
1.72	34.24	"
0.79	43.86	$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$
0.79	43.90	"
0	44.27	$(\text{NH}_4)_2\text{SO}_4$

(Schreinemakers, Z. phys. Ch. 1910, 71. 111.)

$(\text{NH}_4)_2\text{SO}_4 + \text{Li}_2\text{SO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{Li}_2\text{SO}_4$ .

Temp. $-30^\circ$ .		
% $(\text{NH}_4)_2\text{SO}_4$	% $\text{Li}_2\text{SO}_4$	Solid phase
44.1	0	$(\text{NH}_4)_2\text{SO}_4$
40.8	3	"
39.5	6.6	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
30	10	$\text{NH}_4\text{LiSO}_4$
21.6	15	"
15	20	"
12.5	21.9	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
8.9	23	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
0	25.1	"

Temp. $-50^\circ$ .		
45.7	1	$(\text{NH}_4)_2\text{SO}_4$
43.05	5.86	$(\text{NH}_4)_2\text{SO}_4 + \text{NH}_4\text{LiSO}_4$
19.65	16.35	$\text{NH}_4\text{LiSO}_4$
13.90	21.20	"
13.97	21.23	$\text{NH}_4\text{LiSO}_4 + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
11.45	21.75	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
9.63	22.79	"
8.58	23.09	"
7.56	23.86	"
0	24.3	"

(Schreinemakers and Cocheret, Chem. Weekbl. 1905, 2. 771.)

$(\text{NH}_4)_2\text{SO}_4 + \text{MnSO}_4$   
Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{MnSO}_4$  in  $\text{H}_2\text{O}$ .  
G. per 100 g. sat. solution.

Temp. $-30^\circ$ .		
$\text{MnSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$	Solid phase
39.3	0	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$
38.49	3.64	$\text{MnSO}_4 \cdot 5\text{H}_2\text{O} + \text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
33.44	4.91	"
22.06	9.65	"
9.02	20.36	"
2.91	37.42	"
1.75	42.58	$\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{SO}_4$
1.77	43.24	$(\text{NH}_4)_2\text{SO}_4$
0	43.4	"

Temp. $-50^\circ$ .		
36.26	0	$\text{MnSO}_4 \cdot \text{H}_2\text{O}$
35.35	2.95	$\text{MnSO}_4 \cdot \text{H}_2\text{O} + 2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$
30.57	5.14	$2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4$
16.86	17.62	"
6.92	35.98	"
6.29	39.71	"
5.70	43.24	$2\text{MnSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 + (\text{NH}_4)_2\text{SO}_4$
3.49	44.02	$(\text{NH}_4)_2\text{SO}_4$
0	45.7	"

(Schreinemakers, Chem. Weekbl. 1909, 6. 131.)

$(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$ .  
100 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4 + \text{Aq}$  sat. at 16.17° contain 38.41 pts. of the two salts, of which 5.45 pts. are  $\text{K}_2\text{SO}_4$  and 32.96 pts.  $(\text{NH}_4)_2\text{SO}_4$ . (v. Hauer, J. pr. 23. 137.)

100 pts.  $\text{H}_2\text{O}$  dissolve 50.6 pts.  $(\text{NH}_4)_2\text{SO}_4$  and 7.2 pts.  $\text{K}_2\text{SO}_4$  at 11°. (Mulder, J. B. 1866. 67.)

$(\text{NH}_4)_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$  replace each other in solution, so that by adding one of these salts to a seemingly saturated solution of the other, it is dissolved with pptn. of the other salt. (Rüdorff, B. 6. 485.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$  at 19.1°.

Solution	% $\text{K}_2\text{SO}_4$	% $(\text{NH}_4)_2\text{SO}_4$
Both salts in excess	39.3	37.97
15 cc. sat. sol. + 4 g. $\text{K}_2\text{SO}_4$	4.94	33.26
15 cc. sat. sol. + 4 g. $(\text{NH}_4)_2\text{SO}_4$	2.05	40.80

(Rüdorff, B. 6. 482.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{K}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at 25°.

g. $\text{K}_2\text{SO}_4$ per l.	g. $(\text{NH}_4)_2\text{SO}_4$ per l.	g. $\text{K}_2\text{SO}_4$ per l.	g. $(\text{NH}_4)_2\text{SO}_4$ per l.
127.9	0.0	59.28	355.0
135.7	115.7	40.27	482.7
84.2	281.1	0.0	542.3

Results are also given for 14°, 15°, 16°, 30°, 46° and 47°.

(Fock, Z. Kryst. Min. 1897, 28. 365.)

$(\text{NH}_4)_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$ .

Solubility of  $(\text{NH}_4)_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  at 16°.

Pts. per 100 pts.  $\text{H}_2\text{O}$ .

$(\text{NH}_4)_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	Solid phase
2.13	3.361	$\text{Th}(\text{SO}_4)_2 \cdot 9\text{H}_2\text{O}$
4.80	5.269	"
10.02	8.947	"
16.56	13.330	$\text{Th}(\text{SO}_4)_2 \cdot 9\text{H}_2\text{O} + \text{Th}(\text{SO}_4)_2 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
28.00	10.359	$\text{Th}(\text{SO}_4)_2 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 4\text{H}_2\text{O}$
35.20	9.821	" + $\text{Th}(\text{SO}_4)_2 \cdot 2(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
45.14	6.592	$\text{Th}(\text{SO}_4)_2 \cdot 2(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$
49.05	5.750	"
52.88	4.583	$\text{Th}(\text{SO}_4)_2 \cdot 3(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$
69.74	1.653	"

(Barre, A. ch. 1911, (8) 24. 239.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 826.)

Insol. in absolute alcohol. Sol. in 500 pts. alcohol of 0.872 sp. gr., and in 62.5 pts. of 0.905 sp. gr. (Anthon, J. pr. 14. 125.)

Sol. in 217.4 pts. of 66.8% alcohol (sp. gr. = 0.88) at 24.3°. (Pohl, J. pr. 66. 219.)

Tolerably sol. in alcohol, the sp. gr. of which is greater than 0.860. Insol. in alcohol of sp. gr. less than 0.850.

Solubility in dil. alcohol.

When  $(\text{NH}_4)_2\text{SO}_4$  is dissolved in dil. alcohol, two layers are formed, the compositions of which are as follows:

Sp. gr.	Lower layer 100 ccm. contain in g.		
	alcohol	water	salt
1.2240	...	71.43	74.16
1.1775	8.85	68.26	59.54
1.1661	10.62	67.70	56.56
1.1655	11.29	67.34	56.30
1.1735	11.42	66.54	59.20

Sp. gr.	Upper layer 100 ccm. containing.		
	alcohol	water	salt
0.9530	41.37	48.47	5.45
0.9512	44.20	45.95	4.97
0.9440	44.27	45.61	4.51
0.9098	52.64	36.78	1.56
0.8750	62.61	24.60	0.30
0.8549	67.04	18.36	0.09
0.8308	77.55	5.53	0.00

(Bodländer, Z. phys. Ch. 7. 3, 8.)

Solubility in ethyl alcohol + Aq.

Upper layer			
Temp.	g. $\text{H}_2\text{O}$	g. alcohol	g. salt
16.6°	52.80	40.21	6.99
33.0°	47.99	46.75	5.26
41.8°	47.34	47.67	4.99
55.7°	45.90	49.47	4.63
Lower layer			
16.6°	60.33	10.19	29.48
33.0°	61.02	9.80	29.18
41.8°	61.16	9.74	29.10
55.7°	61.59	9.46	28.95

(Traube, Z. phys. Ch. 1887, 1. 509.)



Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in alcohol at  $30^\circ$ .

Two liquid layers are formed between alcohol concentrations of 5.8 and  $62^\circ$ .

Composition of layers.

Upper layer			Lower layer		
% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$	% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
2.2	56.6	41.2	37.1	5.8	57.1
2.6	54.5	42.9	35.7	6.3	58
3.4	52.3	44.3	33.8	7.4	58.8
13.2	31.8	55	21.7	18.4	59.9
17	25	58	17	25	58

At concentration of 62% alcohol, the liquid is homogeneous and contains 1.3%  $(\text{NH}_4)_2\text{SO}_4$ .

(Wibaut, Chem. Weekbl. 1909, 6. 401.)

Solubility of  $(\text{NH}_4)_2\text{SO}_4$  in alcohol at  $60^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
43.02	2.32	54.66
41.1	4.1	54.8
...	...	...
1.2	64.5	34.3
0.2	75.5	24.3

Between  $4.1^\circ$  and  $64.5^\circ$ , two liquid layers are formed.

Composition of layers.

Upper layer			Lower layer		
% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$	% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
1.2	64.5	34.3	41.1	4.1	54.8
1.6	60	38.4	36.8	6	57.2
3.8	50	46.2	30.8	9	60.2
7.4	40	52.6	26.6	12	61.4
10	34.4	55.6	23.6	15	61.4

(Schreinemakers, Z. phys. Ch. 1907, 59. 641.)

Solubility in alcohol + Aq at  $0^\circ$ .

% $(\text{NH}_4)_2\text{SO}_4$	% alcohol	% $\text{H}_2\text{O}$
41.4	0	58.6
30.0	9.41	60.59
...	...	...
...	...	...
0.14	73.03	26.83

Two layers are formed between alcohol concentrations of 9.41 and 73.03%.

(de Waal, Dissert. 1910.)

Solubility in propyl alcohol + Aq at  $20^\circ$ .

% propyl alcohol	% $(\text{NH}_4)_2\text{SO}_4$
20	6.7
30	4.8
40	3.2
50	2.0
60	1.0
70	0.4

(Linebarger, Am. Ch. J. 1892, 14. 380.)

100 g. 95% formic acid dissolve 25.4 g.  $(\text{NH}_4)_2\text{SO}_4$  at  $16.5^\circ$ . (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329). Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in  $\text{CS}_2$ . (Arctowski, Z. anorg. 1894, 6. 257.)

**Ammonium hydrogen sulphate,  $\text{NH}_4\text{HSO}_4$ .**

Sl. deliquescent. Sol. in 1 pt. cold  $\text{H}_2\text{O}$ . (Link.)

Very sl. sol. in alcohol. (Gerhardt, A. ch. (3) 20. 255.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

$(\text{NH}_4)_2\text{H}(\text{SO}_4)_2$ . Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Mitscherlich, Pogg. 39. 198.)

$(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{H}_2\text{SO}_4$ . D'Ans and Schreiner, Z. anorg. 1913, 80. 241.)

**Ammonium pyrosulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Schulze.)

$\text{NH}_4\text{HS}_2\text{O}_7$ . (D'Ans and Schreiner, Z. anorg. 1913, 80. 241.)

**Ammonium octosulphate,  $(\text{NH}_4)_2\text{S}_8\text{O}_{22}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17. 2497.)

**Ammonium antimony sulphate,**

$(\text{NH}_4)_2\text{SO}_4 \cdot \text{Sb}_2(\text{SO}_4)_3$ .

Behaves toward  $\text{H}_2\text{O}$  and abs. alcohol as a mixture of the components. (Metz, Z. anorg. 1905, 48. 152.)

Decomp. very slowly by  $\text{H}_2\text{O}$ . (Gutmann, Arch. Pharm. 1898, 236. 479.)

**Ammonium bismuth sulphate,  $\text{NH}_4\text{Bi}(\text{SO}_4)_3 \cdot 4\text{H}_2\text{O}$ .**

Easily sol. in  $\text{HCl}$ , and  $\text{HNO}_3$  + Aq; less sol. in conc.  $\text{H}_2\text{SO}_4$  and hot dil. acids. Slowly decomp. by cold  $\text{HCl} \cdot \text{H}_2\text{O}_2$ , and dil.  $\text{H}_2\text{SO}_4$  + Aq. (Lüddecke, A. 140. 277.)

**Ammonium cadmium sulphate,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{CdSO}_4 \cdot 6\text{H}_2\text{O}$ .**

Can be recrystallised from a little  $\text{H}_2\text{O}$ . (v. Hauer.)

1 l.  $\text{H}_2\text{O}$  dissolves 723 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

$3(\text{NH}_4)_2\text{SO}_4, \text{CdSO}_4 + 10\text{H}_2\text{O}$ . (André, C. R. 104. 987.)

**Ammonium calcium sulphate,**  
 $(\text{NH}_4)_2\text{Ca}(\text{SO}_4)_2 + \text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Fassbender, B. 11. 1968.)

Sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Rose, Pogg. 110. 292.)

■ This double salt is stable between  $0^\circ$  and  $100^\circ$  in solutions containing an excess of  $(\text{NH}_4)_2\text{SO}_4$ . It is not formed if the solution contains less than 35%  $(\text{NH}_4)_2\text{SO}_4$ . (Barre, C. R. 1909, 148. 1605.)

$(\text{SO}_4)_2\text{Ca}_2(\text{NH}_4)_2$ . Decomp. by  $\text{H}_2\text{O}$ . (D'Ans, B. 1907, 40. 192.)

■ This double salt is formed in the presence of an excess of  $\text{CaSO}_4$  and at temp. above  $80^\circ$ . (Barre, C. R. 1909, 148. 1605.)

$\text{Ca}_2(\text{NH}_4)_2(\text{SO}_4)_4 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (D'Ans, B. 1907, 40. 192.)

**Ammonium calcium cupric sulphate,**  
 $\text{Ca}_2\text{Cu}(\text{NH}_4)_2(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .

Very stable. (D'Ans, B. 1908, 41. 1778.)

**Ammonium calcium potassium sulphate,**  
 $\text{NH}_4\text{CaK}(\text{SO}_4)_2 + \text{H}_2\text{O}$ .

Decomp. by cold  $\text{H}_2\text{O}$ . (Fassbender, B. 11. 1968.)

**Ammonium cerous sulphate,  $(\text{NH}_4)_2\text{Ce}_2(\text{SO}_4)_4$**   
 $+ 8\text{H}_2\text{O}$ .

More sol. in cold than in hot  $\text{H}_2\text{O}$ . (Czudnowicz.)

100 g.  $\text{H}_2\text{O}$  dissolve at:

22.  $3^\circ$  22.  $35^\circ$  35.  $1^\circ$  45.  $2^\circ$

5.331 5.328 5.184 4.993 g. anhydrous salt,

45.  $^\circ$  55.  $3^\circ$  55.  $2^\circ$

2.994 2.240 2.187 g. anhydrous salt,

75.  $4^\circ$  85.  $2^\circ$

1.482 1.184 g. anhydrous salt.

(Wolff, Z. anorg. 1905, 45. 102.)

$5(\text{NH}_4)_2\text{SO}_4, \text{Ce}_2(\text{SO}_4)_3$ . (Barre, C. R. 1910, 151. 873.)

**Ammonium ceric sulphate,  $3(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Ce}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ .

Slightly efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Mendelejeff, A. 168. 50.)

$3(\text{NH}_4)_2\text{SO}_4, 2\text{Ce}(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Mendelejeff.)

**Ammonium chromous sulphate,  $\text{NH}_4\text{Cr}(\text{SO}_4)_2$ .**

0.407 g. mol. anhydrous salt is sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26. 175.)

$+ 6\text{H}_2\text{O}$ . 100 ccm. of sat. aqueous solution contain 55 g. of the salt at  $20^\circ$ . Insol. in alcohol. (Laurent, C. R. 1911, 131. 112.)

**Ammonium chromic sulphate,  $(\text{NH}_4)_2\text{SO}_4$ ,**  
 $\text{Cr}_2(\text{SO}_4)_3$ .

Not attacked by boiling  $\text{H}_2\text{O}$  or conc.  $\text{HCl} + \text{Aq}$ . Very slowly attacked by boiling  $\text{KOH} + \text{Aq}$  (sp. gr. = 1.3). Insol. in  $\text{CrCl}_3 + \text{Aq}$  or  $\text{SnCl}_2 + \text{Aq}$ . (Klobb, Bull. Soc. (3) 9. 664.)  
 $+ 5\text{H}_2\text{O}$ . Is ammonium chromosulphate, which see.

$+ 24\text{H}_2\text{O}$ . Chrome Alum.

*Violet modification.* Efflorescent. Sol. in cold  $\text{H}_2\text{O}$ , but solution is decomp. on heating with formation of green modification. The dil. solution of green modification is gradually converted into violet modification by standing. Alcohol ppts. it from aqueous solution. (Schrötter, Pogg. 53. 526.)

100 cc.  $\text{H}_2\text{O}$  dissolve 10.78 g. anhydrous, or 21.21 g. hydrated salt at  $25^\circ$ . Melts in crystal  $\text{H}_2\text{O}$  at  $45^\circ$ . (Locke, Am. Ch. J. 1901. 26. 174.)

Solubility in  $\text{H}_2\text{O}$ .

Saturation is very slowly reached owing to transition between violet and green modifications. If time of saturation is taken, at  $2\frac{1}{2}$  hours, 100 g. of the solution contain at:

$0^\circ$      $30^\circ$      $40^\circ$

3.77    10.6    15.5 g.  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4$ .

This is assumed to be the solubility of the violet modification.

In 300 hours, 15.96 g. salt are dissolved at  $30^\circ$ , and 24.64 g. in 250 hours at  $40^\circ$ . (Koppel, B. 1906, 39. 3741.)

Calc. from electrical conductivity measurements, a solution containing 3.8 g. of the sulphate in 100 g. contains 48% of the green compound at  $40^\circ$  and 61% at  $55^\circ$ . With solutions of 6-7 times the above concentration equilibrium is reached at  $40^\circ$  with 30-40% green alum. (Koppel.)

Sp. gr. of aqueous solution of violet modification at  $15^\circ$ , containing:

4    8    12%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .  
1.020 1.0405 1.0610

Sat. solution at  $15^\circ$  has sp. gr. = 1.070. (Gerlach.)

*Green modification.* Sol. in  $\text{H}_2\text{O}$  and alcohol. When in aqueous solution, it gradually changes to violet modification.

Sp. gr. of aqueous solution of green modification at  $15^\circ$ , containing:

10    20    30%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
1.044 1.091 1.142

40    50    60%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,  
1.197 1.255 1.317

70    80    90%  $(\text{NH}_4)_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .  
1.384 1.456 1.532

(Gerlach, Z. anal. 28. 498.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

$3(\text{NH}_4)_2\text{SO}_4, \text{Cr}_2(\text{SO}_4)_3$ . Only sl. attacked by boiling  $\text{H}_2\text{O}$ . Not attacked by boiling conc.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Klobb, Bull. Soc. (3) 9. 663.)

**Ammonium cobaltous sulphate,**  
 $(\text{NH}_4)_2\text{Co}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .100 pts.  $\text{H}_2\text{O}$  dissolve at:

0°	10°	18°	23°	35°
8.9	11.6	15.2	17.1	19.6

 pts. anhydrous salt,

40°	45°	50°	60°	75°
22.3	25	28.7	34.5	43.3

 pts. anhydrous salt.  
(Tobler, A. 96. 193.)

100 pts. saturated solution contain at:

20°	40°	60°	80°
14.9	20.8	25.6	33

 pts. anhydrous salt.  
(v. Hauer, J. pr. 74. 433.)

1 l.  $\text{H}_2\text{O}$  dissolves 147.2 g. anhydrous salt at 25°. Tobler's results are inaccurate. (Locke, Am. Ch. J. 1902, 27. 459.)

Pptd. from aqueous solution by alcohol.

**Ammonium cobaltic sulphate,**  
 $(\text{NH}_4)_2\text{Co}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$  with decomp. (Marshall, Chem. Soc. 59. 760.)**Ammonium cobaltous cupric sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CoSO}_4, \text{CuSO}_4 + 12\text{H}_2\text{O}$ .Quite easily sol. in hot  $\text{H}_2\text{O}$ , but on long boiling a basic salt is pptd. (Vohl, A. 94. 58.)**Ammonium cobaltous ferrous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CoSO}_4, \text{FeSO}_4 + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)**Ammonium cobaltous magnesium sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CoSO}_4, \text{MgSO}_4 + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)**Ammonium cobaltous manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CoSO}_4, \text{MnSO}_4 + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)**Ammonium cobaltous nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CoSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)**Ammonium cobaltous zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CoSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)**Ammonium cupric sulphate,  $(\text{NH}_4)_2\text{SCu}$ ,**  
 $\text{CuSO}_4 + 6\text{H}_2\text{O}$ .

Efflorescent in warm air.

Sol. in 1.5 pts. boiling  $\text{H}_2\text{O}$ , and separates almost wholly on cooling. (Vogel, J. pr. 2. 194)  
Sol. in 1.55 pts.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)

100 pts.  $\text{H}_2\text{O}$  at 19° dissolve 26.6 pts., and sat. solution has sp. gr. = 1.1337. (Schiff, A. 109. 426.)

100 g. sat. solution at 30° contain 30.36 g. anhydrous salt. (Schreinemakers, Arch. Néer. Sci. 1910, (2) 15. 92.)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2, 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2, 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13-14°. Mols. per 100 mols.  $\text{H}_2\text{O}$ .

Cu salt	Ni salt	% Cu salt in solid phase
0	0.521	0
0.1476	0.295	10.29
0.2664	0.2089	30.59
0.4165	0.1449	52.23
0.4785	0.1202	78.80
1.0350	0	100

(Fock, Z. Kryst. Min. 1897, 23. 365.)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2, 6\text{H}_2\text{O} + \text{K}_2\text{Cu}(\text{SO}_4)_2, 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13-14°. Mols. per 100 mols.  $\text{H}_2\text{O}$ .

K salt	$\text{NH}_4$ salt	% K salt in solid phase
0	1.035	0
0.897	0.8618	5.06
0.2269	0.6490	16.76
0.2570	0.5887	30.40
0.2946	0.5096	36.63
0.3339	0.3319	50.15
0.4560	0.1961	69.93
0.4374	0	100.

(Fock.)

Solubility of  $(\text{NH}_4)_2\text{Cu}(\text{SO}_4)_2, 6\text{H}_2\text{O} + (\text{NH}_4)_2\text{Zn}(\text{SO}_4)_2, 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at 13-14°. Mols. per 100 mols.  $\text{H}_2\text{O}$ .

Cu salt	Zn salt	% Cu salt in solid phase
0.0422	0.8069	2.39
0.0666	0.5638	4.52
0.1218	0.5115	9.03
0.2130	0.4924	14.67
0.3216	0.4022	22.62
1.035	0	100.

(Fock.)

$(\text{NH}_4)_2\text{SO}_4, 2\text{CuSO}_4$ . Very sol. in  $\text{H}_2\text{O}$  (Klobb, C. R. 115. 230.)

**Ammonium cupric ferrous sulphate.**Sol. in  $\text{H}_2\text{O}$  without decomposition. (Vohl, A. 94. 61.)**Ammonium cupric magnesium sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{MgSO}_4 + 12\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)**Ammonium cupric magnesium potassium sulphate,  $(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schiff.)  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, 2\text{MgSO}_4, \text{K}_2\text{SO}_4 + 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Schiff.)

**Ammonium cupric manganous sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{MnSO}_4 + 12 \text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium cupric nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{NiSO}_4 + 12 \text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Ammonium cupric potassium sulphate,**  
 $\text{NH}_4\text{KSO}_4, \text{CuSO}_4 + 6 \text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Schiff.)

**Ammonium cupric zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{CuSO}_4, \text{ZnSO}_4 + 12 \text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Ammonium cupric sulphate ammonia,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{CuO}, 2 \text{NH}_3$ .

Sol. in 1.5 pts. cold  $\text{H}_2\text{O}$ , but decomp. on exposure to air or dilution. Insol. in alcohol. (Kühn.)

**Ammonium didymium sulphate,**  $(\text{NH}_4)_2\text{SO}_4, \text{Di}_2(\text{SO}_4)_3 + 8 \text{H}_2\text{O}$ .

Sol. in 18 pts.  $\text{H}_2\text{O}$ , and less easily in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . (Marignac.)

Moderately sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43. 362.)

**Ammonium erbium sulphate,**  $(\text{NH}_4)_2\text{SO}_4, \text{Er}_2(\text{SO}_4)_3 + 8 \text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Ammonium gallium sulphate,**  
 $(\text{NH}_4)_2\text{Ga}_2(\text{SO}_4)_4 + 24 \text{H}_2\text{O}$ .

Sol. in cold water and dilute alcohol. Conc. solution clouds up on boiling, but clears on cooling. Dil. solution separates out a basic salt, insol. in hot or cold  $\text{H}_2\text{O}$ . (Boisbaudran.)

**Ammonium glucinum sulphate,**  $(\text{NH}_4)_2\text{SO}_4, \text{GlSO}_4 + 2 \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Atterberg.)

**Ammonium indium sulphate,**  
 $(\text{NH}_4)_2\text{In}_2(\text{SO}_4)_4 + 24 \text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 200 pts. salt at  $16^\circ$ , and 400 pts. at  $30^\circ$ .

Insol. in alcohol.

Melts in crystal  $\text{H}_2\text{O}$  at  $36^\circ$ . (Rössler, J. pr. (2) 7. 14.)  
 $+ 8 \text{H}_2\text{O}$ . (Rössler.)

**Ammonium iridium sulphate,**  $(\text{NH}_4)_2\text{SO}_4, \text{Ir}_2(\text{SO}_4)_3 + 24 \text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Marino, Z. anorg. 1904, 43. 221.)

**Ammonium iron (ferrous) sulphate,**  
 $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 + 6 \text{H}_2\text{O}$ .

Much less sol. in  $\text{H}_2\text{O}$  than  $\text{FeSO}_4 + 7 \text{H}_2\text{O}$ . (Vogel, J. pr. 2. 192.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ \quad 12^\circ \quad 20^\circ \quad 30^\circ \quad 36^\circ$   
 12.2 17.5 21.6 28.1 31.8 pts. anhydrous salt,  
 $45^\circ \quad 55^\circ \quad 60^\circ \quad 65^\circ \quad 75^\circ$   
 36.2 40.3 44.6 49.8 56.7 pts. anhydrous salt.  
 (Tobler, A. 95. 193.)

100 pts.  $\text{H}_2\text{O}$  at  $16.5^\circ$  dissolve 35.9 pts. hydrous salt.

1 l.  $\text{H}_2\text{O}$  dissolves 351 pts. or 1.044 g. mol. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

Sol. in  $\text{H}_2\text{O}$  without decomp. Aq. solution at  $30^\circ$  contains 13.13%  $\text{FeSO}_4$  and 11.45%  $(\text{NH}_4)_2\text{SO}_4$ . (Schreinemakers, C. C. 1910, I. 801.)

Sp. gr. of  $(\text{NH}_4)_2\text{FeSO}_4 + \text{Aq}$  at  $19^\circ$ .

% = %  $(\text{NH}_4)_2\text{FeSO}_4 + 6 \text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.006	11	1.066	21	1.130
2	1.013	12	1.073	22	1.136
3	1.018	13	1.080	23	1.143
4	1.024	14	1.085	24	1.150
5	1.030	15	1.092	25	1.156
6	1.036	16	1.097	26	1.164
7	1.042	17	1.104	27	1.171
8	1.047	18	1.110	28	1.179
9	1.054	19	1.116	29	1.185
10	1.060	20	1.124	30	1.193

(Schiff calculated by Gerlach, Z. anal. 8. 280.)

Insol. in acetone.

**Ammonium ferric sulphate, basic.**

Extremely difficultly sol. in  $\text{HCl} + \text{Aq}$ . Not decomp. by  $\text{KOH} + \text{Aq}$ . (Berzelius.)

$5(\text{NH}_4)_2\text{O}, 3\text{Fe}_2\text{O}_3, 12\text{SO}_3 + 18 \text{H}_2\text{O}$  or  $2(\text{NH}_4)_2\text{O}, \text{Fe}_2\text{O}_3, 4\text{SO}_3 + 4 \text{H}_2\text{O}$ . Sol. in 2.4 pts. cold  $\text{H}_2\text{O}$ . (Maus, Pogg. 11. 79.)

**Ammonium iron (ferric) sulphate,**  $(\text{NH}_4)_2\text{SO}_4, \text{Fe}_2(\text{SO}_4)_3$ .

Attacked slowly by cold  $\text{H}_2\text{O}$ . (Lachaud and Lepierre.)

Nearly insol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84. 363.)

$+ 24 \text{H}_2\text{O}$ . Iron alum. Sol. in 3 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Forchhammer, Ann. Phil. 5. 406.)

100 cc.  $\text{H}_2\text{O}$  dissolve 44.15 g. anhydrous, or 124.40 g. hydrated salt at  $25^\circ$ , or 1.659 g. mols. anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Locke, Am. Ch. J. 1901, 26. 174.)

Sp. gr. of aqueous solution at  $15^\circ$  containing:

5    10    15%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_3 + 24 \text{H}_2\text{O}$ ,  
 1.023 1.047 1.071

20    25    30%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_3 + 24 \text{H}_2\text{O}$ ,  
 1.096 1.122 1.148

35    40%  $(\text{NH}_4)_2\text{Fe}_2(\text{SO}_4)_3 + 24 \text{H}_2\text{O}$ .  
 1.175 1.203

40% solution is sat. at 15°. (Gerlach, Z. anal. 28. 496.)  
 Melts in crystal H<sub>2</sub>O at 40°. (Locke.)  
 3(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. Insol. in cold H<sub>2</sub>O. (Lachaud and Lepierre.)

**Ammonium iron (ferroferic) sulphate,**  
 4(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+3H<sub>2</sub>O.

Sl. sol. in cold H<sub>2</sub>O; decomp. into basic salt by hot H<sub>2</sub>O; insol. in alcohol. (Lachaud and Lepierre, C. R. 114. 916.)

**Ammonium ferrous magnesium sulphate,**  
 4(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 3FeSO<sub>4</sub>, MgSO<sub>4</sub>+24H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Schiff, A. 107. 64.)  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, MgSO<sub>4</sub>+12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Vohl, A. 94. 57.)

**Ammonium ferrous manganous sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, MnSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Vohl, A. 94. 57.)

**Ammonium ferrous nickel sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, NiSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Vohl, A. 94. 57.)

**Ammonium ferrous zinc sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, FeSO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Bette, A. 14. 286.)

**Ammonium lanthanum sulphate, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>,  
 La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O. (Marignac.)  
 Quite sol. in H<sub>2</sub>O. (Cleve.)  
 +2H<sub>2</sub>O. (Barre, C. R. 1910, 151. 872.)  
 5(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 2La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. Sl. sol. in (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq. of concentrations above 60%. (Barre, A. ch. 1911, (8) 24. 246.)  
 5(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Barre.)

**Ammonium lead sulphate, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, PbSO<sub>4</sub>.**

Decomp. by H<sub>2</sub>O into its constituents. (Wöhler and Litton, A. 43. 126.)

Decomp. by H<sub>2</sub>O. Only stable in contact with solutions containing:

13.86 pts. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts. H<sub>2</sub>O at 20°.

19.25 pts. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts. H<sub>2</sub>O at 50°.

24.31 pts. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts. H<sub>2</sub>O at 75°.

29.42 pts. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> per 100 pts. H<sub>2</sub>O at 100°.

(Barre, C. R. 1909, 149. 294.)

**Ammonium lithium sulphate, NH<sub>4</sub>LiSO<sub>4</sub>.**

Solubility in H<sub>2</sub>O = 35.25% at -10° and 36.18% at 70°. (Schreinmakers, C. C. 1906, I. 217.)

This is the only double salt which (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> forms with Li<sub>2</sub>SO<sub>4</sub> below 100°. (Spielrein, C. R. 1913, 157. 48.)

**Ammonium magnesium sulphate,**  
 (NH<sub>4</sub>)<sub>2</sub>Mg(SO<sub>4</sub>)<sub>2</sub>+6H<sub>2</sub>O.

100 pts. H<sub>2</sub>O dissolve 15.9 pts. anhydrous double salt at 13°. (Mulder.)

100 pts. H<sub>2</sub>O dissolve at:

0°	10°	15°	20°	30°
9.0	14.2	15.7	17.9	19.1

pts. anhydrous salt,  
 45° 50° 55° 60° 75°  
 25.6 30.0 31.9 36.1 45.3 pts. anhydrous salt.  
 (Tobler, A. 96. 193.)

More sol. in H<sub>2</sub>O than (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> or MgSO<sub>4</sub>. (Graham.)

1 l. H<sub>2</sub>O dissolves 199 pts. anhydrous salt at 25°. Tobler's results are inaccurate. (Locke, Am. Ch. J. 1902, 27. 459.)

100 g. H<sub>2</sub>O dissolve at:

34°	41° F.
18.22	20.72 g. (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> , MgSO <sub>4</sub> , 6H <sub>2</sub> O.
50°	59° F.
22.48	24.08 g. (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> , MgSO <sub>4</sub> , 6H <sub>2</sub> O,
60°	70° F.
24.81	28.26 g. (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> , MgSO <sub>4</sub> , 6H <sub>2</sub> O,

81° F.

33.33 g. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, 6H<sub>2</sub>O.

(Lothian, Pharm. J. 1910, (4) 80. 546.)

Lothian's results for solubility in H<sub>2</sub>O probably incorrect because of inaccuracy of experimental method. (Seidell, Pharm. J. 1911, (4) 33. 846.)

Solubility of (NH<sub>4</sub>)<sub>2</sub>Mg(SO<sub>4</sub>)<sub>2</sub> in H<sub>2</sub>O at t°.

t°	g. anhydrous salt per 100 g.	
	solution	H <sub>2</sub> O
0	10.58	11.83
10	12.75	14.61
20	15.23	17.96
25	16.45	19.69
30	17.84	21.71
40	20.51	25.86
50	23.18	30.17
60	26.02	35.17
80	32.58	48.32
100	39.66	65.72

(Porlezza, Att. Acc. Linc. 1914, (5) 23. II, 509.)

Min. *Cerbolite*.

**Ammonium magnesium nickel sulphate,**  
 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, NiSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Vohl, A. 94. 57.)

**Ammonium magnesium potassium zinc sulphate,** 2(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 3MgSO<sub>4</sub>, 3K<sub>2</sub>SO<sub>4</sub>, 2ZnSO<sub>4</sub>+30H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Schiff, A. 107. 64.)

(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 2MgSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+18H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Schiff.)

(NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Schiff.)

**Ammonium magnesium zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MgSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}.$   
 Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium manganous sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{MnSO}_4 + 6\text{H}_2\text{O}.$**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . (Jahn.)  
 1 l.  $\text{H}_2\text{O}$  dissolves 372 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)  
 $(\text{NH}_4)_2\text{SO}_4, 2\text{MnSO}_4$ . Readily decomp. by  
 $\text{H}_2\text{O}$ . (Lepierre, C. R. 1895, 120. 924.)

**Ammonium manganic sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Mn}_2(\text{SO}_4)_3.$**

Decomp. by  $\text{H}_2\text{O}$ . Insol. in ether,  $\text{C}_2\text{H}_6$ , and  
 conc.  $\text{H}_2\text{SO}_4$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Le-  
 pierre, Bull. Soc. 1895, (3) 13. 596.)  
 $+24\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Mitscher-  
 lich.)

**Ammonium manganous nickel sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4, \text{NiSO}_4 + 12\text{H}_2\text{O}.$   
 Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium manganous zinc sulphate,**  
 $2(\text{NH}_4)_2\text{SO}_4, \text{MnSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}.$   
 Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Ammonium mercuric sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $3\text{HgSO}_4 + 2\text{H}_2\text{O}.$**

(Hirzel, J. B. 1850. 333.)  
 $(\text{NH}_4)_2\text{SO}_4, \text{HgSO}_4$ . Difficultly sol. in  
 $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

**Ammonium mercurous sulphate ammonia,**  
 $3\text{Hg}_2\text{O}, 2(\text{NH}_4)\text{HgSO}_4, 2\text{NH}_3.$

Insol. in hot or cold, dil. or conc.  $\text{H}_2\text{SO}_4$ ,  
 and  $\text{HNO}_3$ . Sol. in  $\text{HCl}$ . (Tarugi, Gazz.  
 ch. it. 1903, 33. (1) 131.)

**Ammonium nickel sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{NiSO}_4 + 6\text{H}_2\text{O}.$**

Sol. in 4 pts. cold  $\text{H}_2\text{O}$ . (Link, 1796.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

3.5° 10° 16° 20° 30°  
 1.8 3.2 5.8 5.9 8.3 pts. anhydrous salt,

40° 50° 59° 68° 85°  
 11.5 14.4 16.7 18.8 28.6 pts. anhydrous salt.  
 (Tobler, A. 95. 193.)

100 pts. sat. solution contain at  $20^\circ$ , 9.4;  
 at  $40^\circ$ , 13.2; at  $60^\circ$ , 18.6; at  $80^\circ$ , 23.1 pts.  
 anhydrous salt. (v. Hauer, J. pr. 74. 433.)

1 l.  $\text{H}_2\text{O}$  dissolves 75.7 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)  
 Nearly insol. in a weak acid solution of  
 $(\text{NH}_4)_2\text{SO}_4$ . (Thompson, C. C. 1863. 957.)

**Ammonium nickel zinc sulphate,  $2(\text{NH}_4)_2\text{SO}_4,$   
 $\text{NiSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}.$**

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Ammonium nickel sulphate ammonia,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{NiSO}_4, 6\text{NH}_3 + 3\text{H}_2\text{O}.$   
 (André, C. R. 106. 936.)

**Ammonium platonic sulphate,  $2(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Pt}_2(\text{SO}_4)_3 + 25\text{H}_2\text{O}.$**

Sol. in  $\text{H}_2\text{O}$ . (Prost, Bull. Soc. (2) 46. 156.)

**Ammonium potassium sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}.$**

Soluble in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$  dis-  
 solve 13.68 pts. salt. (Thomson, 1831.)  
 Min. *Taylorite*.

**Ammonium praseodymium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{Pr}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}.$

Sl. sol. in  $\text{H}_2\text{O}$ . (von Scheele, Z. anorg.  
 1898, 18. 359.)

**Ammonium rhodium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_4, \text{Rh}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}.$

Very sol.  $\text{H}_2\text{O}$ ; melts in crystal  $\text{H}_2\text{O}$  at  
 $102-103^\circ$ . (Piccini, Z. anorg. 1901, 27. 67.)

**Ammonium samarium sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Sm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}.$**

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve, Bull. Soc. (2) 43.  
 166.)

**Ammonium scandium sulphate,  $(\text{NH}_4)_2\text{SO}_4,$   
 $\text{Sc}_2(\text{SO}_4)_3.$**

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)  
 Sol. in  $\text{H}_2\text{O}$  and in dil.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$   
 (R. J. Meyer, Z. anorg. 1914, 66. 279.)

**Ammonium sodium sulphate,  $\text{NH}_4\text{NaSO}_4 +$   
 $2\text{H}_2\text{O}.$**

100 pts.  $\text{H}_2\text{O}$  dissolve 46.6 pts. of cryst. salt  
 at  $15^\circ$ , and the solution has a sp. gr. of 1.1749.  
 Sp. gr. of aqueous solution containing:  
 31.8 24.44 15.9%  $\text{NH}_4\text{NaSO}_4 + 2\text{H}_2\text{O},$   
 1.1749 1.1380 1.0849  
 12.72 6.36 %  $\text{NH}_4\text{NaSO}_4 + 2\text{H}_2\text{O}.$   
 1.0679 1.0337

(Schiff, A. 114. 68.)

**Ammonium strontium sulphate.**

Insol. in excess of  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  (Rose,  
 Pogg. 110. 296.)

$(\text{NH}_4)_2\text{SO}_4, \text{SrSO}_4$ . This double salt is  
 only stable in contact with nearly sat. solu-  
 tions of  $(\text{NH}_4)_2\text{SO}_4$ . (Barre, C. R. 1909, 149.  
 293.)

**Ammonium tellurium sulphate,**  
 $(\text{NH}_4)\text{HSO}_4, 2\text{TeO}_3, \text{SO}_3 + 2\text{H}_2\text{O}.$

As K salt. (Metsner, A. ch. 1898, (7)  
 15. 203.)

**Ammonium thallic sulphate,  $\text{NH}_4\text{Ti}(\text{SO}_4)_3.$**

(Marshall, C. C. 1902, II. 1089.)  
 $+4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol.  
 in dil. acids. (Fortini, Gazz. ch. it. 1905, 35.  
 (2) 450.)

**Ammonium thorium sulphate**,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2$ .

Easily sol. in  $\text{H}_2\text{O}$  and sat.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$  (Cleve.)  
 $+2\text{H}_2\text{O.}$  (Barre.)  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O.}$  (Barre, A. ch. 1911, (8) 24. 240.)  
 $3(\text{NH}_4)_2\text{SO}_4 \cdot \text{Th}(\text{SO}_4)_2 + 3\text{H}_2\text{O.}$  (B.)

**Ammonium titanium sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{TiO}_2 \cdot \text{SO}_4 + \text{H}_2\text{O.}$

Very sol. in  $\text{H}_2\text{O}$  with decomp.  
 Insol. in conc.  $\text{H}_2\text{SO}_4$ . (Rosenheim, Z. anorg. 1901, 28. 252.)  
 $(\text{NH}_4)_2\text{O} \cdot 2\text{TiO}_2 \cdot 2\text{SO}_4 + 3\text{H}_2\text{O.}$  Slowly decomp. by  $\text{H}_2\text{O.}$  (Blondel, Bull. Soc. 1899, (3) 21. 262.)

**Ammonium titanium sesquisulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot 3\text{Ti}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O.}$

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HCl}$ .  
 Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ . (Stähler, B. 1905, 38. 2623.)

**Ammonium uranous sulphate**,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{U}(\text{SO}_4)_2$ .

Easily sol. in  $\text{H}_2\text{O.}$  (Rammelsberg.)  
 Sol. in  $\text{H}_2\text{O}$  but solution rapidly decomp. (Kohlschütter, B. 1901, 34. 3630.)

**Ammonium uranyl sulphate**,  $(\text{NH}_4)_2\text{SO}_4 \cdot (\text{UO}_2)_2\text{SO}_4 + 2\text{H}_2\text{O.}$

Quite difficultly sol. in  $\text{H}_2\text{O.}$  (Arfvedson.)

**Ammonium vanadous sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{VSO}_4 + 6\text{H}_2\text{O.}$

Decomp. in the air.  
 Sol. in  $\text{H}_2\text{O.}$  (Piccini, Z. anorg. 1899, 19. 205.)  
 Less sol. in  $\text{H}_2\text{O}$  than  $\text{VSO}_4 + 7\text{H}_2\text{O.}$  (Piccini and Marino, Z. anorg. 1902, 32. 60.)

**Ammonium vanadic sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{V}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O.}$

Insol. in  $\text{H}_2\text{O.}$   
 Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ .

Sol. in  $\text{HCl}$ . (Stähler, B. 1905, 38. 3980.)  
 $+24\text{H}_2\text{O.}$  Very sol. in  $\text{H}_2\text{O}$ ; decomp. in the air. (Piccini, Z. anorg. 1896, 11. 108.)  
 100 pts.  $\text{H}_2\text{O}$  dissolve 39.76 pts. salt at  $10^\circ$ .  
 Sp. gr. of sat. solution at  $4^\circ/20^\circ = 1.687$ . (Piccini, Z. anorg. 1897, 12. 446.)

1 l.  $\text{H}_2\text{O}$  dissolves 31.69 g. anhydrous or 78.51 g. hydrated salt at  $25^\circ$ , or 1.210 g. mols. anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ .  
 Mpt. of crystals  $= 45^\circ$ . (Locke, Am. Ch. J. 1901, 28. 175.)

**Ammonium vanadyl sulphate**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{VO}_2\text{SO}_4 + 3\frac{1}{2}\text{H}_2\text{O.}$

Easily sol. in  $\text{H}_2\text{O}$  and in a mixture of alcohol and conc.  $\text{H}_2\text{SO}_4$  but cannot be recryst. therefrom. (Koppel and Behrendt, Z. anorg. 1903, 35. 176.)

$(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{VO}_2\text{SO}_4 + \text{H}_2\text{O.}$  Deliquescent. Slowly but abundantly sol. in  $\text{H}_2\text{O}$ , but cannot be recryst. from it except by addition of  $\text{H}_2\text{SO}_4$ . (Koppel and Behrendt, Z. anorg. 1903, 35. 172.)

**Ammonium yttrium sulphate**,  $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{Y}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$  (Cleve.)

**Ammonium zinc sulphate**,  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4 + 6\text{H}_2\text{O.}$

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $(\text{NH}_4)_2\text{SO}_4 \cdot \text{ZnSO}_4$  at:

$0^\circ$	$10^\circ$	$13^\circ$	$15^\circ$	$20^\circ$
7.3	8.8	10.0	12.5	12.6 pts. salt,
$30^\circ$	$45^\circ$	$60^\circ$	$75^\circ$	$85^\circ$
16.5	21.7	29.7	37.8	46.2 pts. salt.

(Tobler, A. 95. 193.)

1 l.  $\text{H}_2\text{O}$  dissolves 140.8 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

$+7\text{H}_2\text{O.}$  (André, C. R. 104. 987.)

**Ammonium zirconium sulphate.**

Sol. in cold or hot  $\text{H}_2\text{O}$  or in acids. (Berzelius.)

**Ammonium sulphate antimony fluoride**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot 2\text{SbF}_3$ .

Very sol. in  $\text{H}_2\text{O.}$  (Mayer, B. 1894, 27. R. 922.)

**Ammonium sulphate chromic chloride**,  
 $2(\text{NH}_4)_2\text{SO}_4 \cdot \text{CrCl}_3 + 6\text{H}_2\text{O.}$

Sol. in  $\text{H}_2\text{O.}$  (Weinland, B. 1907, 40. 3768.)

**Ammonium sulphate hydrogen peroxide**,  
 $(\text{NH}_4)_2\text{SO}_4 \cdot \text{H}_2\text{O}_2$ .

Efflorescent in air.

Easily sol. in  $\text{H}_2\text{O.}$  (Willstätter, B. 1903, 36. 1829.)

**Antimony sulphate basic**,  $7\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O.}$

Insol. in, and not decomp. by hot or cold  $\text{H}_2\text{O.}$  (Adie, Chem. Soc. 57. 540.)

$5\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3 + 7\text{H}_2\text{O.}$  Insol. in  $\text{H}_2\text{O.}$  (Hensgen, R. t. c. 4. 401.)

$2\text{Sb}_2\text{O}_3 \cdot \text{SO}_3 + 2\text{H}_2\text{O.}$  Not decomp. by cold  $\text{H}_2\text{O.}$  (Adie.)

$\text{Sb}_2\text{O}_3 \cdot \text{SO}_3 = (\text{SbO})_2\text{SO}_4$ . Decomp. by hot  $\text{H}_2\text{O.}$  (Peligot, J. B. 1847. 426.)

$+ \text{H}_2\text{O.}$  As above. (Adie.)

$\text{Sb}_2\text{O}_3 \cdot 2\text{SO}_3$ , and  $+ \text{H}_2\text{O}$ , and  $+ 2\text{H}_2\text{O.}$  Scarcely decomp. by cold, slowly by boiling  $\text{H}_2\text{O.}$  Slowly sol. in dil.  $\text{HCl} + \text{Aq.}$  (Adie.)

**Antimony sulphate**,  $\text{Sb}_2(\text{SO}_4)_3$ .

Very deliquescent. Combines with  $\text{H}_2\text{O}$  to a hard mass with evolution of heat; with more  $\text{H}_2\text{O}$  it becomes liquid, and by repeated treat-

ment with much boiling  $H_2O$  it is wholly decomp. into  $H_2SO_4$  and  $Sb_2O_3$ . (Hensgen, R. t. c. 4. 401.)

**Antimony sulphate, acid,  $Sb_2O_3$ ,  $4SO_3$ ,**

Decomp. by  $H_2O$ . (Adie.)

$Sb_2O_3 + 8$ , or  $9SO_3$ . Decomp. by  $H_2O$ . (Adie.)

**Antimony barium sulphate,**

$Sb_2(SO_4)_3$ ,  $BaSO_4 + 6H_2O$ .

As Ca comp. (Kühl, Z. anorg. 1907, 54. 257.)

**Antimony caesium sulphate,  $SbCs(SO_4)_2$ .**

Slowly decomp. by cold  $H_2O$ . (Gutman, Arch. Pharm. 1908, 246. 188.)

**Antimony calcium sulphate,**

$Sb_2(SO_4)_3$ ,  $CaSO_4 + 6H_2O$ .

Decomp. by  $H_2O$ . (Kühl, Z. anorg. 1907, 54. 257.)

**Antimony lithium sulphate,  $SbLi(SO_4)_2$ .**

Decomp. by  $H_2O$ . (Gutman, Arch. Pharm. 1908, 246. 187.)

**Antimony potassium sulphate,  $KSb(SO_4)_2$ .**

Decomp. by  $H_2O$ . (Gutmann, Arch. Pharm. 1898, 236. 478.)

**Antimony rubidium sulphate,  $SbRb(SO_4)_2$ .**

Slowly decomp. by cold  $H_2O$ . (Gutman.)

**Antimony silver sulphate,  $SbAg(SO_4)_2$ .**

Slowly decomp. by  $H_2O$ . (Kühl, Z. anorg. 1907, 54. 258.)

Slowly decomp. by cold  $H_2O$ . (Gutman Arch. Pharm. 1908, 246. 189.)

**Antimony sodium sulphate,  $NaSb(SO_4)_2$ .**

Easily decomp. by  $H_2O$ . (Gutmann, Arch. Pharm. 1898, 236. 478.)

**Antimony strontium sulphate,  $Sb_2(SO_4)_3$ ,  $SrSO_4 + 6H_2O$ .**

As Ca comp. (Kühl, Z. anorg. 1907, 54. 257.)

**Antimony thallium sulphate,  $SbTl(SO_4)_2$ .**

Slowly decomp. by cold  $H_2O$ . Decomp. by conc.  $H_2SO_4$ . (Gutman, Arch. Pharm. 1908, 246. 189.)

**Arsenic sulphate.**

See Arsenic sulphur trioxide.

**Barium sulphate,  $BaSO_4$ .**

Sol. in 43,000 pts.  $H_2O$  (Kirwan); in 200,000 pts.  $H_2O$  (Margueritte, C. R. 38. 308).

100 pts.  $H_2O$  dissolve 0.002 pt.  $BaSO_4$ . (Ure's Diet.)

$BaCl_2 + Aq$  containing 1 pt.  $BaO$  to 71,000 pts.  $H_2O$ , when treated with  $H_2SO_4$ , becomes turbid in  $\frac{1}{2}$  hour. (Harting, J. pr. 22. 52.)

$Ba(NO_3)_2 + Aq$  containing 1 pt.  $BaO$  to 25,000 pts.  $H_2O$  gives a distinct cloud with  $H_2SO_4$ , or  $Na_2SO_4 + Aq$ ; with 50,000-100,000 pts.  $H_2O$  a slight turbidity is produced; with 200,000-400,000 pts.  $H_2O$  the mixture becomes turbid in a few minutes; while with 800,000 pts.  $H_2O$  no action is visible. (Lassaigne, J. Chim. Méd. 8. 526.)

Sol. in 800,000 pts.  $H_2O$  (Calvert); in 400,000 pts. cold or hot  $H_2O$  (Fresenius).

Calculated from the electrical conductivity of the solution,  $BaSO_4$  is sol. in 429,700 pts.  $H_2O$  at  $18.4^\circ$ , and 320,000 pts. at  $37.7^\circ$ . (Holleman, Z. phys. Ch. 12. 131.)

1 l.  $H_2O$  dissolves 1.72 mg. at  $2^\circ$ ; 1.97 mg. at  $10^\circ$ ; 2.29 mg. at  $19.0^\circ$ ; 2.60 mg. at  $26^\circ$ ; 2.91 mg. at  $34^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

Calculated from the electrical conductivity of the solution,  $BaSO_4$  is sol. in 425,000 pts.  $H_2O$  at  $18.3^\circ$ . Results of Fresenius and Hintz (Z. anal. 1896, 35. 170) are incorrect. (Küster, Z. anorg. 1896, 12. 267.)

Sat. aq. solution contains 2.29 mg.  $BaSO_4$  per liter at  $25^\circ$  when particles of salt are not less than  $1.8\mu$  in diameter.

Sat. aq. solution contains 4.15 mg.  $BaSO_4$  per liter at  $25^\circ$  when particles of salt are  $0.1\mu$  in diameter. ( $\mu = 0.0001$  cm.) (Hulett, Z. phys. Ch. 1901, 37. 398-9.)

In general the influence of the size of the grain on the solubility of the substance is negligible when the solubility exceeds 2%. The increase of normal solubility by using finely divided solids, amounts to 80% in the case of  $BaSO_4$ . (Hulett, Z. phys. Ch. 1904, 47. 366.)

1 l.  $H_2O$  dissolves 2.3 mg.  $BaSO_4$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

Calculated from electrical conductivity of  $BaSO_4 + Aq$ .

0.0190 milli-equivalents are sol. in 1 liter  $H_2O$  at  $18^\circ$ ; 0.0212 at  $25^\circ$ ; 0.0288 at  $50^\circ$ ; 0.0334 at  $100^\circ$ .

(Melcher, J. Am. Chem. Soc. 1910, 32. 55.)

Not attacked by cold  $HCl$  or  $HNO_3 + Aq$  after several hours, and only in traces after several days. On boiling, traces of  $BaSO_4$  dissolve, and the liquid after cooling can be precipitated by  $BaCl_2$  or  $H_2SO_4 + Aq$ , but not by  $H_2O$  alone. (Rose, Pogg. 95. 108.)

By washing  $BaSO_4$  long enough with  $H_2O$  containing  $HCl$  or  $HNO_3$ , [ $HC_2H_3O_2$  (Siegle)], the filtrate can be precipitated by  $H_2SO_4$ , or  $BaCl_2$ . (Piria, J. B. 1858. 334.)

1000 pts. 3%  $HCl + Aq$  dissolve 0.06 pt.  $BaSO_4$  in the cold, and still more on boiling.

230 ccm.  $HCl + Aq$  of 1.02 sp. gr. dissolve 0.048 g.  $BaSO_4$  from 0.679 g.  $BaSO_4$ , when boiled  $\frac{1}{4}$  hour.

168 ccm.  $HCl + Aq$  of 1.03 sp. gr. dissolve 0.0075 g.  $BaSO_4$  from 0.577 g.  $BaSO_4$ , when boiled 5 minutes. (Siegle, J. pr. 69. 142.)



Solubility of  $\text{BaSO}_4$  in  $\text{HCl} + \text{Aq.}$ 

No. cc. $\text{HCl} + \text{Aq.}$ containing 1 mg. equiv. $\text{HCl}$	Mg. $\text{BaSO}_4$ per 1 mg. equiv. of $\text{HCl}$	g. per 100 cc. solution	
		$\text{HCl}$	$\text{BaSO}_4$
2.0	0.133	1.82	0.0067
1.0	0.089	3.65	0.0089
0.5	0.056	7.29	0.0101
0.2	0.017	18.23	0.0086

(Banthisch, J. pr. 1884, 29. 54.)

100,000 pts.  $\text{H}_2\text{O}$  dissolve 0.124 pt.  $\text{BaSO}_4$ ;  
1000 pts.  $\text{HNO}_3 + \text{Aq.}$  of 1.167 sp. gr. dissolve  
2 pts.  $\text{BaSO}_4$ ; 1000 pts.  $\text{HNO}_3 + \text{Aq.}$  of 1.032  
sp. gr. dissolve 0.062 pt.  $\text{BaSO}_4$ . (Calvert,  
Chem. Gaz. 1856. 55.)

When 0.4 g.  $\text{BaSO}_4$  is heated  $\frac{1}{4}$  hour with  
150 ccm.  $\text{HNO}_3 + \text{Aq.}$  of 1.02 sp. gr., 0.165 g.  
is dissolved. (Siegle, J. pr. 69. 142.)

Solubility of  $\text{BaSO}_4$  in  $\text{HNO}_3 + \text{Aq.}$ 

No. cc. $\text{HNO}_3 + \text{Aq.}$ containing 1 mg. equiv. $\text{HNO}_3$	Mg. $\text{BaSO}_4$ per 1 mg. equiv. of $\text{BaSO}_4$	G. per 100 cc. solution	
		$\text{HNO}_3$	$\text{BaSO}_4$
2.0	0.140	3.15	0.0070
1.0	0.107	6.31	0.0107
0.5	0.085	12.61	0.0170
0.2	0.048	31.52	0.0241

(Banthisch, J. pr. 1884, 29. 54.)

Acetic acid has less solvent power than  
other acids. 80 ccm.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$  of 1.02  
sp. gr. boiled with 0.4 g.  $\text{BaSO}_4$   $\frac{1}{4}$  hour dis-  
solve 0.002 g. (Siegle, J. pr. 69. 142.)

Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . (See  
 $\text{BaH}_2(\text{SO}_4)_2$ .)

Sol. in fuming  $\text{H}_2\text{SO}_4$ . (See  $\text{BaS}_2\text{O}_7$ .)

Sol. in 2500 pts. boiling 40%  $\text{HBr} + \text{Aq.}$ ; in  
6000 pts. boiling 40%  $\text{HI} + \text{Aq.}$  (Haslam,  
C. N. 53. 87.)

Sol. in considerable amount in metaphos-  
phoric acid +  $\text{Aq.}$  (Scheerer and Drechsel,  
J. pr. (2) 7. 68.)

Not attacked by boiling conc.  $\text{KOH} + \text{Aq.}$  if  
 $\text{CO}_2$  is not present. (Rose, Pogg. 95. 104.)

Very sl. decomp. by standing a long time  
with cold conc. alkali carbonates +  $\text{Aq.}$

Decomp. by boiling  $\text{Na}_2\text{CO}_3$  or  $\text{K}_2\text{CO}_3 +$   
 $\text{Aq.}$  not by  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$  (See Storer's  
Dict. for analytical data.)

Very sl. sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  1 pt. dissolv-  
ing in 230,000 pts. sat.  $\text{NH}_4\text{Cl} + \text{Aq.}$

500 ccm. sat.  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  with 50 ccm.  
sat.  $\text{NH}_4\text{Cl} + \text{Aq.}$  dissolve 2 g.  $\text{BaSO}_4$ . 100  
ccm. sat.  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  with 100 ccm. sat.  
 $\text{NH}_4\text{Cl} + \text{Aq.}$  dissolve only 0.08 g.  $\text{BaSO}_4$ ,  
therefore above solubility is due to free  
chlorine. (Mittentzwey, J. pr. 75. 214.)

$\text{BaSO}_4$  cannot be precipitated from solu-  
tions containing free  $\text{Cl}_2$ . (Erdmann, J. pr.  
75. 215.)

Pptn. is retarded sl. by tartaric and racemic  
acids. (Spiller.)

$\text{Na}$  metaphosphate prevents pptn. of  $\text{BaSO}_4$ ,  
but not ortho- or pyrophosphate. (Scheerer,  
J. pr. 75. 114.)

Not precipitated in presence of alkali ci-  
trates. (Spiller.)

Much less sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  than in  
 $\text{NH}_4\text{NO}_3 + \text{Aq.}$  Insol. in warm conc.  $\text{Na}_2\text{S}_2\text{O}_8$ ,  
+  $\text{Aq.}$  (Diehl, J. pr. 79. 431.)

Not appreciably sol. in  $\text{H}_2\text{O}$  containing  
ammonium or sodium chloride. (Brett, Witt-  
stein, Wackenroder.)

Not appreciably sol. in  $\text{H}_2\text{O}$  at  $250^\circ$ , or in  
 $\text{H}_2\text{O}$  containing  $\text{Na}_2\text{S}$ . (Senarmont.)

Solubility is increased by alkali nitrates,  
but not appreciably by  $\text{NaCl}$ ,  $\text{KClO}_3$ , or  
 $\text{Ba}(\text{NO}_3)_2$ . (Fresenius, Z. anal. 9. 52.)  
Scarcely sol. in boiling conc.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq.}$   
(Fresenius.)

Solubility in  $\text{H}_2\text{O}$  increased by presence of  
 $\text{MgCl}_2$  (Fresenius); cerium salts (Marignac).

Sol. in  $\text{Fe}_2\text{Cl}_4 + \text{Aq.}$  (Lunge, Z. anal. 19.  
141.)

Solubility in various salts +  $\text{Aq.}$  at  $20-25^\circ$ .

g. salt per l.	Mg. $\text{BaSO}_4$ dissolved per l. in		
	$\text{FeCl}_3$	$\text{AlCl}_3$	$\text{MgCl}_2$
1	58	33	30
2.5	72	43	30
5	115	60	33
10	123	94	33
25	150	116	50
50	160	170	50
100	170	175	50

(Fraps, Am. Ch. J. 1902, 27. 290.)

Solubility in sat. solution of various salts +  
 $\text{Aq.}$ 

Salt	G. $\text{BaSO}_4$ sol. in 1 l. of the solvent
$\text{NaNO}_3$	0.2940
$\text{NaCl}$	0.00783
$\text{NH}_4\text{Cl}$	0.00827

(Ehlert, Z. Elektrochem, 1912, 18. 728.)

Conc.  $\text{CrCl}_3 + \text{Aq.}$  dissolves 40-120 times  
as much  $\text{BaSO}_4$  as  $\text{H}_2\text{O}$ , when boiled there-  
with for 5 days; conc.  $\text{CrCl}_3 + \text{Aq.}$  acidified  
with  $\text{HCl}$ , 450 times as much in 10 days.  
(Kuster, Z. anorg. 1905, 43. 348.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch.  
J. 1898, 20. 827.)

Sol. in  $\text{H}_2\text{O}_2 + \text{Aq.}$  (Gawalowski, C. C.  
1906, II. 7.)

100 cc. 95% formic acid dissolve 0.01 g.  
 $\text{BaSO}_4$  at  $18.5^\circ$ . (Aschan, Ch. Ztg. 1913, 37.  
1117.)

Insol. in methyl acetate. (Naumann, B.  
1909, 43. 3790); in ethyl acetate. (Naumann,  
B. 1904, 37. 3601.)

Min. Barits.

**Barium hydrogen sulphate,  $\text{BaH}_2(\text{SO}_4)_2$ .**

100 pts.  $\text{H}_2\text{SO}_4$  dissolve 2.22 pts.  $\text{BaSO}_4$  (Lies-Bodart and Jacquemin, C. R. 46. 1206); 5.69 pts.  $\text{BaSO}_4$  (Struve, Z. anal. 9. 34).

Boiling  $\text{H}_2\text{SO}_4$  dissolves 10–12% freshly precipitated  $\text{BaSO}_4$  without separating crystals on cooling.  $\text{H}_2\text{SO}_4$  at  $100^\circ$  dissolves more than boiling  $\text{H}_2\text{SO}_4$ , and becomes cloudy if heated to boiling. (Schultz, Pogg. 133. 146.)

1 g.  $\text{BaSO}_4$  pptd. from  $\text{BaCl}_2$  is sol. in 3153 g. 91%  $\text{H}_2\text{SO}_4$ ; from  $\text{Ba}(\text{NO}_3)_2$  is sol. in 1519 g. 91%  $\text{H}_2\text{SO}_4$ . (Varenne and Pauleau, C. R. 93. 1016.)

100 pts. hot conc.  $\text{H}_2\text{SO}_4$  dissolve approx. 6 pts.  $\text{BaSO}_4$ . (Rohland, Z. anorg. 1910, 66. 206.)

10 ccm. of sat.  $\text{BaSO}_4$  + absolute  $\text{H}_2\text{SO}_4$  contain approx. 2.851 g.  $\text{BaSO}_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

Equilibrium in the system  $\text{BaSO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$  at  $25^\circ$ .

Composition of the solution

% $\text{H}_2\text{SO}_4$	g. $\text{BaSO}_4$ per l.	Solid phase
73.83	0.030	$\text{BaSO}_4$
78.04	0.135	"
80.54	0.285	"
83.10	0.800	"
85.78	3.215	$\text{BaSO}_4, 2\text{H}_2\text{SO}_4, \text{H}_2\text{O}$
88.08	12.200	"
93.17	49.665	$\text{BaSO}_4, \text{H}_2\text{SO}_4$

(Volkhonski, C. C. 1910, I. 1954; C. A. 1911. 617.)

Decomp. by  $\text{H}_2\text{O}$ , alcohol, or ether.

+  $2\text{H}_2\text{O}$ . (Schultz.)

$\text{BaSO}_4, 2\text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ . (Volkhonski.)

**Barium pyrosulphate,  $\text{Ba}_2\text{S}_2\text{O}_7$ .**

100 pts. fuming  $\text{H}_2\text{SO}_4$  dissolve 15.89 pts.  $\text{BaSO}_4$ . (Struve, Z. anal. 9. 34.)

Very deliquescent.

Decomp. with  $\text{H}_2\text{O}$  with hissing. (Schultz-Sellack, B. 4. 111.)

**Barium calcium sulphate,  $3\text{BaSO}_4, \text{CaSO}_4$ .**

Min. *Dreelite*.

**Barium platinic sulphate (?).**

Insol. in  $\text{H}_2\text{O}$  or boiling  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . Sol. in hot conc.  $\text{H}_2\text{SO}_4$  or aqua regia. (E. Davy.)

**Barium tin (stannic) sulphate,  $\text{BaSO}_4, \text{Sn}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . Insol. in  $\text{HCl}$ . (Weinland and Kühl, Z. anorg. 1907, 54. 249.)

**Barium titanium sulphate,  $2\text{BaSO}_4, 3\text{Ti}(\text{SO}_4)_2$ .**

Ppt. Decomp. by  $\text{H}_2\text{O}$ , giving titanic acid. (Weinland, Z. anorg. 1907, 54. 255.)

**Barium sulphate potassium chloride,  $3\text{BaSO}_4, \text{KCl}$ .**

Ppt. (Silberberger, M. 1904, 25. 233.)

**Bismuth sulphate, basic,  $(\text{BiO})_2\text{SO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

+  $2\text{H}_2\text{O}$ . (Heintz, Pogg. 63. 55.)

$4\text{Bi}_2\text{O}_3, 3\text{SO}_3 + 15\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Leist.)

$(\text{BiO})\text{HSO}_4 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

+  $2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of  $(\text{BiO})_2\text{SO}_4 + 2\text{H}_2\text{O}$ . (Heintz.)

$3\text{Bi}_2\text{O}_3, 2\text{SO}_3 + 2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Athanasesco, C. R. 103. 271.)

$5\text{Bi}_2\text{O}_3, 11\text{SO}_3 + 17\text{H}_2\text{O}$ . This sulphate crystallizes out from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4, 6\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4, 12\text{H}_2\text{O}$ . (Adie, Proc. Chem. Soc. 1899, 15. 226.)

$\text{Bi}_2\text{O}_3, 2\text{SO}_3, 2\frac{1}{2}\text{H}_2\text{O}$  is in equilibrium at  $50^\circ$  with 5.4–51.4%  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$\text{Bi}_2\text{O}_3, \text{SO}_3$  is in equilibrium at  $50^\circ$  with acid solutions weaker than 5.4%  $\text{H}_2\text{SO}_4$ .

(Allan, Am. Ch. J. 1902, 27. 287.)

**Bismuth sulphate,  $\text{Bi}_2(\text{SO}_4)_3$ .**

Very hygroscopic. Takes up  $\text{H}_2\text{O}$  with strong evolution of heat to form  $2\text{Bi}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}$ , which becomes  $\text{Bi}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$  at  $100^\circ$ . Decomp. by boiling  $\text{H}_2\text{O}$  into  $\text{Bi}_2\text{O}_3, \text{SO}_3 + \text{H}_2\text{O}$ . (Hensgen, J. B. 1885. 552.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Bismuth sulphate, acid,  $\text{Bi}_2\text{O}_3, 4\text{SO}_3$ .**

$\text{Bi}_2\text{O}_3, 4\text{SO}_3$  is in equilibrium at  $50^\circ$  with 51.4–90%  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Allan, Am. Ch. J. 1902, 27. 287.)

+  $\text{H}_2\text{O}$ . Crystallizes out from sulphuric acid at temp. above  $170^\circ$ . (Adie, Proc. Chem. Soc. 1899, 15. 226.)

+  $3\text{H}_2\text{O}$ . Crystallizes from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4, \text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4, 2\text{H}_2\text{O}$ . (Adie.)

+ 7, or  $9\text{H}_2\text{O} = \text{BiH}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids, especially  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Leist, A. 160. 29.)

+  $7\text{H}_2\text{O}$ . Crystallizes out from sulphuric acid of any strength between  $\text{H}_2\text{SO}_4, 3\text{H}_2\text{O}$  and  $\text{H}_2\text{SO}_4, 5\text{H}_2\text{O}$ .

+  $10\text{H}_2\text{O}$ . Crystallizes out from sulphuric acid at temp. below  $170^\circ$ . (Adie.)

**Bismuth potassium sulphate,  $\text{Bi}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$  (?).**

Decomp. by  $\text{H}_2\text{O}$ ; insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Heintz.)

$\text{Bi}_2(\text{SO}_4)_3, 2\text{K}_2\text{SO}_4$ .

$\text{BiK}(\text{SO}_4)_2 = \text{Bi}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4$ . Insol. in cold  $\text{H}_2\text{O}$ ; decomp. by boiling. (Brigham, Am. Ch. J. 14. 170.)

**Bismuth sodium sulphate**,  $\text{Bi}_2\text{Na}_4(\text{SO}_4)_4$ .  
(Lüdecke, A. 140. 277.)

**Boron sulphate.**

See Borosulphuric acid.

**Bromomolybdenum sulphate.**

See under Bromomolybdenum compounds.

**Cadmium sulphate, basic**,  $2\text{CdO}$ ,  $\text{SO}_3$ , and  $+\text{H}_2\text{O}$ .

Difficultly sol. in  $\text{H}_2\text{O}$ . (Stromeyer.) Sl. sol. in hot  $\text{H}_2\text{O}$ . (Habermann, M. 6. 432.)

$4\text{CdO}$ ,  $\text{SO}_3$ . (Pickering, Chem. Soc. 1907, 91. 1987.)

**Cadmium sulphate**,  $\text{CdSO}_4$ .

Sat.  $\text{CdSO}_4 + \text{Aq}$  contains at:

0°	10°	24°	30°	65°
35.9	37.5	41.5	42.0	49.7% $\text{CdSO}_4$
86°	94°	130°	165°	188°
43.5	91.6	27.7	14.7	7.1
				2.3% $\text{CdSO}_4$

$\text{CdSO}_4$  easily forms supersat. solutions. (Étard, A. ch. 1894, (7) 2. 552.)

Solubility in  $\text{H}_2\text{O}$ .

t°	Per cent $\text{CdSO}_4$ in sat. solution	Solid phase
-18	43.35	Ice
-10	43.27	"
0	43.01	$\text{CdSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
+10	43.18	"
15	43.20	"
20	43.37	"
30	43.75	"
40	43.99	"
60	44.99	"
62	45.06	"
72	46.2	"
73.5	46.6	"
74.5	46.7	"
75	46.5	$\text{CdSO}_4 \cdot \text{H}_2\text{O}$
77	42.2	"
78.5	41.5	"
85	39.6	"
90	38.7	"
95	38.1	"
100	37.8	"

(Mylius and Funk, B. 1897, 30. 825.)

See also under  $\text{CdSO}_4 + 2\frac{1}{2}\text{H}_2\text{O}$ , and  $7\text{H}_2\text{O}$ .

Sp. gr. at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 14.0 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.0122$ .

Sp. gr. at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 14.0 g.  $\text{CdSO}_4$  in 100 g.  $\text{H}_2\text{O} = 1.0121$ .

Sp. gr. at  $12^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 57.2 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.0514$ .

Sp. gr. at  $0^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 183.1 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.1552$ .

Sp. gr. at  $13^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 183.1 g.  $\text{CdSO}_4$  in 1000 g.  $\text{H}_2\text{O} = 1.1529$ .

(Fouqué, Ann. Observ. 1868, 9. 172.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{CdSO}_4$	1	5	10	15
Sp. gr.	1.0084	1.0486	1.1026	1.1607

% $\text{CdSO}_4$	20	25	30	35
Sp. gr.	1.2245	1.295	1.3725	1.4575

% $\text{CdSO}_4$	36
Sp. gr.	1.4743

(Grotrian, W. Ann. 1883, 18. 193.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at room temp. containing:

	7.14	14.66	22.011% $\text{CdSO}_4$
	1.0681	1.1591	1.2681

(Wagner, W. Ann. 1883, 18. 268.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CdSO}_4 + \text{Aq}$	Sp. gr.
1-normal	1.0973
$\frac{1}{2}\text{N}$ "	1.0487
$\frac{1}{4}\text{N}$ "	1.0244
$\frac{1}{8}\text{N}$ "	1.0120

(Wagner, Z. phys. Ch. 1890, 5. 36.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$ .

% $\text{CdSO}_4$	t°	Sp. gr. at t°	Sp. gr. at $18^\circ$
0.0289	17.29	0.99908	0.99893
...	23.65	0.99776	...
0.0498	18.00	...	0.99915
0.0999	18.00	...	0.99961
0.495	18.00	...	1.0034
0.981	18.00	...	1.0084

(Wershofen, Z. phys. Ch. 1890, 5. 494.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{CdSO}_4 + \text{Aq}$  containing 29.4654%  $\text{CdSO}_4 = 1.36289$ ; containing 21.3671%  $\text{CdSO}_4 = 1.24211$ . (Schönrock, Z. phys. Ch. 1893, 11. 781.)

Sp. gr. of  $\text{CdSO}_4 + \text{Aq}$  at  $18^\circ/4^\circ$ .

% $\text{CdSO}_4$	25.121	18.172
Sp. gr.	1.297	1.200

% $\text{CdSO}_4$	9.952	5.639
Sp. gr.	1.101	1.055

(de Muynck, W. Ann. 1894, 53. 561.)

$\text{CdSO}_4 + \text{Aq}$  containing 13.40%  $\text{CdSO}_4$  has sp. gr.  $20^\circ/20^\circ = 1.1429$ .

$\text{CdSO}_4 + \text{Aq}$  containing 16.79%  $\text{CdSO}_4$  has sp. gr.  $20^\circ/20^\circ = 1.1847$ .

(Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 282.)

Sp. gr. of  $\text{CdSO}_4$  at  $18.2^\circ$ , when  $p$ =per cent strength of solution;  $d$ =observed density;  $w$ =volume conc. in grams per cc. ( $\frac{pd}{100} = w$ .)

p	d	w
39.86	1.5639	0.6231
31.53	1.4080	0.4439
26.85	1.3310	0.3574
24.17	1.2901	0.3118
18.35	1.2084	0.2217
13.27	1.1437	0.1518
9.97	1.1045	0.1102
7.46	1.0764	0.0803
6.12	0.0619	0.0650
2.52	0.0242	0.0259
1.45	0.0132	0.0147
0.464	0.0033	0.0046

(Barnes, J. phys. Ch. 1898, 2. 543.)

Sp. gr. of  $\text{CdSO}_4$ +Aq sat. at  $25^\circ$  and 1 atm. =1.617. (Sinnige, Z. phys. Ch. 1909, 67. 518.)

See also under  $\text{CdSO}_4$ + $2\frac{1}{2}\text{H}_2\text{O}$ , and + $4\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329); methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

+ $\text{H}_2\text{O}$ . See Mylius and Funk, under  $\text{CdSO}_4$ .

+ $1\frac{1}{2}\text{H}_2\text{O}$ . (Worobieff, Bull. Soc. 1896, (3) 16. 1754.)

+ $2\frac{1}{2}\text{H}_2\text{O}$ . 1 pt.  $\text{H}_2\text{O}$  dissolves 0.59 pt. anhydrous salt at  $23^\circ$ , and not much more on heating. Sat. solution boils at  $102^\circ$ . Precipitated by alcohol. (v. Hauer.)

100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{CdSO}_4$  at  $t^\circ$ .

$t^\circ$	G. $\text{CdSO}_4$
0	75.52
5	75.65
7	65.73
9	75.85
11.5	75.94
13	76.04
15	76.11
16	76.16
17	76.13
18	76.14
19	76.18
25	76.79

(Kohnstamm and Cohen, W. Ann. 1898, 65. 352.)

100 pts.  $\text{H}_2\text{O}$  dissolves at:

$13.7^\circ$   $14.98^\circ$   $15.0^\circ$   $16.0^\circ$

76.06 76.09 76.14 76.18 pts. anhydrous salt,

$16.96^\circ$   $18.0^\circ$   $19.0^\circ$   $25.0^\circ$

76.26 76.32 76.39 76.81 pts. anhydrous salt.

(Steinwehr, W. Ann. 1902, (4) 9. 1050.)

100 g.  $\text{H}_2\text{O}$  dissolve 76.02 g.  $\text{CdSO}_4$  at  $25^\circ$ . (Stortenbecker, Z. phys. Ch. 1900, 34. 109.)

Solubility of  $\text{CdSO}_4$ + $2\frac{1}{2}\text{H}_2\text{O}$  at  $25^\circ$  and varying pressures.

Pressure in atmospheres	G. $\text{CdSO}_4$ in 100 g. $\text{H}_2\text{O}$
1	76.80
500	77.85
500	78.08
1000	78.77
1000	78.68

Det. by another method

Pressure in atmospheres	G. $\text{CdSO}_4$ in 100 g. $\text{H}_2\text{O}$
250	77.53
500	78.02
750	78.60
1000	78.96

(Cohen and Sinnige, Trans. Farad. Soc. 1910, 5. 269.)

Sp. gr. at  $21.6/0^\circ$  of  $\text{CdSO}_4$ +Aq containing 11.47%  $\text{CdSO}_4$ + $\frac{1}{2}\text{H}_2\text{O}$ =1.0944. (Kannnikoff, J. pr. 1885, (2) 31. 346.)

100 g.  $\text{H}_2\text{O}$  dissolve 57.61 g.  $\text{CdSO}_4$ +10.63 g.  $\text{FeSO}_4$  at  $25^\circ$ . (Stortenbecker, Z. phys. Ch. 1900, 34. 109.)

+ $4\text{H}_2\text{O}$ . (Lescœur, A. ch. 1895, (7) 4. 222.)

Sp. gr. at  $15^\circ$  of  $\text{CdSO}_4$ +Aq containing 10 g.  $\text{CdSO}_4$ + $4\text{H}_2\text{O}$  in 100 cc. of solution = 1.0790; containing 20 g.  $\text{CdSO}_4$ + $4\text{H}_2\text{O}$  in 100 cc. of solution = 1.1522. (Traube, J. pr. 1885, (2) 31. 207.)

Could not be obtained. (Mylius and Funk.)

+ $7\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

$t^\circ$	% $\text{CdSO}_4$
-17	44.45
-16	44.5
-12	45.3
-10	46.1
-7	47.5
-5	48.5
-4.5	48.7

(Mylius and Funk, B. 1897, 30. 828.)

Cadmium caesium sulphate,  $\text{CdSO}_4$ ,  $\text{Cs}_2\text{SO}_4$ + $6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton, Chem. Soc. 63. 337.)  
1 l.  $\text{H}_2\text{O}$  dissolves 1399 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

**Cadmium calcium potassium sulphate**,  
 $\text{Ca}_2\text{CdK}_2(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .  
 (D'Ans, B. 1908, 41. 1778.)

**Cadmium cerium sulphate**,  $\text{CdSO}_4, \text{Ce}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (Wyruboff.)

**Cadmium hydrazine sulphate**,  
 $\text{CdH}_2(\text{SO}_4)_2, 2\text{N}_2\text{H}_4$ .  
 1 pt. is sol. in 202.5 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ .  
 Not attacked by dil. acids. Easily sol. in  
 $\text{NH}_4\text{OH} + \text{Aq}$ . (Curtius, J. pr. 1894, (2) 60.  
 331.)

**Cadmium magnesium sulphate**,  $\text{CdSO}_4$ ,  
 $\text{MgSO}_4 + 14\text{H}_2\text{O}$ .  
 Very efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Schiff, A.  
 104. 325.)

**Cadmium potassium sulphate**,  $\text{K}_2\text{SO}_4, \text{CdSO}_4$ ,  
 $+1\frac{1}{2}\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (v. Hauer, Pogg. 133. 176.)  
 100 pts.  $\text{H}_2\text{O}$  dissolve 42.50 pts. anhydrous  
 salt at  $26^\circ$ ;  
 100 pts.  $\text{H}_2\text{O}$  dissolves 42.80 pts. anhydrous  
 salt at  $31^\circ$ ;  
 100 pts.  $\text{H}_2\text{O}$  dissolve 43.45 pts. anhydrous  
 salt at  $40^\circ$ ;  
 100 pts.  $\text{H}_2\text{O}$  dissolve 44.90 pts. anhydrous  
 salt at  $64^\circ$ . (Wyruboff, Bull. Soc. Min.  
 1901, 24. 68.)  
 $+2\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 42.89 pts.  
 anhydrous salt at  $16^\circ$ ; 46.82 pts. at  $31^\circ$ ;  
 47.40 pts. at  $40^\circ$ . (Wyruboff.)  
 $+4\text{H}_2\text{O}$ . Efflorescent. (Wyruboff, Bull.  
 Soc. Min. 1891, 14. 235.)  
 $+6\text{H}_2\text{O}$ . Very efflorescent, and easily  
 decomp. (Schiff.)  
 Does not exist. (Wyruboff.)

**Cadmium rubidium sulphate**,  $\text{CdSO}_4$ ,  
 $\text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .  
 Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Tutton.)  
 1 l.  $\text{H}_2\text{O}$  dissolves 767 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

**Cadmium sodium sulphate**,  $\text{CdSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2 + 2\text{H}_2\text{O}$  in 100 g.  
 $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
24	35.49	24.04
25	35.88	24.46
30	36.28	24.605
35	36.69	24.99
40	37.24	25.455

(Koppel, Z. phys. Ch. 1905, 52. 413.)

Decomp. by  $\text{H}_2\text{O}$  below  $20.5^\circ$ .

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2, 2\text{H}_2\text{O} + \text{CdSO}_4$ ,  
 $\frac{1}{2}\text{H}_2\text{O}$  in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$	$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$	$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
0	73.54	8.85	15	73.76	9.425	30	73.915	11.10
5	73.38	8.67	20	73.81	9.453	35	75.01	12.32
10	72.76	9.55	25	73.71	10.48	40	75.385	13.75

(Koppel.)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2, 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ ,  
 $10\text{H}_2\text{O}$  in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
-14.8	72.68	8.32
0	66.325	11.625
5	61.78	12.97
10	55.34	14.785
12	51.615	15.95
15	46.60	17.99
19.8	36.13	22.16
20	36.25	23.52
24	27.82	29.17
25	25.59	31.06
30	14.62	44.145

(Koppel.)

Solubility of  $\text{CdNa}_2(\text{SO}_4)_2, 2\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ ,  
 (anhydrous) in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{CdSO}_4$	Grams $\text{Na}_2\text{SO}_4$
35	13.26	47.06
40	16.25	46.27

(Koppel.)

**Cadmium sulphate ammonia**,  $\text{CdSO}_4, 6\text{NH}_3$ .  
 Sol. in  $\text{H}_2\text{O}$  with separation of  $\text{CdO}$ . (Rose,  
 Pogg. 20. 152.)  
 $\text{CdSO}_4, 4\text{NH}_3 + 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ .  
 (Malaguti and Sarzeau, A. ch. (3) 9. 431.)  
 $+2\text{H}_2\text{O}$ . Ppt. (André, C. R. 104. 987.)  
 $+2\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with separation of  
 basic sulphate. (Müller, A. 149. 70.)  
 $\text{CdSO}_4, 3\text{NH}_3$ . (Isambert, C. R. 1870, 70.  
 457.)

**Cadmium sulphate cupric oxide**,  $\text{CdSO}_4$ ,  
 $3\text{CuO} + x\text{H}_2\text{O}$ .  
 (Recoura, C. R. 1901, 132. 1415.)  
 $2\text{CdSO}_4, 3\text{CuO} + 8\text{H}_2\text{O}$ . (Mailhe, A. ch.  
 1902, (7) 27. 383.)  
 $+12\text{H}_2\text{O}$ . (Mailhe.)  
 $6\text{CdSO}_4, 20\text{CuO} + x\text{H}_2\text{O}$ . (Recoura, C. R.  
 1901, 132. 1415.)

**Cadmium sulphate hydrazine**,  $\text{CdSO}_4$ ,  
 $2\text{N}_2\text{H}_4$ .

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  but cannot be  
 cryst. therefrom. (Franzen, Z. anorg. 1908,  
 60. 282.)

**Cadmium sulphate hydrogen chloride,**  
 $3\text{CdSO}_4, 4\text{HCl} + 4\text{H}_2\text{O}$ .

Very deliquescent. (Baskerville and Harris, J. Am. Chem. Soc. 1901, **23**, 896.)

$3\text{CdSO}_4, 8\text{HCl}$ . Very deliquescent. (Baskerville and Harris.)

**Cæsium sulphate,  $\text{Cs}_2\text{SO}_4$ .**

Not deliquescent.

100 pts.  $\text{H}_2\text{O}$  dissolve 158.7 pts.  $\text{Cs}_2\text{SO}_4$  at  $-2^\circ$ .

100 cc.  $\text{H}_2\text{O}$  at  $17-18^\circ$  dissolve 163.5 g.  $\text{Cs}_2\text{SO}_4$ . (Tutton, Chem. Soc. 1894, **65**, 632.)

Solubility in  $\text{H}_2\text{O}$ .

$t^\circ$	G. $\text{Cs}_2\text{SO}_4$ per 100 g.		$\frac{\text{g. } \text{Cs}_2\text{SO}_4}{\text{cc. } \text{H}_2\text{O}}$	$t^\circ$	G. $\text{Cs}_2\text{SO}_4$ per 100 g.		$\frac{\text{g. } \text{Cs}_2\text{SO}_4}{\text{cc. } \text{H}_2\text{O}}$
	Solution	$\text{H}_2\text{O}$			Solution	$\text{H}_2\text{O}$	
0	62.6	167.1	3.42	60	66.7	199.9	3.78
10	63.4	173.1	3.49	70	67.2	205.0	3.83
20	64.1	178.7	3.56	80	67.8	210.3	3.88
30	64.8	184.1	3.62	90	68.3	214.9	3.92
40	65.5	189.9	3.68	100	68.8	220.3	3.97
50	66.1	194.9	3.73	108.6	69.2	224.5	4.00

(Berkeley, Trans. Roy. Soc. 1904, **203**, A. 210.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$ .

Sat. solution contains 54.7%  $\text{Cs}_2\text{SO}_4 + 11.45\% \text{Na}_2\text{SO}_4$  at  $25^\circ$ . (Foote, J. Am. Chem. Soc. 1911, **33**, 467.)

Insol. in alcohol. (Bunsen.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329); (Eidmann, C. C. 1899, II, 1014.)

Solubility in glycol at ord. temp. = 3.0-3.2%. (de Coninck, Belg. Acad. Bull. 1905, 359.)

**Cæsium hydrogen sulphate,  $\text{CsHSO}_4$ .**

Sol. in  $\text{H}_2\text{O}$ .

**Cæsium pyrosulphate,  $\text{Cs}_2\text{S}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$ .

**Cæsium octosulphate,  $\text{Cs}_8\text{S}_8\text{O}_{32}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17, 2497.)

**Cæsium calcium sulphate,  $\text{Ca}_2\text{Cs}_2(\text{SO}_4)_2$ .**

Very stable. (D'Ans, B. 1908, **41**, 1776.)

**Cæsium chromium sulphate,  $\text{Cs}_2\text{Cr}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

Melts in crystal  $\text{H}_2\text{O}$  at  $116^\circ$ . (Locke.)

Solubility in  $\text{H}_2\text{O}$ .

Temp.	G. per litre	G. mols. anhydrous salt per l.
$25^\circ$	5.7	0.015
$30^\circ$	9.6	0.025
$35^\circ$	12.06	0.032
$40^\circ$	15.3	0.0405

(Locke, Am. Ch. J. 1901, **26**, 180.)

**Cæsium cobaltous sulphate,  $\text{Cs}_2\text{SO}_4, \text{CoSO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Tutton, Chem. Soc. **63**, 337.)

1 l.  $\text{H}_2\text{O}$  dissolves 418.8 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, **27**, 459.)

**Cæsium cobaltic sulphate,  $\text{Cs}_2\text{Co}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

Melts in crystal  $\text{H}_2\text{O}$  at  $116^\circ$ . (Locke, Am. Ch. J. 1901, **26**, 183.)

**Cæsium copper sulphate,  $\text{Cs}_2\text{SO}_4, \text{CuSO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 460 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, **27**, 459.)

**Cæsium gallium sulphate,  $\text{Cs}_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

(Soret, Arch. sc. phys. nat. 1888, (3) **20**, 531.)

**Cæsium indium sulphate,  $\text{Cs}_2\text{In}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

75.7 g. anhydrous (117.39 hydrated) salt or 0.172 g. mols of anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Locke, Am. Ch. J. 1901, **26**, 175.)

100 pts.  $\text{H}_2\text{O}$  dissolve 3.04 pts. at  $16.5^\circ$ . (Chabrière and Rengade, C. R. 1900, **131**, 1301.)

**Cæsium iridium sulphate,  $\text{Cs}_2\text{SO}_4, \text{Ir}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .**

Mpt.  $109-110^\circ$ .

Very sl. sol. in cold. More easily sol. in hot  $\text{H}_2\text{O}$ . (Marino, Z. anorg. 1904, **42**, 218.)

**Cæsium iron (ferrous) sulphate,  $\text{Cs}_2\text{SO}_4, \text{FeSO}_4 + 6\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 1011 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, **27**, 459.)

**Cæsium iron (ferric) sulphate,  $\text{Cs}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

Melts in crystal  $\text{H}_2\text{O}$  at  $71^\circ$ . (Locke.)

Solubility in H<sub>2</sub>O.

t°	G. per litre	G. mols. anhydrous salt per litre
25	17.1	0.045
30	25.2	0.066
35	37.5	0.099
40	60.4	0.156

(Locke, Am. Ch. J. 1901, 26. 180.)

**Cesium lanthanum sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2H<sub>2</sub>O.

(Baskerville, J. Am. Chem. Soc. 1904, 26. 67.)

2Cs<sub>2</sub>SO<sub>4</sub>, 3La<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. (Baskerville.)**Cesium magnesium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
MgSO<sub>4</sub>+6H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Tutton.)1 l. H<sub>2</sub>O dissolves 533 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)**Cesium manganous sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
MnSO<sub>4</sub>+8H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Tutton.)Sol. in H<sub>2</sub>O and acids with decomp. (Piccini, Z. anorg. 1899, 20. 14.)1 l. H<sub>2</sub>O dissolves 804 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 45.)**Cesium manganic sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+24H<sub>2</sub>O.Decomp. by H<sub>2</sub>O and dil. acids with separation of MnO<sub>2</sub>. Sol. in 1:3 H<sub>2</sub>SO<sub>4</sub>+Aq and in conc. HNO<sub>3</sub>. Insol. in acetic acid. Sol. in oxalic acid+Aq. (Christensen, Z. anorg. 1901, 27. 332.)**Cesium neodymium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
Nd<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+3H<sub>2</sub>O.

(Baskerville, J. Am. Chem. Soc. 1904, 26. 74.)

**Cesium nickel sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, NiSO<sub>4</sub>+  
6H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Tutton.)1 l. H<sub>2</sub>O dissolves 255.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)**Cesium praseodymium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>,  
Pr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+2H<sub>2</sub>O.

(Baskerville, J. Am. Chem. Soc. 1904, 26. 73.)

+4H<sub>2</sub>O. (Baskerville.)**Cesium rhodium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+  
24H<sub>2</sub>O.Sl. sol. in cold, sol. in warm H<sub>2</sub>O; mpt. 110-111°. (Piccini, Z. anorg. 1901, 27. 64.)**Cesium thallic sulphate**, CsTl(SO<sub>4</sub>)<sub>2</sub>+  
1½H<sub>2</sub>O.

Hygroscopic. (Locke, Am. Ch. J. 1902, 27. 283.)

+3H<sub>2</sub>O. Very sl. sol. in cold; easily sol. in hot H<sub>2</sub>O. Can be recryst. from H<sub>2</sub>SO<sub>4</sub>+Aq. The recryst. salt is at once decomp. by H<sub>2</sub>O or 95% alcohol. (Locke.)**Cesium thorium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, Th(SO<sub>4</sub>)<sub>2</sub>+  
2H<sub>2</sub>O.Sl. sol. in H<sub>2</sub>O. (Manuelli, Gazz. ch. it. 1903, 32. (2) 523.)**Cesium titanium sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, Ti<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+  
24H<sub>2</sub>O.

Deliquesces in the air and is decomp.

Sl. sol. in cold H<sub>2</sub>O; decomp. by hot H<sub>2</sub>O. (Piccini, Gazz. ch. it. 1895, 25. 542.)Sl. sol. in cold H<sub>2</sub>O, more sol. in hot H<sub>2</sub>O acidified with H<sub>2</sub>SO<sub>4</sub>.

Decomp. in neutral aq. solution. (Piccini, Z. anorg. 1898, 17. 356.)

**Cesium uranyl sulphate**, Cs<sub>2</sub>(UO<sub>2</sub>)(SO<sub>4</sub>)<sub>2</sub>+  
2H<sub>2</sub>O.

As Na salt. (de Coninck, C. C. 1905, I. 1306.)

**Cesium vanadium sulphate**, Cs<sub>2</sub>V<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+  
24H<sub>2</sub>O.7.71 g. anhydrous (13.1 g. hydrated) salt, or 0.0204 gr. mols. of the anhydrous salt are sol. in 1 l. H<sub>2</sub>O at 25°. (Locke, Am. Ch. J. 1901, 26. 175.)Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Piccini, Z. anorg. 1896, 11. 114.)100 pts. H<sub>2</sub>O dissolve 0.464 pts. of the salt at 10° and sp. gr. of the solution at 4°/20° = 2.033. More sol. in hot H<sub>2</sub>O than in cold. (Piccini, Z. anorg. 1897, 13. 446.)**Cesium zinc sulphate**, Cs<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+  
6H<sub>2</sub>O.Sol. in H<sub>2</sub>O. (Bunsen and Kopp, Pogg. 113. 337.)1 l. H<sub>2</sub>O dissolves 386.3 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)**Cesium zirconium sulphate**, Zr<sub>2</sub>O<sub>3</sub>.(CsSO<sub>4</sub>)<sub>2</sub>+  
11H<sub>2</sub>O.

Ppt. (Rosenheim, B. 1905, 38. 815.)

**Calcium sulphate**, CaSO<sub>4</sub>, and +2H<sub>2</sub>O.The older determinations of the solubility of CaSO<sub>4</sub> in H<sub>2</sub>O have little, but historical, value, as the solutions were usually either non-saturated or supersaturated. They may be tabulated as follows.

A = pts.  $\text{H}_2\text{O}$  required for dissolving 1 pt.  $\text{CaSO}_4$ , and B for 1 pt.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	A	B	Authority
Hot or cold	500	...	Fourcroy
Cold	500	...	Bergmann
Boiling	450	...	"
All temp.	322	...	Lassaigne
(?)	438	...	Anthou
(?)	250-300	...	Dumas
Hot or cold	578.5	461.5	Bucholz
Cold	480	380	Giese
Hot	491	388	"
15-20°	492	388	Tipp
12.5°	503	397	Lecoq

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts.  $\text{CaSO}_4$ .

$t^\circ$	Pts. $\text{CaSO}_4$	$t^\circ$	Pts. $\text{CaSO}_4$	$t^\circ$	Pts. $\text{CaSO}_4$
0	0.205	35	0.254	70	0.244
5	0.219	40	0.252	80	0.239
12	0.233	50	0.251	90	0.231
20	0.241	60	0.248	100	0.217
30	0.249	..	...	...	...

(Poggiale, A. ch. (3) 8. 469.)

Poggiale worked with supersat. solutions. (Droeze, B. 10. 330.)

$\text{H}_2\text{O}$  dissolves  $\text{CaSO}_4$  most abundantly at 35° (Poggiale); at 32-41° (Marignac).

1 pt.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  dissolves at:

0°	18°	24°	32°	38°
in 415	386	378	371	368 pts. $\text{H}_2\text{O}$ ,
41°	53°	72°	86°	99°
in 370	375	391	417	451 pts. $\text{H}_2\text{O}$ ,

or (by calculation) 1 pt. anhydrous  $\text{CaSO}_4$  dissolves at:

0°	18°	24°	32°	38°
in 525	488	479	470	466 pts. $\text{H}_2\text{O}$ ,
41°	53°	72°	86°	99°
in 468	474	495	528	571 pts. $\text{H}_2\text{O}$ .

The above nonsat. solutions are obtained by using a large excess of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ . The undissolved part retains its water of crystallisation.  $\text{CaSO}_4$ , dehydrated at 130-140°, forms a supersaturated solution with  $\text{H}_2\text{O}$  in 10 minutes, containing 1 pt.  $\text{CaSO}_4$  to 110 pts.  $\text{H}_2\text{O}$ , which soon deposits crystals. The undissolved part takes up its water of crystallisation. Ignited  $\text{CaSO}_4$  dissolves very slowly in  $\text{H}_2\text{O}$ , so that in 24 hours the solution contains  $1/111$  to  $1/101$  anhydrous  $\text{CaSO}_4$ . By longer contact solution continues with formation of supersaturated solutions, which contain after 10-30 days  $1/312$  to  $1/311$   $\text{CaSO}_4$ , but these become normal as the anhydrous  $\text{CaSO}_4$  gradually takes up its water of crystallisation. The mineral anhydrite behaves similarly, water taking up  $1/483$   $\text{CaSO}_4$  in 1 day,  $1/311$  in 40 days, and  $1/457$  in 8 months.

Supersaturated solutions are also obtained

by evaporation of a saturated solution. By evaporation with heat, solutions are obtained containing  $1/308$   $\text{CaSO}_4$ , and in the cold with  $1/119$   $\text{CaSO}_4$ , in the solution over the separated  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ . Neutralising dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  with  $\text{CaCO}_3$  gives a solution containing  $1/114$   $\text{CaSO}_4$ , which crystallises out partly in 24 hours, leaving  $1/311$   $\text{CaSO}_4$  dissolved.

Supersaturated solutions containing  $1/110$  to  $1/116$   $\text{CaSO}_4$  deposit crystals rapidly; those under  $1/100$  do not crystallise spontaneously. A solution containing  $1/311$  shows crystals in 14 days, and contains  $1/311$  in 1 month,  $1/414$  in 2 months,  $1/446$  in 3 months, in spite of repeated shaking.

Boiling diminishes the supersaturation without however removing it entirely. (Marignac, A. ch. (5) 1. 274.)

1 pt.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  is sol. in 443 pts.  $\text{H}_2\text{O}$  at 13.7°; in 447 pts.  $\text{H}_2\text{O}$  at 14.2°; in 421 pts.  $\text{H}_2\text{O}$  at 20.2°; in 419 pts.  $\text{H}_2\text{O}$  at 21.2°; ind in 445 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$  sat. at 18.7°. (Church, J. B. 1867. 192.)

Church's solutions were not sat. (Droeze, B. 10. 330.)

1000 pts.  $\text{H}_2\text{O}$  dissolve 2.19 pts.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at 16.5°; 2.352 pts.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at 22°. (Cossa, Gazz. ch. it. 1873. 135.)

Cossa's solutions were not saturated. (Droeze.)

$\text{CaSO}_4 + 2\text{H}_2\text{O}$  is sol. in 415 pts.  $\text{H}_2\text{O}$  at 0°; in 412 pts.  $\text{H}_2\text{O}$  at 5°; in 407 pts.  $\text{H}_2\text{O}$  at 10°; in 398 pts.  $\text{H}_2\text{O}$  at 15°; in 371 pts.  $\text{H}_2\text{O}$  at 20°; in 365 pts.  $\text{H}_2\text{O}$  at 25°; in 361 pts.  $\text{H}_2\text{O}$  at 30°; in 359 pts.  $\text{H}_2\text{O}$  at 35°. (Droeze, B. 10. 330.)

Sol. in 500 pts.  $\text{H}_2\text{O}$  at 12.5°. (From Marignac's and his own results, de Boisbaudran, A. ch. (5) 3. 477.)

$\text{CaSO}_4$  is sol. in 564.5 pts.  $\text{H}_2\text{O}$  at 0.8°; 506.27 pts. at 14°; 472-3 pts. at 32.5-38.8°; 498.73 pts. at 64°; 533.92 pts. at 79.6°. (Raupenstrauch, M. 6. 563.)

According to Goldammer (C. C. 1888. 708)  $\text{H}_2\text{O}$  is fully saturated with  $\text{CaSO}_4$  by shaking the finely-powdered substance 5 minutes therewith.

The following results were obtained. Figures denote pts.  $\text{H}_2\text{O}$  in which 1 pt.  $\text{CaSO}_4$  was dissolved at  $t^\circ$  (a) from pptd.  $\text{CaSO}_4$ , "ipse fact.," (b) from pptd.  $\text{CaSO}_4$ , "gehe," (c) from "glacies mariae pulv.," (d) from "glacies Mariae pulv.," containing less than  $2\text{H}_2\text{O}$ .

$t^\circ$	a	b	c	$t^\circ$	d
0	561.5	558	557.5	0	476.5
7.5	526	526	520	...	...
15	497.5	497.5	493	20	436
22.5	481	481.5	479	...	...
30	475	475	470	...	...
37.5	463	469	465.5	40	450
45	473.5	474.5	470.5	...	...
60	484	486.5	482	60	476
75	507.5	508	503	80	502.5
90	533.5	530	534	...	...
100	556	557	534.5	100	547



Burnt gypsum easily forms supersat. solutions containing nearly 1%  $\text{CaSO}_4$ . It forms supersat. solutions more readily at  $0^\circ$ , and that tendency decreases with increase of temp., hence figures in (d) which contained burnt gypsum. (Goldammer, C. C. 1888. 708.)

Calculated from electrical conductivity of  $\text{CaSO}_4 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 2.07 g.  $\text{CaSO}_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

The anhydrous salt varies in solubility. Solubility depends (1) upon temp. and time of drying, (2) upon the relative amount of salt, (3) upon time of shaking. Possibly  $\alpha$  and  $\beta$  modifications. (Potilisin, C. C. 1894, II. 515.)

2.04 gr. are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

At  $15^\circ$  and after 5 minutes shaking, the highest degree of supersaturation which can be obtained with pure sol. calcium sulphate = 9.47 g. of the anhydrous salt or 11.976 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  in 1 l. of  $\text{H}_2\text{O}$ . (Cavazzi, C. C. 1905, I. 1694.)

Solubility of  $\text{CaSO}_4$  in 100 pts.  $\text{H}_2\text{O}$  at high temp.

$t^\circ$	Pts. $\text{CaSO}_4$	$t^\circ$	Pts. $\text{CaSO}_4$	$t^\circ$	Pts. $\text{CaSO}_4$
140	0.078	175-185	0.027	250	0.016
165	0.056	240	0.018	...	...

(Tilden and Shenstone, Phil. Trans. 1884. 31.)

Pptn. of  $\text{CaSO}_4$  which has been started by heating solution to  $140$ – $150^\circ$  continues even after solution has cooled. (Storer.)

$\text{CaSO}_4$  is completely insol. in sea water or pure  $\text{H}_2\text{O}$  at temperatures between  $140^\circ$  and  $150^\circ$ . (Cousté.)

Solubility of  $\text{CaSO}_4$  in sea water at temperatures over  $100^\circ$ .  $t^\circ$  = temp.; P = pressure in atmospheres; % = per cent  $\text{CaSO}_4$  in sat. solution.

$t^\circ$	P	%	$t^\circ$	P	%
103	1	0.500	118.5	1.50	0.226
103.8	1	0.477	121.2	1.5	0.183
105.15	1	0.432	124	2	0.140
108.6	1.25	0.395	127.9	2	0.097
111	1.25	0.355	130	2.5	0.060
113.2	1.25	0.310	133.3	2.5	0.023
115.8	1.50	0.267	...	...	...

(Cousté, Ann. Min. (5) 5. 80.)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  at various pressures.

100 g. sat.  $\text{CaSO}_4 + \text{Aq}$  at 1 atmos. pressure and  $15^\circ$  contain 0.206 g.  $\text{CaSO}_4$ ; at 20 atmos. pressure and  $15^\circ$  contain 0.227 g.  $\text{CaSO}_4$ ; at 1 atmos. pressure and  $16.2^\circ$  contain 0.213 g.  $\text{CaSO}_4$ . (Möller, Pogg. 117. 386.)

#### Soluble anhydrite:

1 l.  $\text{H}_2\text{O}$  dissolves 22.8 milliequivalents at  $100^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves 6.4 milliequivalents at  $156^\circ$ .

#### Anhydrite:

1 l.  $\text{H}_2\text{O}$  dissolves 9.2 milliequivalents at  $100^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves 2.7 milliequivalents at  $156^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves 0.7 milliequivalents at  $218^\circ$ .

(Melcher, J. Am. Chem. Soc. 1910, 32. 63.)

See also under gypsum, p. 953.

Maximum solubility is at  $37.5^\circ$ . (Cameron, J. phys. Chem. 1901, 5. 572.)

Sp. gr. of sat.  $\text{CaSO}_4 + \text{Aq}$  at  $15^\circ = 1.0022$ . (Stolba, J. pr. 97. 503.)

Sp. gr. of sat.  $\text{CaSO}_4 + \text{Aq}$  at  $31^\circ = 1.0031$ .

1 pt.  $\text{CaSO}_4$  is sol. in 218 pts.  $\text{H}_2\text{O}$  containing  $\text{CO}_2$ . (Beyer, Arch. Pharm. (2) 150. 193.)

Sl. sol. in cold  $\text{HCl} + \text{Aq}$ ; completely sol. in boiling dil.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Rose, Pogg. 95. 108.)

#### Solubility of $\text{CaSO}_4$ in $\text{HCl} + \text{Aq}$ .

$t^\circ$	% $\text{HCl}$	100 ccm. dissolve g. of $\text{CaSO}_4$	$t^\circ$	% $\text{HCl}$	100 ccm. dissolve g. of $\text{CaSO}_4$
25	0.77	0.6405	25	6.12	1.6539
25	1.56	0.8821	101	0.77	1.1209
25	3.06	1.2639	102	3.06	3.1780
25	4.70	1.5342	103	6.12	4.6902

(Lunge, J. Soc. Chem. Ind. 4. 31.)

#### Solubility in $\text{HNO}_3 + \text{Aq}$ at $25^\circ$ .

g. $\text{HNO}_3$ per 100 cc.	g. $\text{CaSO}_4$ per 100 cc. solution	g. $\text{HNO}_3$ per 100 cc.	g. $\text{CaSO}_4$ per 100 cc. solution
0	0.208	6	1.48
1	0.56	8	1.70
2	0.82	10	1.84
3	1.02	12	1.98
4	1.20		

(Banthisch, J. pr. 1884, 29. 52.)

For solubility in  $\text{H}_2\text{SO}_4$ , see  $\text{CaH}_2(\text{SO}_4)_2$ .

#### Solubility in $\text{H}_3\text{PO}_4 + \text{Aq}$ at $25^\circ$ .

G. $\text{P}_2\text{O}_5$ per l.	G. $\text{CaSO}_4$ per l.	Sp. gr. $25^\circ/25^\circ$
0.0	2.126	...
5.0	3.138	1.002
10.5	3.734	1.007
21.4	4.456	1.016
46.3	5.760	1.035
105.3	7.318	1.075
145.1	7.920	1.106
204.9	8.383	1.145
312.0	7.965	1.221
395.7	6.848	1.230
494.6	5.573	1.344

(Taber, J. phys. Chem. 1906, 10. 628.)

Solubility in formic acid at  $25^\circ$ .

100 cc. of solution of acid containing 4%

dissolve 0.24 g.  $\text{CaSO}_4$ . (Banthisch, J. pr. 1884, 29. 52.)

Solubility of  $\text{CaSO}_4$  in chloracetic acid at 25°. 100 cc. of solution of acid containing 4% dissolve 0.22 g.  $\text{CaSO}_4$ ; 10%, 0.25 g. (Banthisch, J. pr. 1884, 29. 52.)

Solubility in  $\text{H}_2\text{O}$  is increased by presence of  $\text{NH}_4\text{Cl}$  (Vogel, J. pr. 1. 196), ammonium succinate (Wittstein, Repert. 57. 18),  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2\text{B}_4\text{O}_7$  (Popp, A. Suppl. 8. 11); also  $\text{KNO}_3$  (Vogel, Jun.),  $\text{Na}_2\text{SO}_4$  (Henry, J. Pharm. 12. 31),  $\text{NaCl}$  (Trommsdorff, N. J. Pharm. 18, 1. 234.)

Decomp. by alkali carbonates + Aq. (See Storer's Dict.)

1 g.  $\text{CaSO}_4$  is sol. in 162 ccm. sat.  $\text{KCl}$ +Aq at 8°; in 147 ccm. sat.  $\text{NaCl}$ +Aq at 8.5°; in 93 ccm. sat.  $\text{NH}_4\text{Cl}$ +Aq at 12.5°; in 94 ccm. sat.  $\text{KNO}_3$ +Aq; in 92 ccm. sat.  $\text{NaNO}_3$ +Aq; in 320 ccm. sat.  $\text{NH}_4\text{NO}_3$ +Aq; in 54 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{NO}_3$ +Aq; in about 2000 ccm. sat.  $\text{K}_2\text{SO}_4$ +Aq. (Droeze.)

More sol. in  $\text{Fe}_2\text{Cl}_6$ ,  $\text{Cr}_2\text{Cl}_6$ ,  $\text{CuCl}_2$ ,  $\text{ZnCl}_2$ +Aq than in  $\text{H}_2\text{O}$ , but not more sol. in  $\text{CaCl}_2$ +Aq. (Gladstone.)

$\text{NH}_4\text{Cl}$ +Aq.  
1 g.  $\text{CaSO}_4$  is sol. in 92 ccm. sat.  $\text{NH}_4\text{Cl}$ +Aq at 13.5°; in 94 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{Cl}$ +Aq at 13.5-15.5°; in 200 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{Cl}$ +Aq at 13.5°; in 183 ccm.  $\frac{1}{2}$  sat.  $\text{NH}_4\text{Cl}$ +Aq at 100°. (Faasbender, B. 9. 1360.)

Solubility of  $\text{CaSO}_4$  in 25%  $\text{NH}_4\text{Cl}$ +Aq.

t°	% $\text{CaSO}_4$	t°	% $\text{CaSO}_4$
8	1.030	60	1.333
9	1.023	80	1.026
25	1.096	120	1.000
39	1.126	...	...

(Tilden and Shenstone, Roy. Soc. Proc. 38. 335.)

Solubility in  $\text{NH}_4\text{Cl}$ +Aq increases with percentage of  $\text{NH}_4\text{Cl}$ , but if solution contains more than 60 g.  $\text{NH}_4\text{Cl}$  per l. more  $\text{CaO}$  dissolves than  $\text{SO}_3$ . With 333 g.  $\text{NH}_4\text{Cl}$  per l., the solution contains 4.9 g.  $\text{SO}_3$  and 4.4 g.  $\text{CaO}$ , while the  $\text{SO}_3$  content requires only 3.4 g.  $\text{CaO}$ . (Ditte, C. R. 1898, 126. 694.)

Solubility of  $\text{CaSO}_4$  in  $\text{NH}_4\text{Cl}$ +Aq at 25°.

Grams $\text{NH}_4\text{Cl}$ per liter	Grams $\text{CaSO}_4$ per liter
10.8	3.90
24.4	5.38
46.7	7.07
94.5	8.80
149.7	10.30
198.6	10.85
210.0	10.88
275.0	10.60
325.0	9.40
375.3 (saturated)	7.38

(Cameron and Brown, J. phys. Chem. 1905, 9. 211.)

$\text{CaCl}_2$ +Aq.

Solubility of  $\text{CaSO}_4$  in  $\text{CaCl}_2$ +Aq at t°.

t°	% $\text{CaCl}_2$	100 ccm. dissolve g. of $\text{CaSO}_4$	t°	% $\text{CaCl}_2$	100 ccm. dissolve g. of $\text{CaSO}_4$
23	3.54	0.1225	25	16.91	0.0702
24	6.94	0.0963	101.0	3.54	0.1370
25	10.36	0.0886	102.5	10.36	0.1426
25	15.90	0.0734	103.5	16.91	0.1301

(Lunge, l. c.)

Solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  containing various amts. of  $\text{CaCl}_2$  at 20°. 100 pts.  $\text{H}_2\text{O}$  containing pts.  $\text{CaCl}_2$  dissolve pts.  $\text{CaSO}_4$ .

Pts. $\text{CaCl}_2$	Pts. $\text{CaSO}_4$	Pts. $\text{CaCl}_2$	Pts. $\text{CaSO}_4$
0.00	0.225	19.80	0.041
11.50	0.078	51.00	0.000
14.39	0.063	67.05	0.000

(Tilden and Shenstone.)

Solubility of  $\text{CaSO}_4$  in  $\text{CaCl}_2$ +Aq at t°.

t°	% $\text{CaCl}_2$	% $\text{CaSO}_4$	t°	% $\text{CaCl}_2$	% $\text{CaSO}_4$
15	15.00	0.063	94	15.16	0.110
21	14.70	0.068	138	14.70	0.071
39	15.00	0.091	170	14.82	0.031
72	14.90	0.100	195	14.70	0.022

(Tilden and Shenstone, l. c.)

Solubility in  $\text{CaCl}_2$ +Aq at 25°.

g. per l. of solution		g. per l. of solution	
$\text{CaCl}_2$	$\text{CaSO}_4$	$\text{CaCl}_2$	$\text{CaSO}_4$
0.00	2.06	51.53	1.02
7.49	1.24	97.02	0.84
11.96	1.18	192.71	0.47
25.77	1.10	280.30	0.20
32.05	1.08	367.85	0.03

(Cameron and Seidell, J. phys. Ch. 1901, 5. 643.)

1000 pts. of 1%  $\text{CaCl}_2$ +Aq. dissolve 1.1414 pts.  $\text{CaSO}_4$ ; 40%  $\text{CaCl}_2$ , 0.2130 pts.  $\text{CaSO}_4$ . (Orloff, Chem. Soc. 1903, 84, (2) 211.)

Solubility in  $\text{CaO}_2\text{H}_2 + \text{Aq}$  at  $25^\circ$ .

G. $\text{CaSO}_4$ per l.	G. $\text{CaO}$ per l.	Solid phase
0.0	1.166	$\text{Ca}(\text{OH})_2$
0.391	1.141	"
0.666	1.150	"
0.955	1.215	"
1.214	1.242	"
1.588	1.222	$\text{Ca}(\text{OH})_2$ and $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
1.634	0.939	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
1.722	0.611	"
1.853	0.349	"
1.918	0.176	"
2.030	0.062	"
2.126	0.0	"

(Cameron and Bell, J. Am. Chem. Soc. 1906, 28, 1221.)

 $\text{MgCl}_2 + \text{Aq}$ .

Sol. in 324 pts.  $\text{MgCl}_2 + \text{Aq}$  (34.1%  $\text{MgCl}_2$ ) at  $19^\circ$ . (Karsten.)

1 g.  $\text{CaSO}_4$  is sol. in 146 ccm.  $\frac{1}{2}$  sat.  $\text{MgCl}_2 + \text{Aq}$  at  $13.5^\circ$ . (Fassbender.)

1 l.  $\frac{1}{2}$  sat.  $\text{MgCl}_2 + \text{Aq}$  dissolves 6.83 g.  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  at  $13.5^\circ$ . (Droese.)

Solubility of  $\text{CaSO}_4$  in  $\text{MgCl}_2 + \text{Aq}$ .

$t^\circ$	% $\text{MgCl}_2$	% $\text{CaSO}_4$
9	19.7	0.765
39	11.1	2.744
80	9.99	1.038

(Tilden and Shenstone, l. c.)

Solubility in  $\text{MgCl}_2 + \text{Aq}$  at  $26^\circ$ .

g. per l. of solution			g. per l. of solution		
$\text{MgCl}_2$	$\text{CaSO}_4$	$\text{H}_2\text{O}$	$\text{MgCl}_2$	$\text{CaSO}_4$	$\text{H}_2\text{O}$
0.0	2.08	997.9	121.38	8.62	972.2
8.50	4.26	996.5	206.98	6.57	949.9
19.18	5.69	994.5	337.0	2.77	908.7
46.64	7.59	989.1	441.0	1.39	878.6

(Cameron and Seidell, J. phys. Ch. 1901, 5, 645.)

1 l. sat.  $\text{MgCl}_2 + \text{Aq}$  at  $25^\circ$  containing 476.5 g.  $\text{MgCl}_2$  dissolves 1.09 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9, 214.)

 $\text{NH}_4\text{NO}_3 + \text{Aq}$ .

1 g.  $\text{CaSO}_4$  is sol. in 320 ccm. sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $8-9^\circ$ ; in 54 ccm.  $\frac{2}{3}$  sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $13.5^\circ$ ; in 103 ccm.  $\frac{2}{3}$  sat.  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $13.5^\circ$ . (Fassbender.)

Solubility of  $\text{CaSO}_4$  in  $\text{NH}_4\text{NO}_3 + \text{Aq}$  at  $25^\circ$ .

G. $\text{NH}_4\text{NO}_3$ per l.	G. $\text{CaSO}_4$ per l.
10	3.18
25	3.93
55	5.80
100	7.65
150	8.88
200	9.85
300	10.80
400	11.40
550	12.02
750	12.20
1000	11.81
1200	11.10
1400	10.02
saturated	7.55

(Cameron and Brown, J. phys. Chem. 1905, 9, 213.)

 $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$ .Solubility of  $\text{CaSO}_4$  in  $\text{Ca}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Weight of 1000 cc. of solution	G. $\text{Ca}(\text{NO}_3)_2$ per l.	G. $\text{CaSO}_4$ per l.
998.1	0	2.084
1013.8	25	1.238
1031.7	50	1.196
1067.3	100	1.134
1136.9	200	0.929
1203.5	300	0.759
1265.6	400	0.569
1328.1	500	0.403
1352.0	544	0.346

(Seidell and Smith, J. phys. Chem. 1904, 8, 498.)

 $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$ .Solubility of  $\text{CaSO}_4$  in  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$ .

Weight of 1000 cc. of solution grams	G. $\text{Mg}(\text{NO}_3)_2$ per l.	G. $\text{CaSO}_4$ per l.
998.1	0	2.084
1020.5	25	5.772
1039.8	50	7.884
1078.6	100	9.920
1149.8	200	13.340
1219.0	300	14.000
1282.1	400	14.683
1355.3	514	15.040

(Seidell and Smith, J. phys. Chem. 1904, 8, 497.)

1 l. sat.  $\text{Mg}(\text{NO}_3)_2 + \text{Aq}$  at  $25^\circ$  containing 615.1 g.  $\text{Mg}(\text{NO}_3)_2$  dissolves 15.26 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9, 214.)

**KNO<sub>3</sub>+Aq.**

1 g. CaSO<sub>4</sub> is sol. in 94 ccm. sat. KNO<sub>3</sub>+Aq at 13.5°; in 82 ccm. sat. KNO<sub>3</sub>+Aq at 15.5°; in 68 ccm. nearly sat. KNO<sub>3</sub>+Aq at 20°. (Fassbender.)

**Solubility in KNO<sub>3</sub>+Aq at 25°.**

Wt. of 1000 ccm. of solution grams	G. KNO <sub>3</sub> per l.	G. CaSO <sub>4</sub> per l.
998.1	0.0	2.084
1008.1	12.5	3.284
1015.4	25.0	4.080
1032.1	50.0	5.255
1032.5	100.0	6.855
1092.4	150.0	7.907
1122.4	200.0	8.688
1153.9	260.0	6.278
		a { 12.112

a Probably due to formation of double salt of calcium and potassium sulphates, CaK<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+H<sub>2</sub>O.

(Seidell and Smith, J. phys. Chem. 1908, 8, 496.)

**NaNO<sub>3</sub>+Aq.**

1 g. CaSO<sub>4</sub> is sol. in 92 ccm. sat. NaNO<sub>3</sub>+Aq at 8.5°; in 318 ccm. 1/3 sat. NaNO<sub>3</sub>+Aq at 13.5°. (Fassbender.)

100 ccm. sat. NaNO<sub>3</sub>+Aq dissolve 1.086 g. CaSO<sub>4</sub>+2H<sub>2</sub>O; 100 ccm. 1/3 sat. NaNO<sub>3</sub>+Aq dissolve 0.314 g. CaSO<sub>4</sub>+2H<sub>2</sub>O. (Droeze, B. 10. 338.)

**Solubility in NaNO<sub>3</sub>+Aq at 25°.**

Wt. of 1000 ccm. of solution grams	G. NaNO <sub>3</sub> per l.	G. CaSO <sub>4</sub> per l.
998.1	0	2.084
1016.3	25	4.252
1034.0	50	5.500
1058.4	100	7.100
1133.6	200	8.790
1191.6	300	9.282
1363.9	600	7.886
1390.4	655	7.238

(Seidell and Smith, J. phys. Chem. 1904, 8, 495.)

1 l. sat. NaNO<sub>3</sub>+Aq at 25°, containing 668.4 g. NaNO<sub>3</sub>, dissolves 5.52 g. CaSO<sub>4</sub>. (Cameron and Brown, J. phys. Ch. 1905, 9, 214.)

**Solubility in KBr+Aq at 21°.**

G. KBr per l.	G. CaSO <sub>4</sub> per l.	G. KBr per l.	G. CaSO <sub>4</sub> per l.
0	2.05	100	6.3
10	3.1	125	6.7
20	3.6	150	7.0
40	4.5	200	7.3
60	5.2	250	Double salt.
80	5.9		

(Ditte, A. ch. 1898, (7) 14. 294.)

**KCl+Aq.**

1 g. CaSO<sub>4</sub> is sol. in 162 ccm. sat. KCl+Aq at 8°; in 295 ccm. 1/3 sat. KCl+Aq at 9°.

**Solubility in KCl+Aq at 21°.**

g. per l.		g. per l.	
KCl	CaSO <sub>4</sub>	KCl	CaSO <sub>4</sub>
0	2.05	60	6.6
10	3.6	80	7.2
20	4.5	100	7.5
40	5.8	125	Double Salt

(Ditte, A. ch. 1898, (7) 14. 294.)

**Solubility in KI+Aq at 21°.**

G. KI per l.	G. CaSO <sub>4</sub> per l.	G. KI per l.	G. CaSO <sub>4</sub> per l.
0	2.05	100	5.1
10	2.8	125	5.45
20	3.2	150	5.8
40	3.9	200	5.95
60	4.5	250	6.00
80	4.85	300	Double salt.

(Ditte, l. c.)

**NaCl+Aq.**

Sol. in 122 pts. sat. NaCl+Aq. (Anthon.) Insol. in sat. NaCl+Aq, but more sol. in dil. NaCl+Aq than in H<sub>2</sub>O. Maximum solubility in NaCl+Aq is when the sp. gr. is 1.033.

1 g. CaSO<sub>4</sub> is sol. in 147 ccm. of sat. NaCl+Aq at 8.5°; in 150 ccm. of sat. NaCl+Aq at 13.5°; in 149 ccm. of 1/3 sat. NaCl+Aq at 13.5°; in 244 ccm. of 1/3 sat. NaCl+Aq at 13.5°. (Fassbender.)

100 ccm. sat. NaCl+Aq dissolve 0.6785 g. CaSO<sub>4</sub>+2H<sub>2</sub>O at 8.5°; 0.6665 g. CaSO<sub>4</sub>+2H<sub>2</sub>O at 13.5°. 100 ccm. 1/3 sat. NaCl+Aq dissolve 0.671 g. CaSO<sub>4</sub>+2H<sub>2</sub>O at 13.5°; 1/3 sat. NaCl+Aq dissolve 0.4085 g. CaSO<sub>4</sub>+2H<sub>2</sub>O at 13.5°. (Droeze.)

**Solubility of CaSO<sub>4</sub> in NaCl+Aq at t°.**

t°	% NaCl	% CaSO <sub>4</sub>	t°	% NaCl	% CaSO <sub>4</sub>
20	19.90	0.823	130	19.92	0.392
44	19.93	0.830	165	20.04	0.250
67	19.95	0.832	169	20.05	0.244
85	19.90	0.823	179	20.10	0.229
101	20.08	0.682	225	21.00	0.178

(Tilden and Shenstone, Roy. Soc. Proc. 38. 331.)

Solubility of  $\text{CaSO}_4$  in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{NaCl}$	100 ccm. dissolve g. of $\text{CaSO}_4$	$t^\circ$	% $\text{NaCl}$	100 ccm. dissolve g. of $\text{CaSO}_4$
21.5	3.53	0.5115	17.5	17.46	0.7369
19.5	7.35	0.6429	101.0	3.53	0.4891
21	11.12	0.7215	102.5	14.18	0.6248
18	14.18	0.7340	103	17.46	0.6299

(Lunge, J. Soc. Chem. Ind. 4. 31.)

100 pts.  $\text{H}_2\text{O}$  containing pts.  $\text{NaCl}$  dissolve pts.  $\text{CaSO}_4$  at  $20^\circ$ .

Pts. $\text{NaCl}$	Pts. $\text{CaSO}_4$	Pts. $\text{NaCl}$	Pts. $\text{CaSO}_4$	Pts. $\text{NaCl}$	Pts. $\text{CaSO}_4$
0.00	0.225	5.05	6.34	24.40	0.820
0.52	0.301	10.00	7.38	35.10	0.734
2.03	0.441	20.00	0.823	35.86	0.709
5.02	6.15	...	...	...	...

(Tilden and Shenstone.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26^\circ$ .

g. per l.		wt. of 1 cc. solution	g. per l.		wt. of 1 cc. solution
$\text{NaCl}$	$\text{CaSO}_4$		$\text{NaCl}$	$\text{CaSO}_4$	
0.00	2.12	0.9998	176.50	7.12	1.1196
9.11	6.66	1.0644	228.76	6.79	1.1488
143.99	7.18	1.0981	264.17	6.50	1.1707
148.34	7.16	1.012	320.49	5.72	1.2034

(Cameron, J. phys. Ch. 1901, 5. 556.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $15^\circ$ .

G. $\text{CaSO}_4$ per l.		G. $\text{NaCl}$ per l.	
2.3		0.6	
2.5		1.1	
3.1		5.1	
3.7		10.6	
4.8		31.1	
5.6		51.4	
7.4		139.9	

(Cameron, J. phys. Ch. 1901, 5. 559.)

Solubility in  $\text{NaCl} + \text{Aq}$  at  $26^\circ$ .

$\text{NaCl}$ in 100 g. $\text{H}_2\text{O}$	$\text{CaSO}_4$ in 100 g. $\text{H}_2\text{O}$
0.0000	0.2126
9.4307	0.6886
15.2056	0.7581
15.6859	0.7575
18.8570	0.7605
25.0478	0.7439
29.3509	0.7219
36.5343	0.6515

(Cameron, J. phys. Ch. 1901, 5. 564.)

Solubility in  $\text{NaCl} + \text{Aq}$ .

$30^\circ$		$52^\circ$		$70^\circ$		$82^\circ$	
G. $\text{NaCl}$ per l.	G. $\text{CaSO}_4$ per l.	G. $\text{NaCl}$ per l.	G. $\text{CaSO}_4$ per l.	G. $\text{NaCl}$ per l.	G. $\text{CaSO}_4$ per l.	G. $\text{NaCl}$ per l.	G. $\text{CaSO}_4$ per l.
0.5	2.5	0.5	2.3	0.5	2.2	0.0	2.07
10.3	3.6	1.1	2.4	10.0	3.4	1.0	2.18
30.3	5.0	5.0	2.9	29.6	4.9	5.0	2.65
47.3	6.1	10.1	3.5	48.8	5.8	10.1	3.30
73.4	6.9	29.6	5.0	132.7	7.4	29.5	4.68
126.9	7.3	48.3	5.8	195.0	7.6	48.8	5.54
192.4	7.7	75.7	6.6	...	...	74.9	6.23
...	...	131.6	7.1	...	...	128.7	7.00
...	...	195.9	7.4	...	...	195.1	7.15

(Cameron, J. phys. Ch. 1901, 5. 562.)

1 l. sat.  $\text{NaCl} + \text{Aq}$  at  $25^\circ$  containing 318.3 g.  $\text{NaCl}$  dissolves 5.52 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9. 214.)Solubility in  $\text{NaCl} + \text{Aq}$ .

G. $\text{NaCl}$ per l. of $\text{NaCl} + \text{Aq}$	G. anhydrous $\text{CaSO}_4$ dissolved per litre	
	at $14^\circ$	at $26^\circ$
0.0	1.70	2.10
2.925	2.32	2.70
5.850	2.79	3.15
11.70	3.41	3.75
14.62	3.68	4.00
29.25	4.40	4.70
58.50	5.72	6.00
87.75	6.58	6.85
102.3	6.90	7.15
117.0	7.10	7.30
131.6	7.20	7.30
146.2	7.10	7.13
160.8	7.00	7.05
175.6	6.80	6.80
204.7	6.30	6.30
234.0	5.90	5.90
263.2	5.50	5.52
292.6	5.30	5.30

(d'Anselme, Bull. Soc. 1903, (3) 29. 373.)

Solubility in  $\text{NaCl} + \text{Aq}$ .

G. $\text{NaCl}$ in 100 cc. solution	G. $\text{CaSO}_4 + 2\text{H}_2\text{O}$
0.00	0.200 g.
2.44 g.	0.635 g.
4.77 g.	0.826 g.
9.50 g.	1.056 g.
14.22 g.	1.193 g.
23.15 g.	1.275 g.
31.30 g.	1.583 g.

(Cloes, Bull. Soc. 1903, (3) 29. 167.)

Solubility in NaCl + Aq at  $t^\circ$ .

When a sat. solution of NaCl is shaken with a mixture of solid NaCl and  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ , the calcium sulphate dissolved, calculated from the amount of CaO in solution, is always greater than that calculated from the sulphuric acid in solution. Similar results are obtained when solid calcium sulphate alone is shaken with a sat. solution of NaCl.

$t^\circ$	In 100 g. of the solution		
	Cl	$\text{CaSO}_4$ calc. from CaO	$\text{CaSO}_4$ calc. from $\text{SO}_4$
0	15.253	0.4464	0.4334
10	15.920	0.4477	0.4426
25	15.967	0.4609	0.4542
40	16.123	0.4938	0.4730
50	16.270	0.5093	0.4832
60	16.324	0.5305	0.5047
62.5	16.361	...	0.5091
65	16.459	0.5435	0.3749
71	16.486	0.5578	0.3631
75	16.524	0.5603	0.3587
85	16.670	0.5399	0.3519
99	17.128	0.4066	0.3414

(Arth, Bull. Soc. 1906, (3) 35. 780.)

Within a temp. range from  $25^\circ$ – $80^\circ$   $\text{CaSO}_4$  forms no double salt in solutions of NaCl. At any concentration with respect to the latter maximum solubility occurs with 155 g. NaCl per l. and amounts to 7.3 g.  $\text{CaSO}_4$  at  $80^\circ$ . (Cameron, J. phys. Chem. 1907, 11. 496.)

See also under Gypsum, p. 653.

Solubility of  $\text{CaSO}_4$  in NaCl + Aq in contact with solid  $\text{Ca}(\text{HCO}_3)_2$ .

G. $\text{CaSO}_4$ per l.	G. $\text{Ca}(\text{HCO}_3)_2$ per l.	G. NaCl per l.
1.9298	0.0603	0.000
2.7200	0.0724	3.628
3.4460	0.0885	11.490
5.1560	0.1006	39.620
6.4240	0.0603	79.520
5.2720	0.0563	121.900
4.7860	0.0482	193.800
4.4620	0.0402	267.600

(Cameron and Seidell, J. phys. Chem. 1901, 5. 653.)

$(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ .

Sol. in 287 pts.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  (1:4). (Fresenius, Z. anal. 30. 593.)

1 g.  $\text{CaSO}_4$  is sol. in 327 ccm.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $9^\circ$ ; in 369 ccm.  $\frac{1}{2}$  sat.  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $13.5^\circ$ . (Fassbender.)

Solubility in sat.  $(\text{NH}_4)_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$  is the same as in  $\text{H}_2\text{O}$ . (Droeze, B. 10. 330.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

g. per l. solution			g. per l.		
$(\text{NH}_4)_2\text{SO}_4$	$\text{CaSO}_4$	wt. of 100 cc. solution	$(\text{NH}_4)_2\text{SO}_4$	$\text{CaSO}_4$	wt. of 100 cc. solution
0.00	0.208	99.91	6.575	0.144	100.36
0.129	0.204	99.91	13.15	0.146	100.82
0.258	0.199	99.92	26.30	0.162	101.76
0.821	0.181	99.95	84.9	0.233	105.34
1.643	0.166	99.99	169.8	0.333	110.32
3.287	0.154	100.10	339.6	0.450	119.15

(Sullivan, J. Am. Chem. Soc. 1905, 27. 529.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $50^\circ$ .

Sp. gr.	$(\text{NH}_4)_2\text{SO}_4$ per l.	$\text{CaSO}_4$ per l.	Solid phase
...	0	2.168	$\text{CaSO}_4 + 2\text{H}_2\text{O}$
1.0026	15.65	1.609	
1.0113	30.67	1.750	
1.0440	91.6	2.542	
1.0819	160.4	3.402	
1.1108	221.6	4.068	
1.1385	280.6	4.690	
1.1653	340.6	5.084	
1.1972	415.6	5.336	
1.1964	416.5	5.354	
1.2043	428.4	4.632	$\text{CaSO}_4, (\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$
1.2187	479.4	3.524	
1.2437	530.8	2.152	$(\text{NH}_4)_2\text{SO}_4$
1.2480	558.0	1.986	
1.2502	564.7	1.98	
1.2508	566.0	1.08	
1.2510	566.7	0	

(Bell and Taber, J. phys. Chem. 1906, 10. 120.)

Solubility of  $\text{CaSO}_4$  in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $t^\circ$ .

Excess of $(\text{NH}_4)_2\text{SO}_4$			Excess of $\text{CaSO}_4$		
$t^\circ$	% $\text{CaSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$	$t^\circ$	% $\text{CaSO}_4$	% $(\text{NH}_4)_2\text{SO}_4$
6	0.1529	41.82	3	0.3782	36.62
40.5	0.1569	44.55	31	0.4070	35.50
58	0.1662	46.07	60	0.5063	34.97
78	0.1968	47.51	75	0.5898	34.86
100	0.2546	49.45	80	0.6108	34.88
			84	0.5725	32.40
			100	0.4895	25.97

(Barre, C. R. 1909, 143. 1605.)

The solubility of  $\text{CaSO}_4$  in  $\text{H}_2\text{O}$  is considerably increased by the presence of  $(\text{NH}_4)_2\text{SO}_4$ .

but decreased by the presence of  $K_2SO_4$ .  
(Barre, C. R. 1909, 148. 1606.)

### $CuSO_4 + Aq.$

Solubility in  $CuSO_4 + Aq$  at  $25^\circ$ .

Sp. gr. of the solution $25^\circ/25^\circ$	g. $CuSO_4$ per l.	g. $CaSO_4$ per l.
1.002	1.144	2.068
1.005	3.564	1.986
1.007	6.048	1.944
1.009	7.279	1.858
1.016	14.814	1.760
1.021	19.729	1.736
1.030	29.543	1.688
1.041	39.407	1.718
1.051	49.382	1.744
1.061	58.880	1.782
1.098	97.950	1.931
1.146	146.725	2.048
1.192	196.021	2.076
1.218	224.916	2.088

(Bell and Taber, J. phys. Ch. 1907, 11. 637.)

### $MgSO_4 + Aq.$

Insol. in sat.  $MgSO_4 + Aq.$

1 g.  $CaSO_4$  is sol. in 1162 ccm.  $\frac{1}{10}$  sat.  $MgSO_4 + Aq$  at  $13.5^\circ$ . (Fassbender, B. 9. 1360.)

† Sol. in 635 pts. sat.  $MgSO_4 + Aq$  at  $19^\circ$ . (Karsten.)

Absolutely insol. in sat.  $MgSO_4 + Aq.$  and pptd. from aqueous solution by the addition of  $MgSO_4$ . (Droeze, B. 10. 340.)

1 l.  $\frac{1}{10}$  sat.  $MgSO_4 + Aq$  dissolves 0.86 g.  $CaSO_4 + 2H_2O$ . (Droeze.)

Solubility in  $MgSO_4 + Aq$  at  $25^\circ$ .

g. per l.		Sp. gr. at $25^\circ/25^\circ$	g. per l.		Sp. gr. at $25^\circ/25^\circ$
$MgSO_4$	$CaSO_4$		$MgSO_4$	$CaSO_4$	
0.0	2.046	1.0032	149.67	1.597	1.1377
3.20	1.620	1.0055	165.7	1.549	1.1479
6.39	1.507	1.0090	171.2	1.474	1.1537
10.64	1.471	1.0118	198.8	1.422	1.1813
21.36	1.478	1.0226	232.1	1.254	1.2095
42.68	1.558	1.0419	265.6	1.070	1.2382
64.14	1.608	1.0626	298.0	1.860	1.2624
85.67	1.617	1.0833	330.6	0.647	1.2877
128.28	1.627	1.1190	355.0	0.501	1.3023

(Cameron and Bell, J. phys. Ch. 1906, 10. 210.)

### $K_2SO_4 + Aq.$

1 g.  $CaSO_4$  is sol. in 2325 ccm. sat.  $K_2SO_4 + Aq.$  at  $13.5^\circ$ ; in 664 ccm.  $\frac{1}{10}$  sat.  $K_2SO_4 + Aq$  at  $13.5^\circ$ .

Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$ .

g. per l.		wt. of 1 cc. of solution
$K_2SO_4$	$CaSO_4$	
0.0	2.08	0.9981
4.88	1.60	1.0036
5.09	1.56	1.0038
9.85	1.45	1.0075
19.57	1.49	0.151
28.35	1.55	1.0229
30.66	1.57	1.0236
32.47*	1.58	...

\*Solid phase syngenite.  
(Cameron and Breazeale, J. phys. Ch. 1904, 8. 335.)

Solubility in  $K_2SO_4 + Aq.$  at  $25^\circ$ .

In 1000 g. of the solution  
mole  $K_2SO_4$                       mole  $CaSO_4$   
3.223                                  0.223

(D'Ans, Z. anorg. 1909, 62. 151.)

Solubility of  $CaSO_4$  in  $K_2SO_4 + Aq$  at  $t^\circ$ .

$t^\circ$	Excess of $K_2SO_4$		Excess of $CaSO_4$	
	% $CaSO_4$	% $K_2SO_4$	% $CaSO_4$	% $K_2SO_4$
0°	0.1296	2.00	0.0229	6.99
18	0.1531	2.79	0.0271	9.81
51	0.1754	4.21	0.0300	14.18
80	0.1922	5.00	0.0349	17.55
99	0.1980	5.39	0.0371	19.70

(Barre, C. R. 1909, 148. 1606.)

### $Ag_2SO_4 + Aq.$

1 l. of the solution contains 2.31 g.  $CaSO_4$ , +7.23 g.  $Ag_2SO_4$  = 9.54 g. mixed salts at  $17^\circ$ .  
Sp. gr. = 1.0083.

1 l. of the solution contains 2.61 g.  $CaSO_4$ , +8.11 g.  $Ag_2SO_4$  = 10.72 g. mixed salts at  $25^\circ$ .  
Sp. gr. = 1.010. (Euler, Z. phys. Ch. 1904, 49. 313.)

### $Na_2SO_4 + Aq.$

1 g.  $CaSO_4$  is sol. in 398 ccm. sat.  $Na_2SO_4 + Aq$  at  $10.5^\circ$ .

Solubility of  $CaSO_4$  in  $Na_2SO_4 + Aq$  at  $22^\circ$

G. $CaSO_4$ per l.	G. $Na_2SO_4$ per l.
2.084	0.000
1.583	2.771
1.433	13.820
1.408	16.360
1.569	39.310
1.841	77.320
2.185	133.00
2.414	193.800
*2.578	*222.580

\*Both  $CaSO_4$  and  $Na_2SO_4$  as solid phases in contact with the solution.  
(Cameron and Seidell, J. phys. Chem. 1901, 5. 650.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

wt. of 1000 ccm. of solution grams	g. $\text{Na}_2\text{SO}_4$ per l.	g. $\text{CaSO}_4$ per l.
1001.26	2.390	1.650
1007.59	9.535	1.457
1011.45	14.132	1.388
1020.46	24.369	1.471
1031.48	36.979	1.563
1039.12	46.150	1.650
1079.47	94.220	1.980
1096.47	115.084	2.096
1142.66	146.612	2.234
1176.47	205.105	2.503
1212.00	257.100	2.650

(Cameron and Breazeale, J. phys. Chem. 1904, 8. 340.)

1 l. sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$  containing 254.09,  $\text{Na}_2\text{SO}_4$  dissolves 2.58 g.  $\text{CaSO}_4$ . (Cameron and Brown, J. phys. Ch. 1905, 9 214.)

Hydration is retarded by dil. solutions and accelerated by conc. solution of sodium, potassium, ammonium and magnesium sulphates. (Rohland, Z. Elektrochem. 1908, 14. 422.)

More than 10 times as much  $\text{CaSO}_4$  dissolves in sat.  $\text{Na}_2\text{S}_2\text{O}_8 + \text{Aq}$  as in  $\text{H}_2\text{O}$ . (Diehl. Insol. in alcohol. of 0.905 sp. gr. or less. (Anthon, J. pr. 14. 125.)

Solubility in 10% alcohol = 0.0970 g.  $\text{CaSO}_4$  per 100 g. solution. (Magnanini, Gazz. Ch. it. 1901, 31. (2) 544.)

Sol. in dil. alcoholic solutions of  $\text{NH}_4\text{NO}_3$ ,  $\text{KNO}_3$ ,  $\text{NaNO}_3$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KCl}$ , and  $\text{NaCl}$ . (Margueritte, C. R. 38. 308.)

Sol. to considerable extent in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ , especially if freshly pptd. More sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in  $\text{NH}_4\text{Cl} + \text{Aq}$ . (Weppen, J. pr. 11. 182.)

More sol. in  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$  than in other  $\text{NH}_4$  salts. (Cohn, J. pr. (2) 35. 43.)

More sol. in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$  or  $\text{KCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Mulder.)

Solubility in N/200 potassium hydrogen tartrate +  $\text{Aq}$  = 0.2323 g.  $\text{CaSO}_4$  per 100 g. solution. (Magnanini, Gazz. ch. it. 1901, 31. (2) 544.)

72.61 millimols. per l. of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  are sol. at  $25^\circ$  in ammonium citrate +  $\text{Aq}$  (concentration = 0.5 millimols. per l.)

36.39 millimols per l. of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  are sol. at  $25^\circ$  in sodium citrate +  $\text{Aq}$ . (Concentration = 0.25 millimols per l. (Rindell, Z. phys. Ch. 1910, 70. 452.)

100 pts. glycerine dissolve 0.957 pt.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ , and solubility increases with the temp. (Asselin, C. R. 76. 884.)

100 g. glycerine (sp. gr. 1.256) dissolve 5.17 g.  $\text{CuSO}_4$  at  $15-16^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

Solubility in 10% alcoholic N/200  $\text{KHC}_2\text{H}_3\text{O}_2 + \text{Aq}$  = 0.0866 g.  $\text{CaSO}_4$  per 100 g. solution.

Solubility in N/200  $\text{KHC}_2\text{H}_3\text{O}_2 + \text{Aq}$  + 5% tartaric acid = 0.2556 g.  $\text{CaSO}_4$  per 100 g. solution.

Solubility in 10% alcoholic N/400  $\text{KHC}_2\text{H}_3\text{O}_2 + 5\%$  tartaric acid = 0.1086 g.  $\text{CaSO}_4$  in 100 g. solution. (Magnanini.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethylacetate. (Naumann, B. 1910, 43. 314.)

Solubility in sugar +  $\text{Aq}$  at  $t^\circ$ .

% sugar	G. $\text{CaSO}_4$ dissolved in 1 l. sugar solutions					
	$30^\circ$	$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$	$80^\circ$
0	...	2.157	1.730	1.730	1.652	1.710
10	2.041	1.730	1.730	1.574	1.574	1.613
20	1.808	1.652	1.419	1.380	1.419	1.263
27	1.550	1.438	1.361	1.283	1.283	0.972
35	1.263	1.050	1.088	1.108	0.914	...
42	1.030	...	0.777	0.816	0.855	0.729
49	...	0.564	0.739	0.564	0.603	0.486
55	...	0.486	0.505	0.486	0.369	0.330

(Stolle, Z. Ver. Zuckerind, 1900, 50. 331.)

Min. Anhydrite.

+  $2\text{H}_2\text{O}$ . Min. Gypsum.

Gypsum. A sat. aq. solution of gypsum of particles not less than  $2\mu$  contains 2.085 g.  $\text{CaSO}_4$  per litre at  $25^\circ$ .

A sat. aq. solution of gypsum of particles not smaller than  $0.3\mu$  contains 2.476 g.  $\text{CaSO}_4$  per liter at  $25^\circ$ . ( $\mu = 0.0001$  cm.) (Hulett and Allen, Z. phys. Ch. 1901, 37. 391 and 393.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{CaSO}_4$ in 100 ccm. of the solution	Density of the solution at $t^\circ$
0	0.17590	1.001970
10	0.19285	1.001727
18	0.20160	1.000590
25	0.20805	0.999109
30	0.20975	0.997891
35	0.20960	0.996122
40	0.20970	0.994390
45	0.20835	0.992370
55	0.20095	0.987960
65.3	0.19320	0.982560
75	0.18475	0.977724
100	0.16195	...

(Hulett and Allen, J. Am. Chem. Soc. 1902, 24. 674.)

1 l.  $\text{H}_2\text{O}$  dissolves 2.13 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $25^\circ$ . (Euler, Z. phys. Ch. 1904, 49. 314.)

2023 mg. are dissolved in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

1 l.  $\text{H}_2\text{O}$  dissolves 2.267 g.  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  at  $0^\circ$ ; 2.684 g. at  $35^\circ$ ; 2.662 g. at  $50^\circ$ ; and 2.155 g. at  $100^\circ$ . (Cavazzi, C. C. 1905, I. 1693.)



1 l.  $\text{H}_2\text{O}$  dissolves 29.5 milliequivalents at  $18^\circ$ ; 30 at  $50^\circ$ ; 23.3 at  $100^\circ$ . (Melcher, J. Am. Chem. Soc. 1910, **32**, 63.)

See also under  $\text{CaSO}_4$ .

Solubility of pulverized gypsum in  $\text{NaCl} + \text{Aq}$  at  $23^\circ$ .

Grams gypsum	G. $\text{NaCl}$ per l.	G. $\text{CaSO}_4$ per l.
2.99	0.99	2.37
3.82	4.95	3.02
4.48	10.40	3.54
6.31	30.19	4.97
7.51	49.17	5.94
8.53	75.58	6.74
9.42	129.50	7.50
9.17	197.20	7.25
8.88	229.70	7.03
7.19	306.40	5.68
6.79	315.55	5.37

(Cameron, J. phys. Chem. 1901, **5**, 559.)

See also under  $\text{CaSO}_4$ .

$+\frac{1}{2}\text{H}_2\text{O}$ . Plaster of Paris contains  $\frac{1}{2}\text{H}_2\text{O}$  according to Chatelier (C. C. 1889, **1**, 203).

#### Calcium hydrogen sulphate, $\text{CaH}_2(\text{SO}_4)_2$ .

100 pts.  $\text{H}_2\text{SO}_4$  of 1.82 sp. gr. dissolve about 2 pts.  $\text{CaSO}_4$ ; 100 pts. fuming  $\text{H}_2\text{SO}_4$  dissolve 10.17 pts.  $\text{CaSO}_4$  (Struve, Z. anal. **9**, 34); 100 pts.  $\text{H}_2\text{SO}_4$  dissolve 2.5 pts.  $\text{CaSO}_4$  (Lieb-Bodart and Jacquemin, C. R. **46**, 1206);  $\text{CaSO}_4$  is precipitated by  $\text{H}_2\text{O}$  from  $\text{H}_2\text{SO}_4$  solution.

100 pts. boiling  $\text{H}_2\text{SO}_4$  dissolve 10 pts.  $\text{CaSO}_4$ . (Schultz, Pogg. **133**, 137.)

#### Solubility of $\text{CaSO}_4$ in $\text{H}_2\text{SO}_4 + \text{Aq}$ .

wt. of 1000 com. of solution at $25^\circ$	g. $\text{H}_2\text{SO}_4$ per l.	g. $\text{CaSO}_4$ per l. at		
		$25^\circ$	$35^\circ$	$43^\circ$
999.1067	0.00	2.126	...	2.145
1002.493	0.48	2.128	2.209	2.236
1002.553	4.87	2.144	2.451	2.456
1005.091	8.11	2.203	...	2.760
1009.787	16.22	2.382	...	3.116
1030.151	48.67	2.727	3.397	3.843
1043.470	75.00	2.841	...	4.146
1075.613	97.35	2.779	3.606	...
...	146.01	2.571	3.150	4.139
1113.392	194.70	2.313	...	3.551
1141.755	243.35	1.901	...	2.959
1168.143	292.02	1.541	...	2.481

(Cameron and Breazeale, J. phys. Chem. 1903, **7**, 574.)

100 pts. hot conc.  $\text{H}_2\text{SO}_4$  dissolve approx. 10 pts.  $\text{CaSO}_4$ . (Rohland, Z. anorg. 1910, **68**, 206.)

Decomp. by  $\text{H}_2\text{O}$ .

Calcium hexahydrogen sulphate,  $\text{CaH}_6(\text{SO}_4)_4$ .  
Decomp. by  $\text{H}_2\text{O}$ . (Schultz, Pogg. **133**, 137.)

Calcium cupric potassium sulphate,  
 $\text{Ca}_2\text{K}_2\text{Cu}(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .  
(D'Ans, B. 1908, **41**, 1778.)

Calcium magnesium potassium sulphate,  
 $2\text{CaSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .  
Min. *Polyhalite*. Sol. in  $\text{H}_2\text{O}$  with residue of  $\text{CaSO}_4$ .  
 $4\text{CaSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ . Min. *Krugite*. Decomp. by  $\text{H}_2\text{O}$ .

Calcium potassium sulphate,  $\text{CaK}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$ .

Min. *Syngenite*. Sol. in 400 pts.  $\text{H}_2\text{O}$ . (Zepharovitch.) Less sol. than  $\text{K}_2\text{SO}_4$ .  
Decomp. by heating with separation of  $\text{CaSO}_4$ .  
Decomp. by  $\text{H}_2\text{O}$  until 25 g.  $\text{K}_2\text{SO}_4$  are dissolved in a litre, after which there is no decomposition. (Ditte, C. R. **84**, 86.)

Easily sol. in dil. acids. (Phillips.)

Solubility of syngenite,  $\text{CaK}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$  in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Wt. of 1000 cem. of solution grams	g. $\text{K}_2\text{SO}_4$ per l.	g. $\text{CaSO}_4$ per l.
1013.08	16.31	*1.495
1015.78	19.87	1.529
1020.01	25.01	1.537
1024.54	30.83	1.565
1036.82	46.99	0.810
1058.10	75.45	0.451
1085.91	112.87	0.330

\*In first four determinations syngenite completely decomposed.

(Cameron and Breazeale, J. phys. Chem. 1904, **8**, 339.)

This double salt is stable between  $0^\circ$  and  $99^\circ$  in the presence of an excess of either  $\text{CaSO}_4$  or  $\text{K}_2\text{SO}_4$ . In this temp. interval the double sulphate,  $2\text{CaSO}_4, \text{K}_2\text{SO}_4, 3\text{H}_2\text{O}$  described by Ditte (C. R. **84**, 867) does not exist. (Barre, C. R. 1909, **148**, 1607.)

$\text{Ca}_2\text{K}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$ . (Ditte, C. R. **84**, 867.)

$5\text{CaSO}_4, \text{K}_2\text{SO}_4 + \text{H}_2\text{O}$ . Slowly decomp. by  $\text{H}_2\text{O}$ . (van't Hoff and Geiger, B. A. B. 1904, 935.)

Calcium potassium zinc sulphate,  
 $\text{Ca}_2\text{K}_2\text{Zn}(\text{SO}_4)_4 + 2\text{H}_2\text{O}$ .  
(D'Ans, B. 1908, **41**, 1778.)

Calcium rubidium sulphate,  $\text{Ca}_2\text{Rb}_2(\text{SO}_4)_2$ .

(D'Ans, B. 1907, **40**, 4913.)  
 $+3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Ditte, C. R. **84**, 86.)

$\text{CaRb}_2(\text{SO}_4)_2 + \text{H}_2\text{O}$ . (D'Ans.)

**Calcium sodium sulphate,  $\text{CaNa}_2(\text{SO}_4)_2$ .**

Min. *Glauberite*. Gradually sol. in  $\text{H}_2\text{O}$ , but crystals of  $\text{CaSO}_4 + 2\text{H}_2\text{O}$  soon separate out. (Fritzsche.)

Insol. in alcohol, and conc.  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ ; decomp. by  $\text{H}_2\text{O}$ . (Folkhard, C. N. 43. 6.)

$\text{CaNa}_2(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Fritzsche.)

**Calcium titanium sulphate,  $\text{CaSO}_4, \text{Ti}(\text{SO}_4)_2$ .**

Ppt.; decomp. by  $\text{H}_2\text{O}$  giving titanic acid. (Weinland, Z. anorg. 1907, 54. 254.)

**Calcium uranium sulphate.**

Min. *Uranochalcite*.

Min. *Medjidite*. Easily sol. in dil.  $\text{HCl} + \text{Aq}$ .

**Cerous sulphate,  $\text{Ce}_2(\text{SO}_4)_3$ .**

Anhydrous cerous sulphate is much more sol. in  $\text{H}_2\text{O}$  than the hydrated salt.

Easily sol. in cold  $\text{H}_2\text{O}$  if added thereto in small amounts. If large amount of  $\text{Ce}_2(\text{SO}_4)_3$  is treated with a little  $\text{H}_2\text{O}$  it hardens with evolution of heat, and becomes very difficultly soluble. 100 pts.  $\text{H}_2\text{O}$  dissolve 161 pts.  $\text{Ce}_2(\text{SO}_4)_3$  at  $0^\circ$  and 17.86 pts. at  $19^\circ$ .

$\text{Ce}_2(\text{SO}_4)_3 + \text{Aq}$  sat. in cold deposits  $\text{Ce}_2(\text{SO}_4)_3$  at  $75^\circ$ , and only 2.25 pts. remain in solution at  $100^\circ$ . (Jolin, Bull. Soc. (2) 21. 536.)

100 pts.  $\text{H}_2\text{O}$  dissolve 8.31 pts.  $\text{Ce}_2(\text{SO}_4)_3$  at  $20^\circ$ ; 8.08 pts. at  $45^\circ$ ; 4.95 pts. at  $60^\circ$ ; 0.504 pt. at  $100^\circ$ . (Bühlig, J. pr. (2) 12. 240.)

60 pts. anhydrous salt dissolve quickly at  $0-3^\circ$  in 100 pts.  $\text{H}_2\text{O}$ .

At  $15^\circ$  the solution solidifies, and the mother liquor contains only 27.88%  $\text{Ce}_2(\text{SO}_4)_3$ . At  $15^\circ$  the maximum attainable strength is 31.62%  $\text{Ce}_2(\text{SO}_4)_3$ . (Brauner, Chem. Soc. 53. 357.)

100 pts.  $\text{H}_2\text{O}$  dissolve 10.747 pts.  $\text{Ce}_2(\text{SO}_4)_3$  at  $16^\circ$ ; 9.648 pts. at  $19^\circ$ ; 6.949 pts. at  $33^\circ$ .

The solubility of  $\text{Ce}_2(\text{SO}_4)_3$  in  $\text{H}_2\text{O}$  is diminished by the addition of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ . (Barre, C. R. 1910, 151. 872.)

Sp. gr. of  $\text{Ce}_2(\text{SO}_4)_3 + \text{Aq}$  was found to be constant whether  $\text{Ce}_2(\text{SO}_4)_3$  or  $\text{Ce}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  was used. The following results were obtained at  $15^\circ$ .

Pts. $\text{Ce}_2(\text{SO}_4)_3$ to 100 pts. $\text{H}_2\text{O}$	Sp. gr.	Pts. $\text{Ce}_2(\text{SO}_4)_3$ to 100 pts. $\text{H}_2\text{O}$	Sp. gr.
3.17	1.03005	12.66	1.11917
6.11	1.05812	14.56	1.13665
8.35	1.07910	15.64	1.14623
9.61	1.09085	21.19	1.19640
10.55	1.09939	31.62	1.28778
11.66	1.10987	...	...

(Brauner, Chem. Soc. 53. 357.)

4.5 pts.  $\text{Ce}_2(\text{SO}_4)_3$  dissolve in 100 pts.  $\text{H}_2\text{SO}_4$ . (Wyrouboff, Bull. Soc. (3) 2. 745.)

**Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $16^\circ$ .**

Per 100 pts. $\text{H}_2\text{O}$	
$(\text{NH}_4)_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0.00	10.747
3.464	1.026
9.323	0.782
19.240	0.748
29.552	0.701
45.616	0.497
55.083	0.194
63.920	0.090
72.838	0.035

(Barre, A. ch. 1911, (8) 24. 252.)

**Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $19^\circ-20^\circ$ .**

Per 100 pts. $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0.00	9.64
0.328	0.637
0.684	0.259
1.091	0.0937
1.392	0.057
1.699	0.0303
2.640	0.012
3.589	0.0065
5.660	0.0046
7.710	0.0037

(Barre, A. ch. 1911, (8) 24. 251.)

**Solubility in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $16^\circ$ .**

Per 100 pts. $\text{H}_2\text{O}$	
$\text{K}_2\text{SO}_4$	$\text{Ce}_2(\text{SO}_4)_3$
0.00	10.747
0.178	0.956
0.510	0.432
0.726	0.250
1.290	0.0419

(Barre, A. ch. 1911, (8) 24. 248.)

$+4\text{H}_2\text{O}$ . 100 g.  $\text{H}_2\text{O}$  dissolve at:

$35^\circ$   $40^\circ$   $50^\circ$   $57^\circ$   
8.5 6.04 3.43 2.34 g.  $\text{Ce}_2(\text{SO}_4)_3$ .

$65^\circ$   $70^\circ$   $82^\circ$   $100.5^\circ$  bpt. of sat. solution.  
1.883 1.38 1.01 0.43 g.  $\text{Ce}_2(\text{SO}_4)_3$ .

(Koppel, Z. anorg. 1904, 41. 399.)

+5H<sub>2</sub>O.100 pts. H<sub>2</sub>O dissolve pts. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at t°.

t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
100	0.775
80	1.70
60	3.45
50	5.56
40	8.20

(Muthmann and Rolig, Z. anorg. 1898, 16, 456.)

100 g. H<sub>2</sub>O dissolve at:

45° 60° 70°

8.833 3.247 1.929 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

80° 90° 100.5° bpt. of sat. solution.

1.207 0.8355 0.469 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Muthmann and Rolig's determinations are inaccurate. (Koppel.)

+8H<sub>2</sub>O. 100 pts. H<sub>2</sub>O dissolve 14.92 pts.Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at 20° from Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O, (Jolin.)100 pts. H<sub>2</sub>O dissolve pts. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at t°.

t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	19.10	50	12.48
18	17.32	60	9.40
30	16.13	70	4.24

(Muthmann and Rolig.)

100 g. H<sub>2</sub>O dissolve at:

0° 15° 20.4°

10.09 11.06 9.525 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>,

30° 40° 50° 60°

7.388 5.947 4.785 4.064 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Previous determinations are inaccurate. (Koppel, Z. anorg. 1904, 41, 395.)

100 g. sat. solution at 25° contain 7.60 g. anhydrous salt. (Wirth, Z. anorg. 76, 174.)

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at 25°. Solid phase Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.

Normality H <sub>2</sub> SO <sub>4</sub>	In 100 g. of the liquid are dissolved	
	g. Ce <sub>2</sub> O <sub>3</sub>	g. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	4.604	7.60
0.1	4.615	7.618
1.1	3.64	6.00
2.16	3.01	5.018
4.32	2.0	3.301
6.685	0.9115	1.505
9.68	0.4339	0.733
15.15	0.145	0.239

(Wirth, Z. anorg. 1912, 76, 191.)

+9H<sub>2</sub>O. 100 pts. H<sub>2</sub>O dissolve 17.52 pts.Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> from Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>+9H<sub>2</sub>O. (Brauner.100 g. H<sub>2</sub>O dissolve at:

0° 15° 21° 30° 31.2°

20.98 11.87 9.725 7.353 7.185 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>,

31.6° 45° 50° 60° 65°

7.164 5.13 4.673 3.88 3.595 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

(Koppel.)

+12H<sub>2</sub>O.100 pts. H<sub>2</sub>O dissolve pts. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> at t°.

t°	Pts. Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>
0	21.40
18	18.44
25	16.22

(Muthmann and Rolig, Z. anorg. 1898, 16, 457.)

100 g. H<sub>2</sub>O dissolve at:

0° 18.8° 19.2°

16.56 17.52 17.70 g. Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Previous determinations are inaccurate. (Koppel.)

Ceroceric sulphate, Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2Ce(SO<sub>4</sub>)<sub>2</sub>+24H<sub>2</sub>O.Decomp. by H<sub>2</sub>O. Sol. in HCl+Aq with decomp. (Mendelejeff, A. 166, 45.)Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Ce(SO<sub>4</sub>)<sub>2</sub>+31H<sub>2</sub>O. (Jolin.)Ceric sulphate, basic, CeO<sub>2</sub>, SO<sub>3</sub>+2H<sub>2</sub>O.Very sl. sol. in H<sub>2</sub>O.Sol. in 2500 pts. H<sub>2</sub>O. (Mosander.)Boiling H<sub>2</sub>O gradually dissolves out H<sub>2</sub>SO<sub>4</sub>. (Erk.)

Sol. in acids.

8CeO<sub>2</sub>, 7SO<sub>3</sub>+12H<sub>2</sub>O; 8CeO<sub>2</sub>, 7SO<sub>3</sub>+15H<sub>2</sub>O; 6CeO<sub>2</sub>, 5SO<sub>3</sub>+5H<sub>2</sub>O; 4CeO<sub>2</sub>, 3SO<sub>3</sub>+7H<sub>2</sub>O; and 3Ce(SO<sub>4</sub>)<sub>2</sub>, 5Ce(OH)<sub>4</sub>. All are insol. ppts.Ceric sulphate, Ce(SO<sub>4</sub>)<sub>2</sub>.*Anhydrous.* Very slowly sol. in cold, more rapidly in hot H<sub>2</sub>O. When solution has once begun, almost unlimited quantities may be dissolved. Insol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Meyer, B. 1904, 37, 144.)+4H<sub>2</sub>O. Sol. in H<sub>2</sub>O with immediate decomp. (Rammelsberg.)Decomp. by H<sub>2</sub>O. (Muthmann, B. 1900, 33, 1764.)Cerous hydrogen sulphate, Ce<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3H<sub>2</sub>SO<sub>4</sub>.Decomp. by H<sub>2</sub>O. (Wyruboff, Bull. Soc. (3) 2, 745; Brauner, Z. anorg. 1904, 38, 329.)Ceroceric hydrogen sulphate, Ce<sub>2</sub>H(SO<sub>4</sub>)<sub>4</sub>+13H<sub>2</sub>O.Sol. in H<sub>2</sub>O. Forms very supersat. solutions.Solubility in H<sub>2</sub>SO<sub>4</sub> decreases with increase in concentration of the acid. (Meyer, B. 1904, 37, 146.)

**Cerous potassium sulphate**,  $\text{Ce}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Czudnowicz, J. pr. 80. 26.)

$2\text{Ce}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$ . As above. (Hermann, J. pr. 30. 188.)

$+8\text{H}_2\text{O}$ . (Barre, A. ch. 1911, (8) 24. 249.)  $\text{Ce}_2(\text{SO}_4)_3, 2\text{K}_2\text{SO}_4 + 3\text{H}_2\text{O}$ . As above. (Jolin.)

$\text{Ce}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$ . Sol. in about 56 pts.  $\text{H}_2\text{O}$  at  $9-20^\circ$ . Easily sol. in acidified  $\text{H}_2\text{O}$ . Nearly insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Jolin.)

$\text{Ce}_2(\text{SO}_4)_3, 5\text{K}_2\text{SO}_4$ . Insol. in  $\text{K}_2\text{SO}_4 + \text{Aq.}$  (Barre, l.c.)

**Ceric potassium sulphate**,  $\text{Ce}(\text{SO}_4)_2, 2\text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq.}$

**Ceric silver sulphate**,  $10\text{Ce}(\text{SO}_4)_2, 6\text{Ag}_2\text{SO}_4$ .

Only sl. sol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$  in which it is readily sol. (Pozzi-Escot, C. R. 1913, 156. 1074.)

**Cerous sodium sulphate**,  $\text{Ce}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , and still less in  $\text{Na}_2\text{SO}_4 + \text{Aq.}$  100 ccm. sat.  $\text{Na}_2\text{SO}_4 + \text{Aq.}$  dissolve an amount corresponding to 6.2 mg.  $\text{Ce}_2\text{O}_3$ . (Jolin.)

Sl. sol. in  $\text{HCl} + \text{Aq.}$  (Czudnowicz.)

**Cerous thallous sulphate**,  $\text{Ce}_2(\text{SO}_4)_3, 3\text{Tl}_2\text{SO}_4$ .

Ppt.

$\text{Ce}_2(\text{SO}_4)_3, \text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Zachiesche, J. pr. 107. 98.)

$+4\text{H}_2\text{O}$ . Very sl. sol. in cold, somewhat more in warm  $\text{H}_2\text{O}$ . (Wyruboff, Bull. Soc. Min. 14. 83.)

**Cerous tin (stannic) hydrogen sulphate**,  $\text{CeHSn}(\text{SO}_4)_4$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in very dil.  $\text{HCl}$ . (Weinland, Z. anorg. 1907, 54. 251.)

**Chromous sulphate**,  $\text{CrSO}_4 + 7\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 12.35 pts.  $\text{CrSO}_4 + 7\text{H}_2\text{O}$ . Aqueous solution can be boiled without decomp. Sl. sol. in alcohol.

$+ \text{H}_2\text{O}$ . (Moissan, Bull. Soc. 37. 296.)

**Chromic sulphate, basic**,  $3\text{Cr}_2\text{O}_3, 2\text{SO}_3 + 12\text{H}_2\text{O} = 2\text{Cr}_2(\text{SO}_4)(\text{OH})_4, \text{Cr}_2(\text{OH})_4 + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Slowly decomp. by  $\text{KOH} + \text{Aq}$  or  $\text{K}_2\text{CO}_3 + \text{Aq}$ .

$5\text{Cr}_2\text{O}_3, 3\text{SO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Recoura, C. R. 112. 1439.)

$\text{Cr}_2\text{O}_3, \text{SO}_3 = \text{Cr}_2\text{O}_3(\text{SO}_4)$ . Ppt. (Schiff, A. 124. 167.)

$+10\text{H}_2\text{O}$  or  $[\text{Cr}(\text{OH})_3(\text{OH})_2]_2\text{SO}_4$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Werner, B. 1908, 41. 3451.)

$5\text{Cr}_2\text{O}_3, 8\text{SO}_3$ . (?) (Siewert, A. 128. 97.)

$\text{Cr}_2\text{O}_3, 2\text{SO}_3 = \text{Cr}_2\text{O}(\text{SO}_4)_2$ . Easily sol. in a little  $\text{H}_2\text{O}$ , but a precipitate is thrown down

by further addition of  $\text{H}_2\text{O}$ , which redissolves on evaporation.

$5\text{Cr}_2\text{O}_3, 12\text{SO}_3$ . (?) (Siewert.)

$2\text{Cr}_2\text{O}_3, 5\text{SO}_3 + 15\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol and acetone by which it is ppt. from aqueous solution. (Nicolardot, C. R. 1907, 145. 1338.)

**Chromic sulphate**,  $\text{Cr}_2(\text{SO}_4)_3$ .

*Anhydrous*. Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , aqua regia, and  $\text{NH}_4\text{OH} + \text{Aq.}$  Decomp. by boiling caustic alkalies, and slowly by alkali carbonates  $+ \text{Aq.}$  (Schrötter.) According to Traube (A. 71. 92) and Siewert (A. 126. 94), Schrötter's salt is an acid sulphate,  $\text{Cr}_2(\text{SO}_4)_3(\text{OSO}_3\text{OH})_2 = 2\text{Cr}_2(\text{SO}_4)_3, \text{H}_2\text{SO}_4$ . According to Etard (Bull. Soc. (2) 31. 200) both salts exist, and formula of above salt is  $\text{Cr}_2(\text{SO}_4)_3\text{Cr}_2$ . Formula is  $2[(\text{Cr}_2\text{O}_3)_2, (\text{SO}_3)_4]$ ,  $17\text{H}_2\text{SO}_4$ . (?) (Cross and Higgins, Chem. Soc. 41. 113.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

$+6\text{H}_2\text{O}$  (?). *Green modification*. Readily sol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in conc.  $\text{H}_2\text{SO}_4$ .  $\text{H}_2\text{O}$  solution is converted into the violet modification by standing 3-4 weeks. (Schrötter.)

$+11\text{H}_2\text{O}$  (?). Extremely deliquescent; becomes liquid in moist air in 2 minutes. Not pptd. by  $\text{BaCl}_2 + \text{Aq.}$  (Recoura, C. R. 113. 857.)

$+18\text{H}_2\text{O}$ . *Violet modification*. Sol. in 0.833 pt.  $\text{H}_2\text{O}$  at  $20^\circ$ . When the  $\text{H}_2\text{O}$  solution is heated to  $65-70^\circ$  it begins to be converted into the green modification. This conversion is also brought about by cold  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{PCl}_5$ . (Etard, C. R. 84. 1090.)

Sp. gr. of aqueous solution of violet modification of  $\text{Cr}_2(\text{SO}_4)_3$  containing:

5	10	20%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.0275	1.0560	1.1150	
30	40	50%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.1785	1.2480	1.3250	

Sp. gr. of aqueous solution of green modification of  $\text{Cr}_2(\text{SO}_4)_3$  containing:

10	20	30%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.0510	1.1070	1.1680	
40	50	60%	$\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$
1.2340	1.3055	1.3825	

70 80%  $\text{Cr}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ .

1.4650 1.5535

(Gerlach, Z. anal. 28. 494.)

See also Chromosulphuric acid.

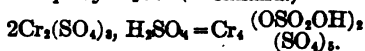
**Chromic hydrogen sulphate**,  $\text{Cr}_2(\text{SO}_4)_3, \text{H}_2\text{SO}_4 + 16\text{H}_2\text{O}$ .

*Two modifications*.

a. *Violet*. Decomp. by  $\text{H}_2\text{O}$ .

b. *Green*. Obtained from violet modification on heating. Sol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1906, 49. 157.)

+24H<sub>2</sub>O. Decomp. by alcohol, giving the normal sulphate. (Weinland.)  
Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2H<sub>2</sub>SO<sub>4</sub>+18H<sub>2</sub>O. Hygroscopic.  
Decomp. by H<sub>2</sub>O. (Weinland.)

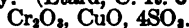


Correct composition of Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> (Traube), which see.

See also Chromosulphuric acid.

**Chromic cupric sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2CuSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>.

Insol. in H<sub>2</sub>O, but gradually decomp. thereby. (Étard, C. R. 87. 602.)



Insol. in H<sub>2</sub>O. (Recoura, C. R. 1893, 117. 39.)

**Chromous hydrazine sulphate**, CrSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>.

Only al. sol. in H<sub>2</sub>O. Sol. in acids. (Traube B. 1913, 46. 1507.)

**Chromic hydroxylamine sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, (NH<sub>2</sub>OH)<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Meyerinh.)

**Chromic iron (ferrous) sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2FeSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>+2H<sub>2</sub>O.

As above. (Étard, l.c.)

**Chromic iron (ferric) sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Insol. in H<sub>2</sub>O. (Étard, C. R. 86. 1399.)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Fe<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>. Insol. in H<sub>2</sub>O. (Étard.)

**Chromic lithium sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3Li<sub>2</sub>SO<sub>4</sub>.

Resembles the corresponding K salt. (Wernicke.)

**Chromic manganous sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 3MnSO<sub>4</sub>.

(Étard, C. R. 86. 1402.)

**Chromic manganic sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Insol. in H<sub>2</sub>O. (Étard, C. R. 86. 1399.)

Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 2H<sub>2</sub>SO<sub>4</sub>. Sl. deliquescent. Sol. in H<sub>2</sub>O with decomp. (Étard.)

**Chromic nickel sulphate**, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, NiSO<sub>4</sub>, 2H<sub>2</sub>SO<sub>4</sub>+3H<sub>2</sub>O.

Insol. in H<sub>2</sub>O, but gradually decomp. thereby. (Étard, C. R. 87. 602.)

**Chromous potassium sulphate**, CrSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O; less sol. in alcohol. (Peligot, A. ch. (3) 12. 546.)

**Chromic potassium sulphate**, K<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.

Anhydrous. a. Sol. in H<sub>2</sub>O when not heated over 350°.

β. Insol. in cold H<sub>2</sub>O and cold acids. When ignited is insol. in hot H<sub>2</sub>O and acids, except slightly in boiling conc. H<sub>2</sub>SO<sub>4</sub>. (Fischer.)

+2H<sub>2</sub>O (?). Insol. in cold H<sub>2</sub>O or dil. acids. Sol. by long boiling with H<sub>2</sub>O, and more quickly when HCl is added. (Hertwig.)

+4H<sub>2</sub>O. Is potassium chromosulphate, which see.

+24H<sub>2</sub>O. *Chrome-alum*. *Violet modification*. Efflorescent at 29°. Sol. in 6-7 pts. cold H<sub>2</sub>O. When the H<sub>2</sub>O solution is heated to 60-70° it is partially decomp. into a green modification, which is more sol. in H<sub>2</sub>O. The green modification on standing in H<sub>2</sub>O solution is very slowly converted back into violet modification. The green modification may also be formed by heating dry salt to 100°, at which temp. it melts in its crystal H<sub>2</sub>O. When all crystal H<sub>2</sub>O has been expelled at 300-350°, it still dissolves in hot H<sub>2</sub>O, but when heated above 350° it becomes insol. in H<sub>2</sub>O. (Löwel, A. ch. (3) 44. 313.)

125.1 g. anhydrous, or 243.9 g. hydrated salt, or 0.441 g. mols. anhydrous salt are sol. in 1 l. H<sub>2</sub>O at 25°. (Locke, Am. Ch. J. 1901, 28. 175.)

Melts in crystal H<sub>2</sub>O at 89°. (Tilden, Chem. Soc. 48. 409.)

Sp. gr. of aqueous solution of violet modification at 15° containing:

5	10	15%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O.
1.02725	1.05500	1.08350	

Sp. gr. of sat. solution at 15° = 1.0985.

Sp. gr. of aqueous solution of green modification at 15° containing:

10	20	30%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O,
1.050	1.103	1.161	
40	50	60%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O,
1.225	1.295	1.371	
70	80	90%	K <sub>2</sub> Cr <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> +24H <sub>2</sub> O.
1.453	1.541	1.635	

(Gerlach, Z. anal. 28. 497.)

Sp. gr. of chrome-alum solutions at 15° containing:

5	10	15	20	25	% salt,
1.0174	1.0342	1.0524	1.0746	1.1004	
30	35	40	45	50	% salt,
1.1274	1.1572	1.1896	1.2352	1.2894	
55	60	65	70	% salt.	
1.3704	1.4566	1.5462	1.6362		

(Franz, J. pr. (2) 5. 298.)

Insol. in alcohol.

3K<sub>2</sub>SO<sub>4</sub>, Cr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. Insol. in H<sub>2</sub>O, acids, or dil. alkalis. Decomp. by boiling with conc. KOH+Aq. (Wernicke, Pogg. 159. 576.)

**Chromic rubidium sulphate**, Rb<sub>2</sub>Cr<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+24H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Pettersson.)

Solubility in  $H_2O$ .

Temp.	G. anhydrous salt per l.	G. mols. of anhydrous salt per l.
25°	25.7	0.079
30°	31.7	0.096
35°	41.1	0.128
40°	59.7	0.181

Melts in crystal  $H_2O$  at 107°.

(Locke, Am. Ch. J. 1901, 26. 180.)

**Chromic sodium sulphate**,  $Na_2Cr_2(SO_4)_4 + 10H_2O$ .

Is sodium chromosulphate, which see. +24 $H_2O$ . More efflorescent than K or  $NH_4$  salt. Sol. in  $H_2O$ , and properties resemble the corresponding K salt.

$Cr_2(SO_4)_3, 3Na_2SO_4$ . Resembles the corresponding K salt.

**Chromic thallous sulphate**,  $Tl_2Cr_2(SO_4)_4 + 24H_2O$ .

0.212 mols. of anhydrous salt are sol. in 1 l.  $H_2O$  at 25°. 1 l.  $H_2O$  dissolves 104.8 g. of anhydrous or 163.8 g. hydrated salt at 25°. Melts in crystal  $H_2O$  at 92°. (Locke, Am. Ch. J. 1901, 26. 175.)

**Chromic sulphate chloride**,  $Cr_2(SO_4)_2Cl_2 + 2H_2O$ .

Slightly hygroscopic. Sol. in  $H_2O$ . (Schiff, A. 124. 176.)

$[CrSO_4, 5H_2O]Cl$ . Sol. in  $H_2O$ . (Weinland, Z. anorg. 1908, 58. 176.)

**Chromyl sulphate**,  $(CrO_3)_2SO_4$ .

Decomp. by  $H_2O$ . (Pictet and Karl, Bull. Soc. 1906, (4) 3. 1114.)

**Cobaltous sulphate, basic.**

Ppt. Insol. in  $H_2O$ . (Berzelius.)  $6CoO, SO_3 + 10H_2O$ . (Athanasesco, C. R. 103. 271.)

$5CoO, SO_3 + 4H_2O$ . Ppt. Very sl. sol. in  $H_2O$ . (Habermann, M. Ch. 5. 432.)

**Cobaltous sulphate**,  $CoSO_4$ .

100 pts.  $H_2O$  dissolve at:

3° 10° 20° 24° 29°  
26.2 30.5 36.4 38.9 40 pts. anhydrous salt,

35° 44° 50° 60° 70°

46.3 50.4 55.2 60.4 65.7 pts. anhydrous salt.

(Tobler, A. 95. 193.)

100 pts.  $H_2O$  at 11–14° dissolve 23.88 pts. anhydrous salt. (v. Hauer, J. pr. 103. 114.)

Solubility in 100 pts.  $H_2O$  at t°, using  $CoSO_4 + 7H_2O$ .

t°	Pts. $CoSO_4$	t°	Pts. $CoSO_4$	t°	Pts. $CoSO_4$
0	24.6	36	43.5	72	65.0
1	25.0	37	44.0	73	65.6
2	25.5	38	44.6	74	66.2
3	26.0	39	45.2	75	66.8
4	26.5	40	45.8	76	67.4
5	27.0	41	46.4	77	68.0
6	27.5	42	47.0	78	68.6
7	28.0	43	47.6	79	69.2
8	28.5	44	48.2	80	69.8
9	29.0	45	48.8	81	70.4
10	29.5	46	49.4	82	71.0
11	30.0	47	50.0	83	71.6
12	30.5	48	50.6	84	72.2
13	31.0	49	51.2	85	72.8
14	31.5	50	51.8	86	73.4
15	32.0	51	52.4	87	74.0
16	32.5	52	53.0	88	74.6
17	33.0	53	53.6	89	75.2
18	33.5	54	54.2	90	75.9
19	34.0	55	54.8	91	76.6
20	34.5	56	55.4	92	77.2
21	35.1	57	56.0	93	77.9
22	35.6	58	56.6	94	78.6
23	36.2	59	57.2	95	79.2
24	36.8	60	57.8	96	79.9
25	37.4	61	58.4	97	80.6
26	38.0	62	59.0	98	81.3
27	38.5	63	59.6	99	81.9
28	39.1	64	60.2	100	82.6
29	39.6	65	60.8	101	83.3
30	40.2	66	61.4	102	83.9
31	40.7	67	62.0	103	84.6
32	41.3	68	62.6	104	85.3
33	41.8	69	63.2	105	86.0
34	42.4	70	63.8	106	86.7
35	42.9	71	64.4	106.4	86.9

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel. 1864. 68.)

100 g.  $H_2O$  dissolve 37.8 g.  $CoSO_4$  at 25°.

(Wagner, Z. phys. Ch. 1910, 71. 430.)

See also +7 $H_2O$ .

Sp. gr. of  $CoSO_4 + Aq$  at t°. S = pts.  $CoSO_4$  in 100 pts. solution;  $S_1$  = mols.  $CoSO_4$  in 100 mols. of solution.

S	$S_1$	Sp. gr.
6.8910	0.852	1.0765
5.8140	0.711	1.0641
4.7095	0.570	1.0517
3.5792	0.429	1.0392
2.4273	0.288	1.0263
1.2099	0.141	1.0131

(Charpy, A. ch. (6) 29. 26.)

Sp. gr. of  $\text{CoSO}_4 + \text{Aq}$  at room temp. containing:

7.239    14.156    21.167%  $\text{CoSO}_4$ .  
1.0860    1.1591    1.2398

(Wagner, W. Ann. 1883, 18. 269.)

Sp. gr. of  $\text{CoSO}_4 + \text{Aq}$  at 25°.

Concentration of $\text{CoSO}_4 + \text{Aq}$	Sp. gr.
1-normal	1.0750
$\frac{1}{15}$ " "	1.0383
$\frac{1}{10}$ " "	1.0193
$\frac{1}{5}$ " "	1.0110

(Wagner, Z. phys. Ch. 1890, 5. 37.)

100 pts. sat. solution of  $\text{CoSO}_4$  and  $\text{CuSO}_4$  contain 22.70 pts. of the two salts.

Solubility of  $\text{CoSO}_4 \cdot 7\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ ,  $10\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	grams $\text{CoSO}_4$	grams $\text{Na}_2\text{SO}_4$
0	21.855	10.07
5	23.94	13.155
10	25.41	16.665

(Koppel, Z. phys. Ch. 1905, 52. 396.)

See also under  $\text{CoNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

$\text{HC}_2\text{H}_3\text{O}_2$  ppt. it completely from  $\text{CoSO}_4 + \text{Aq}$ . (Persoz.)

100 pts. absolute methyl alcohol dissolve 1.04 pts.  $\text{CoSO}_4$  at 18°. (de Bruyn, Z. phys. Ch. 10. 784.)

100 pts. absolute methyl alcohol dissolve 54.5 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at 18°; 100 pts. absolute methyl alcohol dissolve 42.8 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at 3°; 100 pts. 93.5% methyl alcohol dissolve 13.3 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at 3°; 100 pts. 50% methyl alcohol dissolve 1.8 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at 3°.

100 pts. absolute ethyl alcohol dissolve 2.5 pts.  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  at 3°. (de Bruyn, Z. phys. Ch. 10. 786.)

100 g. solution in glycol contain 2.5 g.  $\text{CoSO}_4$ . (de Coninck, Bull. Ac. Belg. 1906. 359.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in ethyl acetate. (Naumann, B. 1904, 37. 3602.)

+ $\text{H}_2\text{O}$ . Sl. sol. in cold, and only very slowly sol. in hot  $\text{H}_2\text{O}$ . (Vortmann, B. 1888.)

+ $4\text{H}_2\text{O}$ . (Fröhde, Arch. Pharm. (2) 127. 92.)

+ $6\text{H}_2\text{O}$ . (Marignac.)

+ $7\text{H}_2\text{O}$ . Sol. in 24 pts. cold  $\text{H}_2\text{O}$ . Insol. in alcohol. (Persoz.)

Solubility of  $\text{CoSO}_4 + 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$ .

t°	g. $\text{CoSO}_4$	t°	g. $\text{CoSO}_4$	t°	g. $\text{CoSO}_4$
0	25.53	15	33.045	30	42.26
5	28.05	20	36.21	35	45.60
10	30.55	25	39.35	40	48.85

(Koppel, Z. phys. Ch. 1905, 52. 395.)

M.-pt. of  $\text{CoSO}_4 + 7\text{H}_2\text{O} = 96-98^\circ$ . (Tilden, Chem. Soc. 45. 409.)

**Cobaltocobaltic sulphate**,  $\text{Co}_2\text{O}_3$ ,  $6\text{CoO}$ ,  $\text{SO}_3 + 15\text{H}_2\text{O}$ .

Precipitate. Insol. in boiling  $\text{CoSO}_4 + \text{Aq}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ . (Gentile, J. pr. 69. 130.)

**Cobaltic sulphate**,  $\text{Co}_2(\text{SO}_4)_3 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with immediate decomp. and liberation of  $\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  without immediate decomp. Sol. in conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Marshall, Chem. Soc. 59. 760.)

**Cobaltous cupric sulphate**,  $2\text{CoSO}_4$ ,  $\text{CuSO}_4 + 21\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer, Pogg. 125. 637.)

+ $36\text{H}_2\text{O}$ . (Liebig.)

$2\text{CoSO}_4$ ,  $2\text{CuSO}_4$ ,  $\text{H}_2\text{SO}_4$ . (Étard.)

**Cobaltous cupric magnesium potassium zinc sulphate**,  $\text{CoSO}_4$ ,  $\text{CuSO}_4$ ,  $\text{MgSO}_4$ ,  $4\text{K}_2\text{SO}_4$ ,  $\text{ZnSO}_4 + 24\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Cobaltous cupric potassium sulphate**,  $\text{CoSO}_4$ ,  $\text{CuSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

Does not exist. (Aston and Pickering, Chem. Soc. 49. 123.)

**Cobaltous hydrazine sulphate**,  $\text{CoH}_2(\text{SO}_4)_2$ ,  $2\text{N}_2\text{H}_4$ .

1 pt. is sol. in 305.16 pts.  $\text{H}_2\text{O}$  at 12°. Sol. in  $\text{HNO}_3$  with decomp. Insol. in  $\text{HCl}$ . (Curtius, J. pr. 1894, (2) 50. 331.)

**Cobaltous iron (ferrous) potassium sulphate**,  $\text{CoSO}_4$ ,  $\text{Fe}_2\text{SO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

$2\text{CoSO}_4$ ,  $2\text{FeSO}_4$ ,  $\text{H}_2\text{SO}_4$ . (Étard.)

**Cobaltous magnesium sulphate**,  $3\text{CoSO}_4$ ,  $\text{MgSO}_4 + 28\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Winkelblech.)

**Cobaltous magnesium potassium sulphate**,  $\text{CoSO}_4, \text{MgSO}_4, \text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Does not exist. (Aston and Pickering, Chem. Soc. 49. 123.)

**Cobaltous manganous potassium sulphate**,  $\text{CoSO}_4, \text{MnSO}_4, 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Cobaltous nickel potassium sulphate**,  $\text{CoSO}_4, \text{NiSO}_4, 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Does not exist. (Thomson, Rep. Brit. Assn. Adv. Sci. 1877. 209.)

**Cobaltous potassium sulphate**,  $\text{CoSO}_4, \text{K}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Less sol. in  $\text{H}_2\text{O}$  than  $\text{CoSO}_4$ .

100 pts.  $\text{H}_2\text{O}$  dissolve at:

0° 12° 15° 20° 25°  
19.1 30 32.5 39.4 45.3 pts. anhydrous salt,

30° 35° 40° 49°  
51.9 55.4 64.6 81.3 pts. anhydrous salt.  
(Tobler, A. 96. 126.)

100 pts. saturated solution contain at:

20° 40° 60° 80°  
14 19.5 24.4 31.8 pts. anhydrous salt.  
(v. Hauer, J. pr. 74. 433.)

1 l.  $\text{H}_2\text{O}$  dissolves 128.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Cobaltic potassium sulphate**,  $\text{K}_2\text{Co}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Marshall, Chem. Soc. 59. 760.)

**Cobaltous potassium zinc sulphate**,  $\text{CoSO}_4, 2\text{K}_2\text{SO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Cobaltous rubidium sulphate**,  $\text{CoSO}_4, \text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 92.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Cobaltic rubidium sulphate**,  $\text{Rb}_2\text{Co}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ . Decomp. by conc.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$ . (Howe and O'Neal, J. Am. Chem. Soc. 1898, 20. 762.)

Melts in crystal  $\text{H}_2\text{O}$  at 47°. (Locke, Am. Ch. J. 1901, 26. 183.)

**Cobaltous sodium sulphate**,  $\text{CoNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ .

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g. $\text{CoSO}_4$	g. $\text{Na}_2\text{SO}_4$
20	26.65	24.91
25	25.365	23.325
30	23.13	21.61
35	22.55	20.85
40	20.975	20.055

(Koppel, Z. phys. Ch. 1905, 52. 397.)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O} + \text{CoSO}_4, 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g. $\text{CoSO}_4$	g. $\text{Na}_2\text{SO}_4$	t°	g. $\text{CoSO}_4$	g. $\text{Na}_2\text{SO}_4$
18.5	28.61	23.82	30	32.695	18.17
20	29.42	23.015	35	34.065	15.61
25	30.73	20.575	40	35.01	13.715

(Koppel, Z. phys. Ch. 1905, 52. 397.)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g. $\text{CoSO}_4$	g. $\text{Na}_2\text{SO}_4$
18.5	25.50	25.65
20	23.18	27.26
25	16.07	35.18
30	9.20	43.74

(Koppel.)

Solubility of  $\text{CoNa}_2(\text{SO}_4)_2, 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$  (anhydrous) in  $\text{H}_2\text{O}$  at t°. 100 g.  $\text{H}_2\text{O}$  dissolve grams  $\text{CoSO}_4$  and grams  $\text{Na}_2\text{SO}_4$ .

t°	g. $\text{CoSO}_4$	g. $\text{Na}_2\text{SO}_4$
35	7.204	50.79
40	7.456	50.095

(Koppel.)

See also  $\text{CoSO}_4 + \text{Na}_2\text{SO}_4$  under  $\text{CoSO}_4$ .

**Cobaltous zinc sulphate**.

Efflorescent. Decomp. on air. (Link, Crell. Ann. 1790, 1. 32.)

**Cobaltous sulphate ammonia**,  $\text{CoSO}_4, 6\text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with separation of ppt. (Rose, Pogg. 20. 152.) Very easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fremy.)

Decomp. by alcohol.

**Cobaltous sulphate hydrazine**,  $\text{CoSO}_4, 3\text{N}_2\text{H}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling with  $\text{H}_2\text{O}$ . Very sol. in dil. acids and  $\text{NH}_3 + \text{Aq}$ . (Franzen, Z. anorg. 1908, 60. 272.)



**Cobaltous sulphate hydroxylamine,  $\text{CoSO}_4$ ,  $\text{NH}_2\text{OH} + 2\text{H}_2\text{O}$ .**

Insol. in cold; sol. in hot  $\text{H}_2\text{O}$  with decomp. (Feldt, B. 1894, 27. 403.)

**Columbium sulphate.**

Sol. in  $\text{H}_2\text{O}$ . (Blomstrand.)

**Cuprous sulphate,  $\text{Cu}_2\text{SO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{HCl}$ , in ammonia and al. sol. in glacial acetic acid. (Reocura, C. R. 1909, 148. 1107.)

**Cupric sulphate, basic,  $10\text{CuO}$ ,  $\text{SO}_3$ .**

(Pickering, Chem. Soc. 1907, 91. 1984.)  
 $8\text{CuO}$ ,  $\text{SO}_3 + 12\text{H}_2\text{O}$ . Ppt. (Kane, A. ch. 72. 269.)

$5\text{CuO}$ ,  $\text{SO}_3 + 6\text{H}_2\text{O}$ . Ppt. (Smith, Phil. Mag. J. 23. 196.)

$4\text{CuO}$ ,  $\text{SO}_3 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Roucher, J. Pharm. (3) 37. 50.)

Min. *Brochantite*. Sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq}$ .

$+3\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in dil. acids, even  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$ . Sl. sol. in  $\text{CuSO}_4 + \text{Aq}$ . Insol. in  $\text{NaC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Caselmann, Z. anal. 4. 24.)

$+4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Proust.) Sol. in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ , and more easily in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3 + \text{Aq}$ . (Lea.)

1 l. cold  $\text{H}_2\text{O}$  dissolves 0.017 g. (Pickering, C. N. 1883, 47. 182.)

$+5\text{H}_2\text{O}$ . Min. *Langite*.

$+16\text{H}_2\text{O}$ . (André, C. R. 100. 1138.)

$7\text{CuO}$ ,  $2\text{SO}_3 + 5\text{H}_2\text{O}$ . (Reindel, J. pr. 100. 1.)

$+6\text{H}_2\text{O}$ . Wholly insol. in cold or hot  $\text{H}_2\text{O}$ . (Habermann, M. Ch. 5. 432.)

$+7\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. Insol. in boiling  $\text{CuSO}_4 + \text{Aq}$ . (Reindel.)

$3\text{CuO}$ ,  $\text{SO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Steinmann, B. 15. 1412.)

$+2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Shenstone, Chem. Soc. 47. 375.)

$+2\frac{1}{2}\text{H}_2\text{O}$ . (Reindel, J. pr. 102. 204.)

$+4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Grimbert and Barré, J. Pharm. (5) 21. 414.)

$5\text{CuO}$ ,  $2\text{SO}_3 + 3\text{H}_2\text{O}$ . (Wibel, Dissert. 1884.)

$11\text{CuO}$ ,  $4\text{SO}_3 + 8\text{H}_2\text{O}$ . (Clowes, C. N. 1898, 78. 155.)

$8\text{CuO}$ ,  $3\text{SO}_3 + 10\text{H}_2\text{O}$ . (Marchlewski and Sachs, Z. anorg. 1892, 1. 405.)

$7\text{CuO}$ ,  $3\text{SO}_3 + 12\text{H}_2\text{O}$ . (Étard, C. R. 1887, 104. 1615.)

$5\text{CuO}$ ,  $2\text{SO}_3 + 5\text{H}_2\text{O}$ . (Sabatier, Gm. K. 5. 1. 839.)

$6\text{H}_2\text{O}$ . Min. *Arnimite*. (Weisbach, J. B. 1886. 2253.)

$2\text{CuO}$ ,  $\text{SO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{CuSO}_4$  and  $4\text{CuO}$ ,  $\text{SO}_3$ . (Roucher.)

Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Pozzi-Escot, Bull. Soc. 1913 (4) 13. 816.)

According to Pickering (C. N. 47. 181) only

$3\text{CuO}$ ,  $\text{SO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$  and  $4\text{CuO}$ ,  $\text{SO}_3 + 4\text{H}_2\text{O}$  are true chemical compounds.

There is at  $25^\circ$  no definite basic sulphate of copper, all the basic sulphates being solid solutions. The solutions in contact with these basic sulphates contain  $\text{SO}_3$  and  $\text{CuO}$  in equivalent quantities and are all al. acid in reaction. (Bell, J. phys. Chem. 1908, 12. 179.)

**Cupric sulphate,  $\text{CuSO}_4$ .**

*Anhydrous*. Absorbs  $\text{H}_2\text{O}$  from the air. Combines with, and dissolves in  $\text{H}_2\text{O}$  with great evolution of heat.

$+ \text{H}_2\text{O}$ . Permanent. Sol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

$+ 2\text{H}_2\text{O}$  (?). (Storer's Dict.)

$+ 3\text{H}_2\text{O}$ . (Étard, C. R. 104. 1614.)

Does not exist. (Cross, C. N. 49. 220.)

See Foote, p. 965.

$+ 5\text{H}_2\text{O}$ . Superficially efflorescent in dry air.

Sol. in 2.34 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ , and sat. solution has -p gr. 1.2147. (Schiff, A. 109. 326.)  
100 pts.  $\text{CuSO}_4 + \text{Aq}$  sat. at b. pt.,  $102.2^\circ$ , contain 45 pts. of the dry salt, or 100 pts.  $\text{H}_2\text{O}$  at  $102.2^\circ$  dissolve 81.82 pts.  $\text{CuSO}_4$ . (Griffiths, Q. J. Sci. 18. 90.)

Sol. in less than 4 pts.  $\text{H}_2\text{O}$  at ord. temp., and more sol. in boiling  $\text{H}_2\text{O}$ . (Bergmann.)

Sol. in 4 pts. cold, and 2 pts. hot  $\text{H}_2\text{O}$ . (Schubarth, 100 pts.  $\text{H}_2\text{O}$  dissolve 33.103 pts.  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  at  $15^\circ$ , and solution has sp. gr. = 1.1859. (Michel and Kraft, A. ch. (3) 41. 478.)

$\text{CuSO}_4 + \text{Aq}$  sat. at  $8^\circ$  has 1.17 sp. gr. (Anthon, A. 24. 210.)

1 pt.  $\text{CuSO}_4 + 5\text{H}_2\text{O}$  dissolves at:

	$4^\circ$	$19^\circ$	$31^\circ$	$37.5^\circ$	$50^\circ$
in 3.32	2.71	1.84	1.7	1.14	pts. $\text{H}_2\text{O}$
	62.5°	75°	87.5°	100°	104°
in 1.27	1.07	0.75	0.55	0.47	pts. $\text{H}_2\text{O}$

(Brandes and Gruner, 1886.)

Sol. at 17.5 in 2.412 pts.  $\text{H}_2\text{O}$ . (Karsten.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$9^\circ$	$10^\circ$	$20^\circ$	$30^\circ$
31.61	36.95	42.31	48.81

$40^\circ$	$50^\circ$	$60^\circ$	$70^\circ$
56.90	65.83	77.39	94.60

$80^\circ$	$90^\circ$	$100^\circ$
118.03	156.44	203.32

pts.  $\text{CuSO}_4 + 5\text{H}_2\text{O}$ . (Poggiale, A. ch. (3) 8. 463.)

100 pts.  $\text{H}_2\text{O}$  dissolve at:

$0^\circ$	$20^\circ$	$35^\circ$	$54^\circ$
17	24.3	28.6	36.1

pts. anhydrous  $\text{CuSO}_4$ . (Tobler, A. 95. 193.)  
100 pts.  $\text{CuSO}_4 + \text{Aq}$  sat. at  $11-14^\circ$  contain 16.23 pts. anhydrous  $\text{CuSO}_4$ . (v. Hauer, J. pr. 103. 114.)

100 pts.  $\text{H}_2\text{O}$  dissolve 15.107 pts.  $\text{CuSO}_4$  at  $0^\circ$ . (Pfaff, A. 99. 224.)

100 pts. H<sub>2</sub>O dissolve pts. CuSO<sub>4</sub> at t°.

t°	Pts. CuSO <sub>4</sub>
0	14.99
17.9	20.16
24.1	22.37

(Diacon, J. B. 1866. 61.)

100 pts. H<sub>2</sub>O dissolve pts. CuSO<sub>4</sub> at t°.

t°	Pts. CuSO <sub>4</sub>	t°	Pts. CuSO <sub>4</sub>	t°	Pts. CuSO <sub>4</sub>
0	14.15	40	28.50	80	54.53
10	17.50	50	33.31	90	64.35
20	20.53	60	39.01	100	75.22
30	24.34	70	45.74	...	...

(Patrick and Aubert, Transactions of Kansas Acad. of Sci. 1874. 19.)

Solubility in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. CuSO <sub>4</sub>	t°	Pts. CuSO <sub>4</sub>	t°	Pts. CuSO <sub>4</sub>
0	15.5	35	27.5	70	45.7
1	16.3	36	27.9	71	46.4
2	16.6	37	28.3	72	47.2
3	16.9	38	28.7	73	47.9
4	17.2	39	29.1	74	48.7
5	17.5	40	29.5	75	49.5
6	17.8	41	29.9	76	50.3
7	18.1	42	30.3	77	51.1
8	18.4	43	30.7	78	51.9
9	18.7	44	31.1	79	52.7
10	19.1	45	31.5	80	53.5
11	19.3	46	31.9	81	54.3
12	19.6	47	32.3	82	55.1
13	19.9	48	32.7	83	55.9
14	20.2	49	33.2	84	56.8
15	20.5	50	33.6	85	57.8
16	20.8	51	34.1	86	58.7
17	21.1	52	34.5	87	59.7
18	21.4	53	35.0	88	60.7
19	21.7	54	35.5	89	61.7
20	22.0	55	36.0	90	62.7
21	22.3	56	36.6	91	63.7
22	22.6	57	37.2	92	64.8
23	23.0	58	37.8	93	65.8
24	23.3	59	38.4	94	66.9
25	23.7	60	39.0	95	68.0
26	24.0	61	39.6	96	69.1
27	24.4	62	40.2	97	70.2
28	24.7	63	40.9	98	71.3
29	25.1	64	41.5	99	72.4
30	25.5	65	42.2	100	73.5
31	25.9	66	42.9	101	74.6
32	26.3	67	43.6	102	75.7
33	26.7	68	44.3	103	76.8
34	27.1	69	45.0	104	77.95

(Mulder, Scheik. Verhandel. 1864. 79.)

If solubility S = pts. anhydrous CuSO<sub>4</sub> in 100 pts. solution,  $S = 11.6 + 0.2614t$  from -2° to 55°;  $S = 26.5 + 0.3700t$  from 55° to 105°;  $S = 45.0 - 0.0293t$  from 105° to 190°. (Étard, C. R. 104. 1614.)

Solubility decreases above 120°, owing to formation of basic salt. (Tilden and Shenstone, Phil. Trans. 1884. 23.)

100 ccm. H<sub>2</sub>O dissolve 14.92 g. CuSO<sub>4</sub> at 0°. (Engel, C. R. 102. 113.)

100 ccm. H<sub>2</sub>O dissolve 22.28-22.30 g. CuSO<sub>4</sub> at 20°. (Trevor, Z. phys. Ch. 7. 468.)

Sat. CuSO<sub>4</sub> + Aq contains % CuSO<sub>4</sub> at t°.

t°	% CuSO <sub>4</sub>	t°	% CuSO <sub>4</sub>
-1	12.1	88	38.8
+7	14.1	89	38.9
9	14.5	94	41.8
18	16.9	96	41.9
20	17.2	97	42.0
20	17.4	100	43.6
35	21.3	108	43.8
39	21.8	110	43.4
45	23.9	116	43.8
54	26.9	116	44.0
54	26.6	120	44.8
61	28.8	132	44.8
63	29.1	133	44.7
65	30.0	143	45.0
70	31.6	160	44.2
71.7	32.6	165	44.5
76	34.5	179	42.9
80	36.6	189	42.2
86	37.8	...	...

(Étard, A. ch. 1894, (7) 2. 554.)

Solubility in H<sub>2</sub>O at t°.

t°	g. CuSO <sub>4</sub> per 100 g. H <sub>2</sub> O
0	14.15
10	17.68
15	19.25
20	20.78
25	22.29 (by interpolation)

(Cohen, Z. phys. Ch. 1907, 60. 713.)

1.399 mol. are sol. in 1 l. H<sub>2</sub>O at 25°. (Herz, Z. anorg. 1910, 67. 366.)

100 g. CuSO<sub>4</sub> + Aq sat. at 30° contain 20.32 anhyd. CuSO<sub>4</sub>. (Schreinemakers, Z. phys. Ch. 1910, 71. 110.)

+7H<sub>2</sub>O. (Boisbaudran, C. R. 65. 1249.)

+6H<sub>2</sub>O. (Boisbaudran, C. R. 66. 487.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $18^\circ$ . % = %  
 $\text{CuSO}_4 + 5\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0063	11	1.0716	21	1.1427
2	1.0126	12	1.0785	22	1.1501
3	1.0190	13	1.0854	23	1.1585
4	1.0254	14	1.0923	24	1.1659
5	1.0319	15	1.0993	25	1.1738
6	1.0384	16	1.1063	26	1.1817
7	1.0450	17	1.1135	27	1.1898
8	1.0516	18	1.1208	28	1.1980
9	1.0582	19	1.1281	29	1.2063
10	1.0649	20	1.1354	30	1.2146

(Schiff, calculated by Gerlach, Z. anal. 8. 288.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $23.9^\circ$ . a=no. of  $\frac{1}{2}$   
 mols. in grms. dissolved in 1000 grms.  
 $\text{H}_2\text{O}$ ; b=sp. gr. if a is  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  ( $\frac{1}{2}$   
 mol. wt. = 125); c=sp. gr. if a is  $\text{CuSO}_4$   
 ( $\frac{1}{2}$  mol. wt. = 80).

a	b	c
1	1.076	1.080
2	1.142	1.154
3	1.200	1.225

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $15^\circ$ .  
 % = %  $\text{CuSO}_4 + 5\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.
5	1.0335	20	1.1443
10	1.0688	25	1.1848
15	1.1060	mother liquor	1.185

(Gerlach, Dingl. 181. 131.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{CuSO}_4$	Sp. gr.	% $\text{CuSO}_4$	Sp. gr.
5	1.0513	15	1.1675
10	1.1073	17.5	1.2003

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $0^\circ$ . S=pts.  $\text{CuSO}_4$   
 in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
11.9315	1.1371	5.2181	1.0578
9.8159	1.1108	2.6460	1.0290
7.5474	1.0833	...	...

(Charpy, A. ch. (6) 29. 26.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at room temp.

% $\text{CuSO}_4$	Sp. gr.
6.79	1.055
12.57	1.1151
17.49	1.1635

(Wagner, W. Ann. 1883, 18. 265.)

Sp. gr. of  $\text{CuSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{CuSO}_4 + \text{Aq}$	Sp. gr.
1-normal	1.0790
$\frac{1}{5}$ "	1.0402
$\frac{1}{10}$ "	1.0205
$\frac{1}{15}$ "	1.0103
$\frac{1}{20}$ "	1.0050

(Wagner, Z. phys. Ch. 1890, 5. 38.)

B.-pt.  $\text{CuSO}_4 + \text{Aq}$  containing pts.  $\text{CuSO}_4$  to  
 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{CuSO}_4$	B.-pt.	Pts. $\text{CuSO}_4$
100.5°	21.3	103.0°	69.0
101.0	36.9	103.5	74.9
101.5	48.0	104.0	80.1
102.0	56.2	104.2	82.2
102.5	63.0	...	...

(Gerlach, Z. anal. 26. 434.)

Sat.  $\text{CuSO}_4 + \text{Aq}$  boils at  $102.2^\circ$ , and con-  
 tains 81.8 pts.  $\text{CuSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .  
 (Griffiths.)

Crust forms at  $102.3^\circ$ , and solution contains  
 60.3 pts.  $\text{CuSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ; highest temp.  
 observed,  $104.8^\circ$ . (Gerlach, Z. anal. 26. 426.)

Sol. in  $\text{HCl} + \text{Aq}$ , causing a reduction of  
 temperature of about  $17^\circ$ .

Very al. sol. in conc.  $\text{H}_2\text{SO}_4$ . (Schulz.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $0^\circ$ .

G. per 100 g. $\text{H}_2\text{O}$		Sp. gr.
$\text{H}_2\text{SO}_4$	$\text{CuSO}_4$	
0.00	14.85	1.144
2.03	14.29	1.143
7.16	15.65	1.158
15.20	9.90	1.170
26.57	6.43	1.195
27.57	6.19	1.211
35.2	3.99	1.224

(Engel, C. R. 1887, 104. 507.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Solution			Solid phase
Sp. gr.	% CuO	% $\text{SO}_3$	
1.2142	9.17	9.26	$\text{CuSO}_4 + 5\text{H}_2\text{O}$
1.2248	5.91	15.90	
1.2593	3.39	23.09	
1.2934	1.82	28.75	
1.4061	1.32	39.74	
1.4256	...	41.29	$\text{CuSO}_4 + 5\text{H}_2\text{O}$ and $\text{CuSO}_4 + 3\text{H}_2\text{O}$
1.4249	...	41.04	
1.4516	1.38	43.63	$\text{CuSO}_4 + 3\text{H}_2\text{O}$
1.4915	1.02	47.82	
1.5124	...	49.07	
1.5408	0.38	51.46	$\text{CuSO}_4 + \text{H}_2\text{O}$
1.5643	0.368	53.51	
1.6824	0.109	62.14	
1.7752	0.105	68.34	
1.8118	0.15	72.41	
1.8266	0.07	74.26	$\text{CuSO}_4$

These results show that the hydrates of  $\text{CuSO}_4$  which are stable at  $25^\circ$  are  $\text{CuSO}_4 + 5\text{H}_2\text{O}$ ,  $+3\text{H}_2\text{O}$  and  $+\text{H}_2\text{O}$ .

(Bell and Taber, J. phys. Chem. 1908, 12, 175.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Solution contains		Solid phase
% $\text{CuSO}_4$	% $\text{H}_2\text{SO}_4$	
18.47	none	$\text{CuSO}_4 + 5\text{H}_2\text{O}$
12.62	11.14	
5.92	25.53	
3.25	36.77	
2.63	42.15	
2.59	47.66	$\text{CuSO}_4 + 5\text{H}_2\text{O}$ and $\text{CuSO}_4 + 3\text{H}_2\text{O}$
2.83	49.00	
2.83	49.20	
2.84	49.29	$\text{CuSO}_4 + 3\text{H}_2\text{O}$
2.70	50.23	
2.19	54.78	$\text{CuSO}_4 + 3\text{H}_2\text{O}$ and $\text{CuSO}_4 + \text{H}_2\text{O}$
2.11	55.84	
2.15	55.60	$\text{CuSO}_4 + \text{H}_2\text{O}$
0.95	61.79	
0.17	77.93	
0.15	83.29	$\text{CuSO}_4 + \text{H}_2\text{O}$
0.19	85.46	
0.44	85.72	$\text{CuSO}_4 + \text{H}_2\text{O}$ and $\text{CuSO}_4$
0.42	85.81	
0.40	86.04	$\text{CuSO}_4$
0.19	92.70	

These results show that the hydrates of  $\text{CuSO}_4$  which are stable at  $25^\circ$  are  $\text{CuSO}_4 + 5\text{H}_2\text{O}$ ,  $+3\text{H}_2\text{O}$  and  $+\text{H}_2\text{O}$ .

(Foote, J. Am. Chem. Soc. 1915, 37, 290.)

Sl. sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ , with separation of a double sulphate.

Solubility of  $\text{CuSO}_4$  in  $\text{CuCl}_2 + \text{Aq}$  at  $30^\circ$ .

% $\text{CuCl}_2$	% $\text{CuSO}_4$	Solid phase
0	20.32	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
6.58	13.62	"
15.68	8.93	"
25.67	4.77	"
39.48	3.21	"
42.47	2.90	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.25	1.14	$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$
43.95	0	"

(Schreinemakers, Arch. Néer. Sci. 1910, (2) 15, 117.)

Solubility of  $\text{CuSO}_4$  in  $\text{LiCl} + \text{Aq}$  at  $25^\circ$ .

Solid phase,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .  
(G. mols. per l. of solution.)

$\text{LiCl}$	$\text{CuSO}_4$
0	1.399
0.73	1.257
1.40	1.176
2.83	1.067

(Hers, Z. anorg. 1910, 67, 366.)

Solubility of  $\text{CuSO}_4$  in  $\text{KCl} + \text{Aq}$  at  $25^\circ$ .

Solid phase,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .  
(G. mols. per l. of solution.)

$\text{KCl}$	$\text{CuSO}_4$
0.56	1.496
1.17	1.561
2.34	1.819

(Hers.)

Solubility of  $\text{CuSO}_4$  in  $\text{NaCl} + \text{Aq}$  at  $25^\circ$ .

Solid phase,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .  
(G. mols. per l. of solution.)

$\text{NaCl}$	$\text{CuSO}_4$
0	1.399
0.36	1.404
1.32	1.426
2.53	1.507

(Hers.)

Solubility of  $\text{CuSO}_4$  in  $\text{RbCl} + \text{Aq}$  at  $25^\circ$ , containing 1.094 g. mols. per l. = 1.568 g. mols. (Hers.)

Slowly sol. in sat.  $\text{KNO}_3 + \text{Aq}$ , with separation of a double sulphate.

Very slowly sol. in sat.  $\text{NaNO}_3 + \text{Aq}$ , with separation of a double sulphate. (Karsten, Berl. Abhandl. 1840, 10.)

Solubility of  $\text{CuSO}_4$  in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $0^\circ$ .

g. per 100 cc. solution		Sp. gr.	g. per 100 cc. solution		Sp. gr.
$(\text{NH}_4)_2\text{SO}_4$	$\text{CuSO}_4$		$(\text{NH}_4)_2\text{SO}_4$	$\text{CuSO}_4$	
0	14.79	1.144	5.59	5.13	1.081
3.61	16.09	1.190	7.51	2.95	1.071
4.63	8.38	1.108	12.31	0.94	1.082
4.90	7.26	1.099	20.65	0.80	1.116

(Engel, C. R. 1886, 102, 114.)

See also under  $(\text{NH}_4)_2\text{SO}_4$ .Solubility of  $\text{CuSO}_4$  in  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $\text{CuSO}_4$	% by wt. $\text{Li}_2\text{SO}_4$	
20.32	0	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
17.50	3.54	"
16.10	6.08	"
13.55	11.94	"
12.14	15.72	"
11.04	17.92	"
10.05	20.55	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O} + \text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
10.08	20.51	"
10.07	20.49	"
6.41	22.23	$\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$
3.39	23.59	"
0	25.24	"

(Schreinemakers, Z. phys. Ch. 1909, 66, 692.)

Sol. in  $\text{CuCl}_2$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{NH}_4\text{Cl} + \text{Aq}$  at  $30^\circ$ . (Schreinemakers, Z. phys. Ch. 1909, 69, 565.)Sol. in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Li}_2\text{SO}_4 + \text{Aq}$ . at  $30^\circ$ . (Schreinemakers, Z. phys. Ch. 1909, 66, 694.)100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{FeSO}_4$  contain 17.43 pts. of the salts at  $11-14^\circ$ . (v. Hauer, J. pr. 103, 114.)100 pts.  $\text{H}_2\text{O}$  dissolve 10.85 pts.  $\text{CuSO}_4$ , 17.47 pts.  $\text{MgSO}_4$ , and 5.78 pts.  $\text{Na}_2\text{SO}_4$  at  $0^\circ$ . (Diacon.)100 pts.  $\text{H}_2\text{O}$  dissolve 7.169 pts.  $\text{CuSO}_4$ , 21.319 pts.  $\text{MgSO}_4$ , and 6.830 pts.  $\text{Na}_2\text{SO}_4$  at  $0^\circ$ . (Plaff.)Slowly and sl. sol. in sat.  $\text{MgSO}_4 + \text{Aq}$ . (Karsten.)Solubility of  $\text{CuSO}_4$  in  $\text{H}_2\text{O}$  in presence of  $\text{MgSO}_4$ . 100 pts.  $\text{H}_2\text{O}$  dissolve—

No.	$\text{CuSO}_4$	$\text{MgSO}_4$	No.	$\text{CuSO}_4$	$\text{MgSO}_4$
1	0	26.37	5	12.03	15.67
2	2.64	25.91	6	13.61	8.64
3	4.75	25.30	7	14.99	0
4	9.01	23.54	.	...	...

In 1, 2, and 3,  $\text{MgSO}_4$  was in excess and given amt.  $\text{CuSO}_4$  added; in 4, both  $\text{CuSO}_4$  and $\text{MgSO}_4$  were in excess; in 5, 6, and 7,  $\text{CuSO}_4$  was in excess. (Diacon, l. c.)100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{MgSO}_4$  contain 28.58 pts. of the salts at  $11-14^\circ$ . (v. Hauer, J. pr. 103, 114.)100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{MnSO}_4$  contain 37.90 pts. of the salts at  $11-14^\circ$ . (v. Hauer.)Solubility of  $\text{CuSO}_4 + \text{MnSO}_4$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

G. per 100 g. $\text{H}_2\text{O}$		G. per 100 g. $\text{H}_2\text{O}$	
$\text{CuSO}_4$	$\text{MnSO}_4$	$\text{CuSO}_4$	$\text{MnSO}_4$
20.2	0	9.39	46.77
19.76	3.69	6.47	53.39
13.65	31.52	3.01	58.93
11.61	39.41	0.0	61.83

(Stortenbecker, Z. phys. Ch. 1900, 34, 112.)

100 pts. sat. solution of  $\text{CuSO}_4$  and  $\text{NiSO}_4$  contain 31.03 pts. of the salts at  $11-14^\circ$ . (v. Hauer.)Solubility of  $\text{CuSO}_4 + \text{NiSO}_4$  in  $\text{H}_2\text{O}$ .

g. per 100 g. $\text{H}_2\text{O}$			Mol. % $\text{CuSO}_4$	
$t^\circ$	$\text{CuSO}_4$	$\text{NiSO}_4$	Solution	Sol. phase
35	9.62	583.9	1.57	0.35
	41.66	484.4	7.69	2.12
	75.39	553.5	11.66	4.77
	106.40	506.5	16.92	6.52
	172.0	483.8	25.6	13.88
67	186.9	468.8	27.90	18.77
				94.91
	20.04	729.3	2.65	0.93
	66.01	706.2	8.31	2.86
	88.08	501.6	13.55	3.92
	147.94	675.0	16.39	6.66
	249.9	747.8	24.46	23.32

(Fock, Z. Kryst. Min. 1897, 28, 387.)

More easily sol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$  than in  $\text{Na}_2\text{SO}_4$  or  $\text{MgSO}_4 + \text{Aq}$ , forming a double sulphate, which separates out. (Karsten.) $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$  mutually displace each other in saturated solutions. (Rüdorff, Pogg. 148, 555.)When  $\text{K}_2\text{SO}_4$  and  $\text{CuSO}_4$  both in excess, are dissolved in  $\text{H}_2\text{O}$ , a maximum of solubility of 15.61 pts. of the two salts in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$  is reached in 30 minutes, after which the solubility decreases. This result is obtained either by treating excess of the two salts with  $\text{H}_2\text{O}$  at  $25^\circ$ , or cooling solutions of the two salts sat. at higher temp. to  $25^\circ$ . The salts are in the proportion of 5.2 pts.  $\text{K}_2\text{SO}_4$  to 10.4 pts.  $\text{CuSO}_4$ . If present in the same proportion as in their saturated solutions, 5.41 pts.  $\text{K}_2\text{SO}_4$  to 10.13 pts.  $\text{CuSO}_4$ , would be required.

If sat. solution of one salt is added to sat. solution of the other,  $K_2Cu(SO_4)_2 + 6H_2O$  separates, as it is less sol. than either simple salt, until a state of equilibrium is reached, after which there is no separation, contrary to Rüdorff (see above). (Trevor, Z. phys. Ch. 7. 486.)

### $CuSO_4 + Na_2SO_4$

Solubility of  $CuSO_4$  in presence of  $Na_2SO_4$  at 0°. 100 pts.  $H_2O$  dissolve—

No.	$CuSO_4$	$Na_2SO_4$	No.	$CuSO_4$	$Na_2SO_4$
1	0	4.53	5	15.84	3.55
2	6.01	5.34	6	15.33	1.98
3	9.81	5.73	7	14.99	0
4	16.67	6.48		...	...

In 1, 2, and 3,  $Na_2SO_4$  was in excess and given amt.  $CuSO_4$  added; in 4, both  $CuSO_4$  and  $Na_2SO_4$  were in excess; in 5, 6, and 7,  $CuSO_4$  was in excess and  $Na_2SO_4$  added. (Diacon, J. B. 1866. 61.)

100 pts.  $H_2O$  dissolve 8.038 pts.  $CuSO_4$  and 6.31 pts.  $Na_2SO_4$  at 0°. (Pfaff, A. 99. 224.)

100 pts.  $H_2O$  dissolve 20.7 pts.  $CuSO_4$  and 15.9 pts.  $Na_2SO_4$  at 15°. (Rüdorff, B. 6. 484.)

### Solubility of $CuSO_4 + Na_2SO_4$

1. Solid phase, 3 mol.  $CuSO_4 + 1$  mol.  $Na_2SO_4$ .

2. Solid phase, 1 mol.  $CuSO_4 + 1$  mol.  $Na_2SO_4$ .

3. Solid phase, 1 mol.  $CuSO_4 + 3$  mol.  $Na_2SO_4$ .

(G. in 100 g.  $H_2O$ .)

t°	1		2		3	
	$CuSO_4$	$Na_2SO_4$	$CuSO_4$	$Na_2SO_4$	$CuSO_4$	$Na_2SO_4$
10	19.75	12.49	19.70	12.50	19.69	12.55
15	20.69	15.88	20.75	15.90	20.70	15.92
30	22.03	16.36	21.00	20.14	15.28	22.70
50	32.37	11.75	31.45	13.41	28.76	15.25

(Massol and Malmes, C. R. 1901, 133. 287.)

### Solubility of $CuSO_4, 5H_2O + Na_2SO_4, 10H_2O$

t°	% $CuSO_4$	% $Na_2SO_4$
0	13.40	6.23
12	14.83	9.82
15	15.00	....

(Koppel, Z. phys. Ch. 1903, 42. 8.)

See also under  $CuNa_2(SO_4)_2 + 6H_2O$ .

### $CuSO_4 + ZnSO_4$

Very slowly sol. in sat.  $ZnSO_4 + Aq$ , forming a double salt which separates. (Karsten.)

100 pts. sat. solution of  $CuSO_4$  and  $ZnSO_4$  contain 32.70 pts. of the salts at 11–14°. (v. Hauer.)

### Solubility of $CuSO_4 + ZnSO_4$ in $H_2O$ at 25°.

Mols. per 100 mols. $H_2O$		Mols. per 100 mols. $H_2O$	
Cu	Zn	Cu	Zn
2.28	0	0.82	5.03
1.83	2.08	0.51	5.59
1.41	3.60	0.30	5.56
1.19	5.01	0.00	6.42
1.86	3.36	1.19	5.01
1.22	4.45	0.51	5.59
1.01	4.72	0.267	5.77
...	...	0.00	5.94

(Stortenbecker, Z. phys. Ch. 1897, 22. 62.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 827.)

Insol. in liquid  $CO_2$ . (Büchner, Z. phys. Ch. 1906, 54. 674.)

100 pts. of a sat. solution in 40% alcohol contains 0.25 pt.  $CuSO_4 + 5H_2O$ ; 20% alcohol, 3.1 pts.; 10% alcohol, 13.3 pts. (Schiff, A. 118. 362.)

Anhydrous  $CuSO_4$  is sol. in absolute methyl alcohol, but insol. in absolute ethyl alcohol.  $CuSO_4 + xH_2O$  is insol. in methyl or ethyl alcohol. (Klepl, J. pr. (2) 25. 526.)

100 pts. absolute methyl alcohol dissolve 1.05 pts. anhydrous  $CuSO_4$  at 18°.

100 pts. absolute methyl alcohol dissolve 15.6 pts.  $CuSO_4 + 5H_2O$  at 18°; 100 pts. 93.5% methyl alcohol dissolve 0.93 pt.  $CuSO_4 + 5H_2O$  at 18°; 100 pts. 50% methyl alcohol dissolve 0.4 pt.  $CuSO_4 + 5H_2O$  at 18°; 100 pts. absolute methyl alcohol dissolve 13.4 pts.  $CuSO_4 + 5H_2O$  at 3°.

100 pts. absolute ethyl alcohol dissolve 1.1 pts.  $CuSO_4 + 5H_2O$  at 3°. (de Bruyn, Z. phys. Ch. 10. 786.)

Methyl alcohol dissolves 11.5%  $CuSO_4 + 5H_2O$  at 0°. (Auger, C. R. 1906, 142. 1272.)

Glacial acetic acid precipitates  $CuSO_4$  completely from  $CuSO_4 + Aq$ .

100 g. 95% formic acid dissolve 0.05 g.  $CuSO_4 + 5H_2O$  at 18.5°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Sol. in glycerine (Pelouze), picoline (Unverdorben).

100 g. glycerine dissolve 36.3 g.  $CuSO_4 + 5H_2O$  at 15–16°. (Ossendowski, Pharm. J. 1907, 79. 575.)

100 g. glycerine dissolve 30.0 g.  $CuSO_4$  at 15.5°.

100 g. solution of  $CuSO_4$  in glycol contain 7.6 g. at 14.6°. (de Coninck, Bull. Ac. Belg. 1905. 257.)

Anhydrous  $CuSO_4$  is insol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014); methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314); benzonitrile. (Naumann, B. 1914, 47. 1370.)

Min. *Chalcanthite*.

**Cupric glucinum sulphate**,  $\text{CuSO}_4 \cdot 4\text{H}_2\text{SO}_4 + 20\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Klatso, J. B. 1868. 205.)

Does not exist. (Marignac, A. ch. (4) 30. 45.)

$9\text{CuSO}_4 \cdot \text{H}_2\text{SO}_4 + 50\text{H}_2\text{O}$ . As above.

Does not exist. (Marignac, l. c.)

**Cupric hydrazine sulphate**,  $\text{CuH}_2(\text{SO}_4)_2 \cdot 2\text{N}_2\text{H}_4$ .

1 pt. is sol. in 1148 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ .

Decomp. by acids.

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$  with decomp. (Curtius, J. pr. 1894, (2) 50. 331.)

**Cupric iron (ferrous) sulphate**,  $\text{CuSO}_4 \cdot \text{FeSO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

$+ 2\text{H}_2\text{O}$ . (Étard.)

$\text{CuSO}_4 \cdot 2\text{FeSO}_4 + 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

$\text{CuSO}_4 \cdot 3\text{FeSO}_4 + 28\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 75 pts. salt at  $7^\circ$ . (Lefort.)

$4\text{CuSO}_4 \cdot \text{FeSO}_4 + 34\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  at  $15.5^\circ$  dissolve 75.91 pts. (Thomson.)

**Cupric iron (ferric) sulphate**,  $\text{CuSO}_4 \cdot \text{Fe}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Bastick.)

**Cupric iron (ferrous) potassium sulphate**,  $\text{CuSO}_4 \cdot \text{FeSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Cupric lead sulphate**,  $\text{CuO} \cdot \text{PbO} \cdot \text{SO}_3 + \text{H}_2\text{O}$ .

Min. *Linarite*.

$3\text{CuO} \cdot 7\text{PbO} \cdot 5\text{SO}_3 + 5\text{H}_2\text{O}$ . Min. *Caledonite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

**Cupric magnesium sulphate**,  $\text{CuSO}_4 \cdot \text{MgSO}_4 + 14\text{H}_2\text{O}$ .

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

$+ 2\text{H}_2\text{O}$ . (Arrot, 1834.)

$\text{CuSO}_4 \cdot 2\text{MgSO}_4 + 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (v. Hauer, Pogg. 125. 638.)

$\text{CuSO}_4 \cdot 7\text{MgSO}_4 + 56\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Schiff, A. 107. 64.)

**Cupric magnesium manganous potassium sulphate**,  $\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot \text{MnSO}_4 \cdot 3\text{K}_2\text{SO}_4 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Cupric magnesium potassium sulphate**,

$\text{CuSO}_4 \cdot \text{MgSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

Does not exist. (Aston and Pickering, Chem. Soc. 49. 123.)

**Cupric magnesium potassium zinc sulphate**,  $\text{CuSO}_4 \cdot \text{MgO}_4 \cdot 3\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 18\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Cupric manganous sulphate**,  $5\text{CuSO}_4 \cdot 2\text{MnSO}_4 + 35\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Schäuffele, J. B. 1862. 340.)

$2\text{CuSO}_4 \cdot 3\text{MnSO}_4 + 25\text{H}_2\text{O}$ . As above. (S.)

$\text{CuSO}_4 \cdot \text{MnSO}_4 + \text{H}_2\text{O}$ . (Étard, C. R. 87. 602.)

**Cupric manganous potassium sulphate**,  $\text{CuSO}_4 \cdot \text{MnSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Cupric nickel sulphate**,  $\text{CuSO}_4 \cdot \text{NiSO}_4 + 3\text{H}_2\text{O}$ .

(Étard, C. R. 87. 602.)

$\text{CuSO}_4 \cdot 2\text{NiSO}_4 + 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

$+ 18\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Boisbaudran, C. R. 66. 497.)

$2\text{CuSO}_4 \cdot 2\text{NiSO}_4 \cdot 3\text{H}_2\text{SO}_4$ . (Étard.)

**Cupric nickel potassium sulphate**,  $\text{CuSO}_4 \cdot \text{NiSO}_4 \cdot 2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

Sol. in 4 pts.  $\text{H}_2\text{O}$ ; insol. in alcohol. (Bette.)

$4\text{CuSO}_4 \cdot \text{K}_2\text{SO}_4 + 4\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ .

$\text{K}_2\text{O} \cdot 4\text{CuO} \cdot 4\text{SO}_3 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , but decomp. by boiling  $\text{H}_2\text{O}$  into  $3\text{CuO} \cdot \text{SO}_3$ .

**Cupric potassium sulphate**,  $\text{K}_2\text{Cu}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 66.666 pts. at  $102.8^\circ$ . (Griffiths.)

Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Pierre.)

Easily sol. in  $\text{H}_2\text{O}$ ; by boiling, de comp. into basic salt. (Persoz, A. ch. (3) 25. 272.)

100 pts.  $\text{H}_2\text{O}$  dissolve 11.14 pts. anhydrous salt at  $25^\circ$ . (Trevor, Z. phys. Ch. 7. 470.)

1 l.  $\text{H}_2\text{O}$  dissolves 116.9 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

See also  $\text{CuSO}_4 \cdot \text{K}_2\text{SO}_4$ .

Min. *Cyanochoirite*.

**Cupric potassium zinc sulphate**,  $\text{CuSO}_4 \cdot 2\text{K}_2\text{SO}_4 \cdot \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Vohl.)

**Cupric rubidium sulphate**,  $\text{CuSO}_4 \cdot \text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton.)

1 l.  $\text{H}_2\text{O}$  dissolves 102.8 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

**Cupric sodium sulphate, basic**,  $\text{Na}_2\text{SO}_4 \cdot \text{Cu}(\text{OH})_2 \cdot 3\text{CuSO}_4 + 2\text{H}_2\text{O}$ .

Min. *Natrochalcite*.

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in acids. (Pallache and Warren, Am. J. Sci. 1908, (4) 26. 346.)

**Cupric sodium sulphate**,  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Solubility of the pure double salt  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

t°	100 grams solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
17.7	14.34	13.34
19.5	14.54	12.90
23	14.36	12.76
30	14.07	12.37
40.15	13.73	12.26

(Koppel, Z. phys. Ch. 1903, 42. 8.)

Solubility of the mixture of  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$  and  $\text{CuSO}_4$ .

t°	100 g. solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
17.7	14.99	13.487
19.5	15.62	12.06
23	16.41	11.35
30	17.97	9.95
40.15	20.56	8.00

(Koppel.)

Solubility of the mixture of  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$  and  $\text{Na}_2\text{SO}_4$ .

t°	100 g. solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
18	13.53	13.844
19.5	11.847	15.116
20	11.339	15.697
23	8.185	18.723
25	6.284	21.198
26	5.507	22.44
28	3.746	24.963
28.3	3.661	...
30	2.607	28.383
30.2	2.422	...
32.2	1.465	32.442
33.9	1.475	32.209
35.3	1.471	32.072
37.2	1.494	31.96

(Koppel.)

Solubility of  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$  in presence of varying amounts of  $\text{Na}_2\text{SO}_4$ .

t°	100 g. solution contain	
	$\text{CuSO}_4$ grams	$\text{Na}_2\text{SO}_4$ grams
30	5.38	22.17
30	5.41	21.92
30.1	3.69	25.37
40.15	3.97	23.90
30	1.57	32.09

(Koppel.)

Copper sulphate and sodium sulphate unite to form a double salt,  $\text{CuSO}_4, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ , which is stable in the presence of the solution above 16.7°. In the presence of copper sulphate the solubility of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is greater than that of the pure salt. (Koppel.)

**Cupric thallous sulphate**,  $\text{CuSO}_4, \text{Tl}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Decomp. by recrystallising from  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) 5. 55.)

1 l.  $\text{H}_2\text{O}$  dissolves 81 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Cupric zinc sulphate**,  $\text{CuSO}_4, 3\text{ZnSO}_4 + 28\text{H}_2\text{O}$

Efflorescent. 100 pts.  $\text{H}_2\text{O}$  dissolve 80 pts. salt at 8°. Sol. in all proportions in boiling  $\text{H}_2\text{O}$ . (Lefort.)

$\text{CuSO}_4, 2\text{ZnSO}_4 + 21\text{H}_2\text{O}$ . (v. Hauer, Pogg. 125. 637.)

$\text{CuSO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$ . (Boisbaudran.)

$2\text{CuSO}_4, 2\text{ZnSO}_4, \text{H}_2\text{SO}_4$ . (Etard.)

**Cuprous sulphate ammonia**,  $\text{Cu}_2\text{SO}_4, 4\text{NH}_3$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ ; decomp. by pure  $\text{H}_2\text{O}$ . (Péchar, C. R. 1903, 136. 504.)

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Foerster and Blankenburg, B. 1906, 39. 4434.)

**Cupric sulphate ammonia, basic**,  $\text{CuSO}_4, 3\text{CuO}, 2\text{NH}_3 + 5\text{H}_2\text{O}$ .

Decomp. by hot  $\text{H}_2\text{O}$ . (Pickering, Chem. Soc. 43. 336.)

**Cupric sulphate ammonia (Cuprammonium sulphate)**,  $\text{CuSO}_4, \text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Kane.)

Decomp. by  $\text{H}_2\text{O}$  giving a basic sulphate. (Bousat, C. R. 1902, 135. 635.)

$\text{CuSO}_4, 2\text{NH}_3, [\text{CuSO}_4, 2\text{NH}_3 + 3\text{H}_2\text{O}]$ . (Mendelejeff, B. 3. 422.)]. Decomp. by excess of  $\text{H}_2\text{O}$  into—

$\text{CuSO}_4, 4\text{NH}_3 + \text{H}_2\text{O}$ . Sol. in 1.5 pts.  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$ . Insol. in alcohol. Insol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . (André, C. R. 100. 1138.)

Sol. in small quantity of  $\text{H}_2\text{O}$ ; decomp. in dil. solution. (Bousat.)

100 g.  $\text{H}_2\text{O}$  dissolve 44.56 g. anhydrous comp. at 25°. (Pudschies, Dissert.)

100 g.  $\text{H}_2\text{O}$  dissolve 18.05 g. at 21–22°. (Horn and Taylor, Am. Ch. J. 1904, 32. 268.)

$\text{CuSO}_4, 5\text{NH}_3$ . Completely sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 150.)

Sol. in small amt. of  $\text{H}_2\text{O}$ ; decomp. in dil. solution. Insol. in liquid  $\text{NH}_3$ . (Bousat, C. R. 1902, 135. 535.)

**Cuprous sulphate carbon monoxide**,  $\text{Cu}_2\text{SO}_4, 2\text{CO} + \text{H}_2\text{O}$ .

Very unstable. (Joannis, C. R. 1903, 136. 615.)



**Cupric sulphate zinc oxide**,  $\text{CuSO}_4 \cdot 2\text{ZnO} + 2\text{H}_2\text{O}$ .

(Larsen, Ch. Z. Repert. 1896, 20, 317.)  
 $2\text{CuSO}_4 \cdot 3\text{ZnO} + 12\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27, 169.)

**Didymium sulphate, basic**,  $\text{Di}_2\text{O}_3 \cdot \text{SO}_3 = (\text{DiO})_2\text{SO}_4$ .

Insol. in cold or boiling  $\text{H}_2\text{O}$ . (Marignac.)  
 Slowly sol. in hot dil.  $\text{HCl} + \text{Aq}$ . Easily sol. in conc. acids.

+  $8\text{H}_2\text{O}$ . Precipitate. (Hermann.)  
 Composition is  $2\text{Di}_2\text{O}_3 \cdot 3\text{SO}_3 + 3\text{H}_2\text{O}$  or  $\text{Di}_2(\text{SO}_4)_3 + \text{Di}_2\text{O}_3 \cdot \text{H}_2\text{O}$ . (Frerichs and Smith.)  
 Composition is  $5\text{Di}_2\text{O}_3 \cdot 3\text{SO}_3 + x\text{H}_2\text{O}$ . (Cleve, B. 11, 910.)

**Didymium sulphate**,  $\text{Di}_2(\text{SO}_4)_3$ .

*Anhydrous*. By saturating cold  $\text{H}_2\text{O}$  and warming the solution, the following results were obtained—100 pts.  $\text{H}_2\text{O}$  dissolve at:

12° 18° 25° 38° 50°  
 43.1 25.8 20.6 13.0 11.0 pts.  $\text{Di}_2(\text{SO}_4)_3$ .  
 +  $6\text{H}_2\text{O}$ .  $\text{H}_2\text{O}$  dissolves this salt very slowly; 100 pts.  $\text{H}_2\text{O}$  dissolve 13 pts.  $\text{Di}_2(\text{SO}_4)_3$  in 24 hours, and 16.4 pts. in 2 days. If solution is evap. in vacuo until  $\text{Di}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  separates out, 34 pts.  $\text{Di}_2(\text{SO}_4)_3$  remain dissolved in 100 pts.  $\text{H}_2\text{O}$ .

+  $5\text{H}_2\text{O}$ . (Cleve.)

+  $8\text{H}_2\text{O}$ . Solutions of this salt contain at:

19° 40° 50° 100°  
 11.7 8.8 6.5 1.6 pts.  $\text{Di}_2(\text{SO}_4)_3$ .

(Marignac, A. ch. (3) 38, 170.)

+  $9\text{H}_2\text{O}$ . (Zschiesche, J. Pr. 107, 75.)

**Didymium potassium sulphate**,  $\text{K}_2\text{SO}_4$ ,

$\text{Di}_2(\text{SO}_4)_3 + 2\text{H}_2\text{O}$ .

Sol. in 63 pts.  $\text{H}_2\text{O}$ . Insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Marignac.)

$3\text{K}_2\text{SO}_4 \cdot \text{Di}_2(\text{SO}_4)_3$ . Sol. in 83 pts.  $\text{H}_2\text{O}$  at 18°. Insol. in cold, sl. sol. in boiling sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ , 100 ccm. of which retain 55 mg.  $\text{Di}_2\text{O}_3$  in solution. (Cleve.)

$4\text{K}_2\text{SO}_4 \cdot \text{Di}_2(\text{SO}_4)_3$ . (Cleve.)

$9\text{K}_2\text{SO}_4 \cdot 2\text{Di}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ . (Cleve.)

**Didymium sodium sulphate**,  $\text{Di}_2(\text{SO}_4)_3$ ,

$\text{Na}_2\text{SO}_4$ , and +  $2\text{H}_2\text{O}$ .

Sol. in 200 pts.  $\text{H}_2\text{O}$  (Marignac), and still less in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$ , 100 ccm. of which dissolve only 70 mg.  $\text{Di}_2\text{O}_3$  at ord. temp. (Cleve.)

**Didymium thallous sulphate**,  $(\text{Di}_2\text{SO}_4)_3$ ,  
 $3\text{Tl}_2\text{SO}_4$ .

Ppt.

$\text{Di}_2(\text{SO}_4)_3$ ,  $\text{Tl}_2\text{SO}_4 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Zschiesche, J. pr. 107, 98.)

**Erbium sulphate**,  $\text{Er}_2(\text{SO}_4)_3$ .

*Anhydrous*. Easily and rapidly sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 43 pts. anhydrous salt at 0°.

+  $8\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than anhydrous salt. 100 pts.  $\text{H}_2\text{O}$  dissolve 30 pts.  $\text{Er}_2(\text{SO}_4)_3$ ; +  $8\text{H}_2\text{O}$  (= 23 pts.  $\text{Er}_2(\text{SO}_4)_3$ ) at about 20°; at 100°, 100 pts.  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  remain dissolved. Sat. solution deposits crystals when heated to 55°. (Höglund.)

100 g. of sat. solution of  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  at 25° in  $\text{H}_2\text{O}$  contains 11.94 g. anhyd.  $\text{Er}_2(\text{SO}_4)_3$ . (Wirth, Z. anorg. 1912, 76, 174.)

Solubility of  $\text{Er}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  in  $\text{H}_2\text{SO}_4$  at 25°.

N = equiv. g.  $\text{H}_2\text{SO}_4$  in 1 l. of solution.

C = g. oxide in 100 g. of solution.

C' = g. anhyd. salt in 100 g. of solution.

N	C	C'	N	C	C'
0	4.604	7.60	4.32	2.00	3.301
0.1	4.615	7.618	6.685	0.9115	1.505
1.1	3.64	6.00	9.68	0.4439	0.733
2.16	3.04	5.018	15.15	0.145	0.239

(Wirth, Z. anorg. 1912, 76, 174.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

**Erbium potassium sulphate**,  $\text{Er}_2(\text{SO}_4)_3$ ,  
 $3\text{K}_2\text{SO}_4$ .

Slowly sol. in  $\text{H}_2\text{O}$ . (Höglund.)

**Erbium sodium sulphate**,  $\text{Er}_2(\text{SO}_4)_3$ ,  $5\text{Na}_2\text{SO}_4$ ,  
 +  $7\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Europium sulphate**,  $\text{Eu}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Stable in the air. (Urbain and Lacombe, C. R. 1904, 138, 628.)

**Gadolinium sulphate**,  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Temp.	Pts. of $\text{Gd}_2(\text{SO}_4)_3$ in 100 pts. $\text{H}_2\text{O}$
0°	3.98
9.3–10.6°	3.33
14.0°	2.80
25.0°	2.40
34.4°	2.26

(Benedicks, Z. anorg. 1899, 22, 409–410.)

100 g. sat. solution of  $\text{Gd}(\text{SO}_4)_3 + 8\text{H}_2\text{O}$  at 25° in  $\text{H}_2\text{O}$  contain 2.981 g. anhyd.  $\text{Gd}_2(\text{SO}_4)_3$ . (Wirth, Z. anorg. 1912, 76, 174.)

Solubility in  $\text{H}_2\text{SO}_4$ . Solid phase,  $\text{Gd}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

N = equiv. g.  $\text{H}_2\text{SO}_4$  in 1 l. of solvent.

C = g. oxide in 100 g. of solution.

$\text{C}_1$  = g. anhyd.  $\text{Gd}_2(\text{SO}_4)_3$  in 100 g. of solution.

N	C	$\text{C}_1$	N	C	$\text{C}_1$
0	1.793	2.981	2.16	1.789	2.974
0.1	1.98	3.291	6.175	0.528	0.8777
0.505	2.365	3.931	12.6	0.0521	0.0867
1.1	2.29	3.807	...	...	...

(Wirth.)

Sol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ .

Gadolinium potassium sulphate,  $\text{Gd}_2(\text{SO}_4)_3 \cdot \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

100 grams. sat. solution in  $\text{K}_2\text{SO}_4 + \text{Aq}$  contains 0.87–0.77 grams  $\text{Gd}_2\text{O}_3$ . (Benedicks, Z. anorg. 1900, 22. 410.)

Gallium sulphate,  $\text{Ga}_2(\text{SO}_4)_3$ .

Not deliquescent, but very sol. in  $\text{H}_2\text{O}$ . Sol. in 60% alcohol; insol. in ether. (Boisbaudran.)

Aqueous solution decomp. into basic salt by boiling, which redissolves, however, on cooling.

Gallium potassium sulphate,  $\text{Ga}_2\text{K}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

(Soret, Arch. sc. phys. nat. 1885, 14. 96.)

Gallium rubidium sulphate,  $\text{Rb}_2\text{Ga}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .

(Soret, Arch. sc. phys. nat. 1885, 14. 96.)

Glucinum sulphate, basic,  $3\text{GIO} \cdot \text{SO}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , but decomp. by heating or dilution. (Berzelius.)

$2\text{GIO} \cdot \text{SO}_3 + 3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

$9\text{GIO} \cdot \text{SO}_3 + 14\text{H}_2\text{O}$  (?). Precipitate. Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

According to Debray, this salt when carefully washed is  $\text{GIO}_2\text{H}_2$ .

Glucinum sulphate,  $\text{GIO}_4$ .

Anhydrous.

Nearly insol. in  $\text{H}_2\text{O}$ , but slowly attacked by cold, rapidly by hot  $\text{H}_2\text{O}$ , and is converted into  $\text{GIO}_4 + 4\text{H}_2\text{O}$  before dissolving. (Parsons, Z. anorg. 1904, 42. 253.)

Sp. gr. of  $\text{GIO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{GIO}_4 + \text{Aq}$	Sp. gr.
1—normal	1.0451
$\frac{1}{5}$ —"	1.0229
$\frac{1}{10}$ —"	1.0114
$\frac{1}{15}$ —"	1.0027

(Wagner, Z. phys. Ch. 1890, 5. 35.)

Solubility of  $\text{GIO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4 + \text{Aq}$ % $\text{H}_2\text{SO}_4$	100 g. of the solution contain g. $\text{GIO}_4$	Solid phase
...	8.212	$\text{GIO}_4 + 6\text{H}_2\text{O}$
5.23	8.429	
9.61	7.944	
18.70	6.603	
34.00	5.631	
40.35	5.773	$\text{GIO}_4 + 4\text{H}_2\text{O}$
45.51	6.628	
50.63	5.438	
56.59	3.640	
63.24	2.244	
65.24	2.128	
73.64	2.185	

(Wirth, Z. anorg. 1913, 79. 359.)

See also under +2, 4, and  $6\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J., 1898, 20. 828.)

+ $\text{H}_2\text{O}$ . (Levi-Malvano, Z. anorg. 1906, 43. 447.)

+ $2\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	G. $\text{GIO}_4$ per 100 g.	
	$\text{H}_2\text{O}$	Solution
80	84.76	45.87
91.4	97.77	49.42
105	118.4	54.21
119	149.3	59.88

(Levi-Malvano.)

+ $4\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .

Sol. in its own weight of  $\text{H}_2\text{O}$  at  $14^\circ$ , and in every proportion of boiling  $\text{H}_2\text{O}$ . Less sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$  than in water. (Debray, A. ch. (3) 44. 25.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{GIO}_4$ per 100 g.		$t^\circ$	g. $\text{GIO}_4$ per 100 g.	
	$\text{H}_2\text{O}$	solution		$\text{H}_2\text{O}$	solution
30	43.78	30.45	95.4	90.63	47.55
40	46.74	31.85	107.2	115.3	53.58
68	61.95	38.27	111	128.3	56.19
85	76.30	43.28	...	...	...

(Levi-Malvano.)

Sl. sol. in dilute, insol. in absolute alcohol.

Can be completely pptd. from  $\text{GIO}_4 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persoz.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+6H<sub>2</sub>O.Solubility in H<sub>2</sub>O at t°.

t°	g. GISO <sub>4</sub> per 100 g.	
	H <sub>2</sub> O	solution
31	52.23	34.32
50	60.67	37.77
72.2	74.94	42.85
77.4	81.87	45.01

(Levi-Malvano.)

100 g. of the aqueous solution contain at 25° 8.212 g. GISO<sub>4</sub>. (Wirth, Z. anorg. 1913, 79. 358.)

**Glucinum iron (ferrous) sulphate**, GISO<sub>4</sub>, FeSO<sub>4</sub> + 17½H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Klatzo, J. B. 1868. 204.)3GISO<sub>4</sub>, FeSO<sub>4</sub> + 28H<sub>2</sub>O. Sol. in H<sub>2</sub>O: (Klatzo.)

Does not exist. (Marignac, A. ch. (4) 30. 45.)

**Glucinum nickel sulphate**, (Gl,Ni)SO<sub>4</sub> + 4H<sub>2</sub>O, or 7H<sub>2</sub>O.

(Klatzo, J. B. 1868. 205.)

Does not exist. (Atterberg, Sv. V. A. F. 1873, 4. 81.)

**Glucinum potassium sulphate**, GISO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O.

Sl. sol. in cold, slowly but more sol. in hot H<sub>2</sub>O. (Debray.)+3H<sub>2</sub>O. (Klatzo.)

**Glucinum potassium hydrogen sulphate**,

GH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2K<sub>2</sub>SO<sub>4</sub> + 4H<sub>2</sub>O.Easily sol. in H<sub>2</sub>O. Partly decomp. by recrystallisation. (Atterberg.)

**Glucinum sodium sulphate**, 2GISO<sub>4</sub>, 3Na<sub>2</sub>SO<sub>4</sub> + 18H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Atterberg.)

**Glucinum zinc sulphate**, 2GISO<sub>4</sub>, 3ZnSO<sub>4</sub> + 35H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Klatzo, J. B. 1868. 205.)

Does not exist. (Atterberg.)

**Gold (auroauric) sulphate**, Au<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Decomp. by moist air, H<sub>2</sub>O, glacial acetic acid, or HNO<sub>3</sub> + Aq (1.42 sp. gr.) Insol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Schottländer, A. 217. 375.)

**Gold (auric) sulphate**, Au<sub>2</sub>O<sub>3</sub> + H<sub>2</sub>O, or Auryl hydrogen sulphate, (AuO)HSO<sub>4</sub>.

Deliquescent. Decomp. by H<sub>2</sub>O. Sol. in HCl + Aq; not attacked by conc. HNO<sub>3</sub> + Aq. Sol. in 6 pts. conc. H<sub>2</sub>SO<sub>4</sub>. (Schottländer.)

**Gold (auric) potassium sulphate**, Au<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, K<sub>2</sub>SO<sub>4</sub>.

Not decomp. immediately by cold H<sub>2</sub>O. (Schottländer.)

**Hydrazine mercuric sulphate hydrazine**,

(N<sub>2</sub>H<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 3HgSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>.Insol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>O containing HCl. (Ferratini, Gazz. ch. it. 1912, 42. (1) 142.)

**Hydroxylamine uranyl sulphate**,

(NH<sub>2</sub>OH)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, 2(UO<sub>2</sub>)SO<sub>4</sub> + 5H<sub>2</sub>O.Extremely sol. in H<sub>2</sub>O from which it can be cryst. (Rimbach, Dissert. 1904.)

**Indium sulphate**, In<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Easily sol. in H<sub>2</sub>O.+9H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O.

**Indium hydrogen sulphate**, InH(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Very deliquescent. (Meyer.)

**Indium potassium sulphate**, InK(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O, but decomp. by boiling. (Rösler, J. pr. (2) 7. 14.)(InO)<sub>2</sub>K(SO<sub>4</sub>)<sub>2</sub> + 3H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Rösler.)

**Indium rubidium sulphate**,

In<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Rb<sub>2</sub>SO<sub>4</sub> + 24H<sub>2</sub>O.44.28 pts. are sol. in 100 pts. H<sub>2</sub>O at 15°. (Chabré, C. R. 1901, 132. 473.)Melts in crystal H<sub>2</sub>O at 42°. (Locke, Am. Ch. J. 1901, 28. 183.)

**Indium sodium sulphate**, InNa(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Rösler, J. pr. (2) 7. 14.)

**Iodine sulphate**, I<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

Ppt. Decomp. by H<sub>2</sub>O. (Fichter, Z. anorg. 1915, 91. 140.)

**Iodyl sulphate**, (IO)<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

Possible composition of Weber's (B. 30. 86) I<sub>2</sub>O<sub>5</sub>, 3SO<sub>3</sub>.

**Iridium sulphate.**

Sol. in  $H_2O$  or alcohol. (Berzelius.)  
 $Ir_2(SO_4)_3$ . Sol. in  $H_2O$ . (Rimbach, Z. anorg. 1907, 52. 409.)

**Iridium potassium sulphate,  $Ir_2(SO_4)_3$ ,  $K_2SO_4 + 24H_2O$ .**

Mpt. 102–103°.  
 Easily sol. in  $H_2O$ . (Marino, Z. anorg. 1904, 42. 220.)  
 $Ir_2(SO_4)_3$ ,  $3K_2SO_4$ . Sol. in  $H_2O$  or dil.  $H_2SO_4$  + Aq; nearly insol. in sat.  $K_2SO_4$  + Aq. (Boisbaudran, C. R. 96. 1406.)

**Iridium rubidium sulphate,  $Ir_2(SO_4)_3$ ,  $Rb_2SO_4$ .**

Sol. in cold; very sol. in hot  $H_2O$ . (Marino, Gazz. ch. it. 1903, 32. (2) 511.)  
 Mpt. 108–109°. (Marino, Z. anorg. 1904, 42. 219.)

**Iridium thallium sulphate,  $Ir_2(SO_4)_3$ ,  $Tl_2SO_4 + 24H_2O$ .**

Very sol. in  $H_2O$ . (Marino, Z. anorg. 1904, 42. 222.)

**Iron (ferrous) sulphate,  $FeSO_4$ .**

+  $H_2O$ .  
 +  $2H_2O$ . Not more sol. in  $H_2O$  than gypsum. (Mitscherlich.)  
 +  $3H_2O$ . Sol. in  $H_2O$ . (Kane.)  
 +  $4H_2O$ . Separates from conc.  $FeSO_4$  + Aq at 80°.  
 +  $7H_2O$ . Efflorescent at 33°.

1 pt.  $FeSO_4 + 7H_2O$  dissolves in 1.6 pts. cold, and 0.3 pt. boiling  $H_2O$ .

1 pt.  $FeSO_4 + 7H_2O$  dissolves at:

10° 15° 25° 33° 46° 60° 81° 90° 100°  
 in 1.64 1.43 0.87 0.66 0.44 0.38 0.37 0.27 0.3 pts.  $H_2O$   
 (Brandes and Firnhaber, Br. Arch. 7. 83.)

When boiled with insufficient  $H_2O$  for solution a white hydrate is formed which separates out. Solubility increases up to 87.5°, and then diminishes, owing to the above separation. (Brandes, Pogg. 30. 581.)

Sol. in 2 pts. cold, and 1 pt. boiling  $H_2O$  (Fourcroy); sol. in 2 pts. cold  $H_2O$  at 18.75° (Abt); sol. in 6 pts.  $H_2O$  at moderate heat, and 0.75 pt. at 100°. (Bergmann.)

100 pts.  $H_2O$  at 15.5° dissolve 45–50 pts. (Ure's Diet.)

100 pts.  $H_2O$  dissolve pts.  $FeSO_4$  at t°.

t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$
0	15.8	21	27.4	45	42.9
10	19.9	30	32.6	55	47.0
12	21.3	37	36.5	70	56.5
20	29.0	..	..	..	..

(Tobler, A. 95. 198.)

100 pts.  $FeSO_4$  + Aq sat. at 11–14° contain 17.02%  $FeSO_4$ . (v. Hauer, J. pr. 103. 114.)

100 pts.  $FeSO_4$  + Aq. sat at 15° contain 37.2%  $FeSO_4 + 7H_2O$ ; solution has sp. gr. 1.2232. (Schiff, A. 118. 362.)

**Solubility in 100 pts.  $H_2O$  at t°.**

t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$	t°	Pts. $FeSO_4$
0	7.9	34	37.1	67	65.1
1	8.7	35	38.0	68	65.0
2	9.5	36	38.9	69	64.9
3	10.4	37	39.8	70	64.8
4	11.2	38	40.7	71	64.7
5	12.0	39	41.7	72	64.5
6	12.9	40	42.6	73	64.4
7	13.7	41	43.5	74	64.2
8	14.5	42	44.4	75	64.0
9	15.3	43	45.3	76	63.7
10	16.2	44	46.2	77	63.4
11	17.0	45	47.1	78	63.1
12	17.9	46	48.1	79	62.7
13	18.7	47	49.0	80	62.3
14	19.5	48	50.0	81	61.9
15	20.4	49	51.0	82	61.5
16	21.2	50	51.9	83	61.0
17	22.1	51	52.9	84	60.4
18	23.0	52	53.8	85	59.8
19	23.8	53	54.8	86	59.2
20	24.7	54	55.7	87	58.5
21	25.6	55	56.7	88	57.7
22	26.4	56	57.7	89	57.0
23	27.3	57	58.7	90	56.2
24	28.1	58	59.7	91	55.3
25	29.0	59	60.7	92	54.3
26	29.9	60	61.7	93	53.3
27	30.8	61	62.7	94	52.2
28	31.7	62	63.7	95	51.0
29	32.6	63	64.8	96	49.6
30	33.5	63.5	65.4	97	48.0
31	34.4	64	65.4	98	46.3
32	35.3	65	65.3	99	44.5
33	36.2	66	65.2	100	42.6

(Mulder, Scheik. Verhandel. 1864. 141.)

If solubility  $S$  = pts. anhydrous  $FeSO_4$  in 100 pts. solution,  $S = 13.5 + 0.3788t$  from  $-2^\circ$  to  $+65^\circ$ ;  $S = 37.5$  constant from  $65^\circ$  to  $98^\circ$ ;  $S = 37.5 - 0.6685t$  from  $98^\circ$  to  $156^\circ$ . Practically insol. at  $156^\circ$ . (Étard, C. R. 106. 740.)

Sat.  $FeSO_4$  + Aq contains at:

−1°	+5°	24°	34°	52°
13.0	15.1	22.7	26.3	32.5% $FeSO_4$
60°	67°	77°	86°	94°
36.4	37.7	37.8	37.8	36.7% $FeSO_4$
102°	112°	130°	152°	
34.7	28.0	17.3	2.5% $FeSO_4$	

(Étard, A. ch. 1894, (7) 2. 553.)

100 g.  $H_2O$  dissolve 26.69 g.  $FeSO_4$  at  $25^\circ$ . (Stortenbecker, Z. phys. Ch. 1900, 34. 109.)

Solubility of  $\text{FeSO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .  
100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{FeSO}_4$ .

$t^\circ$	G. $\text{FeSO}_4$	$t^\circ$	G. $\text{FeSO}_4$
0.00	15.65	52.00	50.20
10.00	20.51	54.03	52.07
15.25	23.86	60.01	54.95
20.13	26.56	65.00	55.59
25.02	29.60	68.02	52.31
30.03	32.93	70.04	56.08
35.07	36.87	77.00	45.90
40.05	40.20	80.41	43.58
45.18	44.32	85.02	40.46
50.21	48.60	90.13	37.27

$\text{FeSO}_4 + 7\text{H}_2\text{O}$  is stable from  $-1.82^\circ$  to  $+56.6^\circ$ ;  $\text{FeSO}_4 + 4\text{H}_2\text{O}$  from  $56.6^\circ$  to  $64.4^\circ$ ;  $\text{FeSO}_4 + \text{H}_2\text{O}$  above this point.

(Fraenckel, Z. anorg. 1907, 55. 228.)

$\text{FeSO}_4 + \text{Aq}$  sat. at  $30^\circ$  contains 24.9 g.  $\text{FeSO}_4$  in 100 g. of solution. (Schreinemakers, Z. phys. Ch. 1912, 71. 110.)

Sp. gr. of  $\text{FeSO}_4 + \text{Aq}$  at  $15^\circ$ .

% = %  $\text{FeSO}_4 + 7\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.005	15	1.082	28	1.161
2	1.011	16	1.088	29	1.168
3	1.016	17	1.094	30	1.174
4	1.021	18	1.100	31	1.180
5	1.027	19	1.106	32	1.187
6	1.032	20	1.112	33	1.193
7	1.037	21	1.118	34	1.200
8	1.043	22	1.125	35	1.206
9	1.048	23	1.131	36	1.213
10	1.054	24	1.137	37	1.219
11	1.059	25	1.143	38	1.226
12	1.065	26	1.149	39	1.232
13	1.071	27	1.155	40	1.239
14	1.077	..	...	..	...

(Gerlach, Z. anal. 8. 287.)

Sp. gr.  $16.6^\circ$  of sat. solution = 1.219. (Greenish and Smith, Pharm. J. 1903, 71. 881.)

Sat.  $\text{FeSO}_4 + \text{Aq}$  boils at  $102.2^\circ$  (Griffiths), and solution contains 64%  $\text{FeSO}_4$ . Crust forms at  $102.3^\circ$ ; highest temp. observed,  $104.8^\circ$ . (Gerlach, Z. anal. 26. 426.)

B.-pt. of  $\text{FeSO}_4 + \text{Aq}$  containing pts.  $\text{FeSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{FeSO}_4$	B.-pt.	Pts. $\text{FeSO}_4$
100.5°	17.7	101.5°	50.4
101.0	34.4	101.6	53.2

(Gerlach, Z. anal. 26. 433.)

100 g. of the sat. solution contain 22.84 g.  $\text{FeSO}_4$  at  $25^\circ$ . (Wirth, Z. anorg. 1913, 79. 364.)

Sol. in hot  $\text{HCl} + \text{Aq}$ . (Kane.)  
Somewhat sol. in conc.  $\text{H}_2\text{SO}_4$ . (Bussy and Lecann.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4 + \text{Aq}$ Normality	100 g. of the solution contain g. $\text{FeSO}_4$	Solid phase
0	22.84	$\text{FeSO}_4 + 7\text{H}_2\text{O}$
2.25	19.03	
6.685	13.40	
10.2	10.30	
12.46	7.26	$\text{FeSO}_4 + \text{H}_2\text{O}$
15.15	4.015	
19.84	0.1522	

(Wirth, Z. anorg. 1913, 79. 364.)

More sol. in water containing NO than in pure  $\text{H}_2\text{O}$ . (Gay, Bull. Soc. (2) 44. 175.)

Completely pptd. from  $\text{FeSO}_4 + \text{Aq}$  by glacial  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persoz.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$ . See under  $(\text{NH}_4)_2\text{SO}_4$ .

Solubility in  $\text{Li}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $\text{FeSO}_4$	% by wt. $\text{Li}_2\text{SO}_4$	
24.87	0	$\text{FeSO}_4, 7\text{H}_2\text{O}$
22.45	4.00	"
21.15	5.58	"
18.79	11.16	"
16.51	15.81	"
16.18	16.52	$\text{FeSO}_4, 7\text{H}_2\text{O} + \text{Li}_2\text{SO}_4, \text{H}_2\text{O}$
16.04	16.49	"
15.39	16.80	$\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$
12.68	18.31	"
5.32	22.15	"
3.74	23.15	"
0	25.1	"

(Schreinemakers, Z. phys. Ch. 1910, 71. 110.)

Solubility of  $\text{FeSO}_4, \text{H}_2\text{O} + \text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$ , in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{FeSO}_4$	Grams $\text{Na}_2\text{SO}_4$
0	18.06	6.13
15.5	25.05	15.97

(Koppel, Z. phys. Ch. 1905, 52. 405.)  
See also under  $\text{FeNa}_2(\text{SO}_4)_2$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

Insol. in liquid  $\text{CO}_2$ . (Büchner, Z. phys. Ch. 1906, 54. 874.)

100 pts. sat. solution of  $\text{FeSO}_4$  in 40% alcohol contains 0.3%  $\text{FeSO}_4$ . (Schiff.)

Insol. in alcohol of 0.905 sp. gr. or less. (Anthon, J. pr. 14. 125.)

Alcohol and  $\text{H}_2\text{SO}_4$  precipitate  $\text{FeSO}_4$  from  $\text{FeSO}_4 + \text{Aq}$ , also glacial acetic acid.

Anhydrous  $\text{FeSO}_4$  is insol. in acetone. (Krug and M'Elroy, 1893.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

100 g. sat. solution in glycol contain 6.0 g.  $\text{FeSO}_4$  at ord. temp. (de Coninck.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Iron (ferrous) sulphate, acid,  $2\text{FeO}$ ,  $3\text{SO}_3$ ,  $2\text{H}_2\text{O}$ .**

This salt exists in contact with solutions containing  $\text{SO}_3 + 1.637 \text{ H}_2\text{O}$  to about  $\text{SO}_3 + 2.186 \text{ H}_2\text{O}$ . (Kenrick, J. phys. Chem. 1908, 12. 704.)

$\text{FeO}$ ,  $2\text{SO}_3 + \text{H}_2\text{O}$ . This compd. exists with solutions containing  $\text{SO}_3 + 1.342 \text{ H}_2\text{O}$  to (about)  $\text{SO}_3 + 1.595 \text{ H}_2\text{O}$ . (Kenrick.)

$\text{FeO}$ ,  $4\text{SO}_3 + 3\text{H}_2\text{O}$ . This compd. is stable with solutions containing from  $\text{SO}_3 + 1.122 \text{ H}_2\text{O}$  to (about)  $\text{SO}_3 + 1.342 \text{ H}_2\text{O}$ . Rapidly sol. in  $\text{H}_2\text{O}$  with ppt. of  $\text{FeSO}_4 + \text{H}_2\text{O}$ . (Kenrick.)

Min. *Melanterite*.

**Iron (ferric) sulphate, basic,  $10\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + \text{H}_2\text{O}$ .**

(Athanasesco, C. R. 103. 27.)

$6\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in warm  $\text{HCl} + \text{Aq}$ . (Scheerer, Pogg. 45. 188.)

$4\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 11\text{H}_2\text{O}$ . (Anthon, Repert. 81. 237.)

$3\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Rather easily sol. in acids. (Scheerer, Pogg. 44. 453; Meister, B. 8. 771.)

$2\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 + 6\text{H}_2\text{O}$ . When pptd. from cold solutions, is sol. in  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$ , but insol. therein when pptd. from hot solutions. (Maus.)

Only basic sulphate which is a true chemical compound. (Pickering, Chem. Soc. 37. 807.)

Min. *Glockerite*. Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ .

+  $7\text{H}_2\text{O}$ . (Meister.)

+  $8\text{H}_2\text{O}$ . (Mühlhauser.)

+  $15\text{H}_2\text{O}$ . Min. *Pissophanite*.

$\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3 = (\text{FeO})_2\text{SO}_4 + 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Soubeiran, A. ch. 44. 329.)

$3\text{Fe}_2\text{O}_3$ ,  $4\text{SO}_3 + 9\text{H}_2\text{O}$ . (Athanasesco.)

$2\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_3 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Wittstein.)

+  $18\text{H}_2\text{O}$ . Min. *Fibrosferite*. Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

$\text{Fe}_2\text{O}_3$ ,  $2\text{SO}_3 + 10\text{H}_2\text{O}$ . Min. *Stypticite*.

+  $15\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; decomp. by heat or evaporation. (Muck, J. pr. 99. 103.)

$2\text{Fe}_2\text{O}_3$ ,  $5\text{SO}_3 + 13\text{H}_2\text{O}$ . Min. *Copiapite*.

$\text{Fe}_2\text{O}_3$ ,  $18\text{H}_2\text{O} = 2\text{Fe}_2\text{O}_3$ ,  $5\text{SO}_3 + 18\text{H}_2\text{O}$ . *a-Copiapit*. This salt is in equilibrium at 25°

with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  lies between 1:2.889 and 1:2.614. (Wirth, Z. anorg. 1914, 87. 37.)

$(\text{OH})\text{Fe}_2(\text{SO}_4)_3 + 13\text{H}_2\text{O}$ .  *$\beta$ -Copiapit*. This salt is in equilibrium at 25° with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  lies between 1:3.472 and 1:2.889. (Wirth, Z. anorg. 1914, 87. 37.)

According to Pickering (Chem. Soc. 37. 807), all basic ferric sulphates are mixtures excepting  $2\text{Fe}_2\text{O}_3$ ,  $\text{SO}_3$ .

**Iron (ferric) sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ .**

*Anhydrous*. Slowly deliquescent. Nearly insol. in  $\text{H}_2\text{O}$ , and  $\text{HCl} + \text{Aq}$ . Insol. in conc.  $\text{H}_2\text{SO}_4$ . Very rapidly sol. in  $\text{FeSO}_4 + \text{Aq}$ , even when very dil. (Barreswil, C. R. 20. 1366.)

Sp. gr. of  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$ . According to F = Franz at 17.5° (J. pr. (2) 5. 280); G = Gerlach at 15° (Z. anal. 28. 494); H = Hager at 18° (Z. anal. 27. 280).

	5	10	15	20 % $\text{Fe}_2(\text{SO}_4)_3$
F	1.0426	1.0854	1.1324	1.1826
G	...	1.096	...	1.205
H	1.046	1.097	1.151	1.208

	25	30	35	40 % $\text{Fe}_2(\text{SO}_4)_3$
F	1.2426	1.3090	1.3782	1.4506
G	...	1.331	...	1.478
H	1.271	1.337	1.411	1.490

	45	50	55	60 % $\text{Fe}_2(\text{SO}_4)_3$
F	1.5298	1.6148	1.7050	1.8006
G	...	1.650	...	...

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 25°.

$\text{H}_2\text{SO}_4 + \text{Aq}$ Normality	100 g. of the solution contain g. $\text{Fe}_2(\text{SO}_4)_3$
2.25	25.02
6.685	14.58
19.84	0.05

(Wirth, Z. anorg. 1913, 79. 364.)

Solubility in  $\text{Al}_2(\text{SO}_4)_3 + \text{Aq}$  at 25°.

100 g. of the solution contain	
G. $\text{Al}_2(\text{SO}_4)_3$	G. $\text{Fe}_2(\text{SO}_4)_3$
...	44.97
2.342	42.44
5.200	38.83
6.626	35.82
8.819	34.02
10.03	32.42
*10.23	31.90
10.70	31.91

\*Solution sat. with respect to both salts. (Wirth and Bakke, Z. anorg. 1914, 87. 48.)  
See also under  $\text{Al}_2(\text{SO}_4)_3$ .

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 828.)

Completely pptd. from  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  by  $\text{HC}_2\text{H}_3\text{O}_2$ . Sol. to large extent in alcohol. Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in acetone.

$+x\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Conc.  $\text{Fe}_2(\text{SO}_4)_3 + \text{Aq}$  may be boiled without decomp., but dil. solutions are decomp. on heating. A solution containing 1 pt. salt to 100 pts.  $\text{H}_2\text{O}$  becomes turbid at  $76^\circ$ ; 1 pt. to 200 pts., at  $56^\circ$ ; 1 pt. to 400 pts., at  $47^\circ$ ; 1 pt. to 800 pts., at  $40^\circ$ ; 1 pt. to 1000 pts., at  $38^\circ$ ; 1 pt. to 10,000 pts., at  $14^\circ$ . (Scheerer.)

$+9\text{H}_2\text{O}$ . Min. *Coquimbite*.

81.43 pts. are sol. in 18.57 pts.  $\text{H}_2\text{O}$ . (Wirth, Z. anorg. 1914, 87. 23.)

This salt is stable at  $25^\circ$  only in contact with solutions in which the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  lies between 1 : 3.472 and 1 : 6.699. (Wirth, Z. anorg. 1914, 87. 35.)

$+10\text{H}_2\text{O}$ . Slowly sol. in  $\text{H}_2\text{O}$ . (Oudemans, R. t. c. 3. 331.)

**Iron (ferroferric) sulphate,  $6\text{FeSO}_4$ ,  $\text{Fe}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O}$ .**

Sol. in all proportions in  $\text{H}_2\text{O}$ . (Poumarède, C. R. 18. 854.)

$3\text{FeSO}_4$ ,  $2\text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{Aq}$ . Insol. in alcohol. (Abich, 1842.)

$\text{FeSO}_4$ ,  $\text{Fe}_2(\text{SO}_4)_3 + 12\text{H}_2\text{O}$ . Min. *Voltaite*. Difficultly sol. in  $\text{H}_2\text{O}$ .

$\text{FeO}$ ,  $\text{Fe}_2\text{O}_3$ ,  $6\text{SO}_3 + 15\text{H}_2\text{O}$ . Deliquescent. (Lefort, J. Pharm. (4) 10. 87.)

**Iron (ferrous) pyrosulphate,  $\text{FeS}_2\text{O}_7$ .**

Deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Bolas, Chem. Soc. (2) 12. 212.)

**Iron (ferric) hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4 + 8\text{H}_2\text{O}$ .**

This salt is in equilibrium at  $25^\circ$  only with solutions where the molecular ratio  $\text{Fe}_2\text{O}_3 : \text{SO}_3$  is more acid than 1 : 6.699. (Wirth and Bakke, Z. anorg. 1914, 87. 34.)

Sat. solution of  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{H}_2\text{SO}_4 + 8\text{H}_2\text{O}$  in abs. alcohol at  $25^\circ$  contains 8 g.  $\text{Fe}_2\text{O}_3$  + 17.18 g.  $\text{SO}_3$  per 100 g. sat. solution. (Wirth and Bakke.)

Decomp. by  $\text{H}_2\text{O}$ . (Recoura, C. R. 1903, 137. 118.)

In contact with solutions containing 25% to 28%  $\text{SO}_3$  at  $25^\circ$ , the stable solid is  $\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_3 + 10\text{H}_2\text{O}$ . In contact with solutions containing more than 28%, the stable solid is  $\text{Fe}_2\text{O}_3$ ,  $4\text{SO}_3 + 10\text{H}_2\text{O}$ . (Cameron and Robinson, J. phys. Chem. 1907, 11. 650.)

**Iron (ferroferric) hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{FeSO}_4$ ,  $2\text{H}_2\text{SO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ , but slowly decomp. thereby. Sol. in  $\text{H}_2\text{SO}_4$ . (Étard, C. R. 87. 602.)

**Iron (ferrous) hydrazine sulphate,  $\text{FeH}_2(\text{SO}_4)_2$ ,  $2\text{N}_2\text{H}_4$ .**

1 pt. is sol. in 325 pts.  $\text{H}_2\text{O}$  at  $12^\circ$ . (Curtius, J. pr. 1894, (2) 50. 331.)

**Iron (ferrous) magnesium sulphate,  $\text{FeSO}_4$ ,  $\text{MgSO}_4 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Schiff.)

**Iron (ferric) magnesium sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{MgSO}_4 + 24\text{H}_2\text{O}$ .**

(Bastick.)

**Iron (ferrous) magnesium potassium sulphate,  $2\text{K}_2\text{SO}_4$ ,  $\text{FeSO}_4$ ,  $\text{MgSO}_4 + 12\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Iron (ferric) manganous hydrogen sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $2\text{MnSO}_4$ ,  $\text{H}_2\text{SO}_4$ .**

Insol. in cold  $\text{H}_2\text{O}$ . (Étard.)

$\text{Fe}_2(\text{SO}_4)_3$ ,  $2\text{MnSO}_4$ ,  $3\text{H}_2\text{SO}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 86. 1399.)

**Iron (ferric) manganic sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{Mn}_2(\text{SO}_4)_3$ .**

Insol. in cold  $\text{H}_2\text{O}$ ; decomp. by hot  $\text{H}_2\text{O}$  and  $\text{HCl} + \text{Aq}$ . (Étard.)

**Iron (ferrous) manganous potassium sulphate,  $\text{FeSO}_4$ ,  $\text{MnSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Iron (ferrous) nickel sulphate,  $2\text{FeSO}_4$ ,  $2\text{NiSO}_4$ ,  $\text{H}_2\text{SO}_4$ .**

(Étard, C. R. 87. 602.)

**Iron (ferric) nickel sulphate,  $\text{Fe}_2(\text{SO}_4)_3$ ,  $\text{NiSO}_4$ ,  $2\text{H}_2\text{SO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. (Étard, C. R. 87. 602.)

**Iron (ferrous) nickel potassium sulphate,  $\text{FeSO}_4$ ,  $\text{NiSO}_4$ ,  $2\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Vohl, A. 94. 57.)

**Iron (ferrous) potassium sulphate,  $\text{FeSO}_4$ ,  $\text{K}_2\text{SO}_4$ .**

$+2\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 9. 19.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$	$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$
0.5	22.79	80	42.34
17.2	31.98	90	42.73
40.1	40.86	95	41.01
60	42.63	..	...

(Küster and Thiel, Z. anorg. 1899, 21. 116.)

$+4\text{H}_2\text{O}$ .Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$	$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$
0.5	22.94	80	40.46
17.2	26.79	90	43.82
40.1	32.41	95	44.11
60	35.68	..	...

(Küster and Thiel.)

 $+6\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve at  $t^\circ$ :

$0^\circ$	$10^\circ$	$14.5^\circ$	$16^\circ$	$25^\circ$
19.6	24.5	29.1	30.9	36.5 pts. anhydrous salt,
$35^\circ$	$40^\circ$	$55^\circ$	$65^\circ$	$70^\circ$
41	45	56	59.3	64.2 pts. anhydrous salt.

(Tobler, A. 95. 193.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$	$t^\circ$	% $\text{FeK}_2(\text{SO}_4)_2$
0.5	18.36	60	42.93
17.2	25.16	80	45.29
40.1	36.72	..	...

(Küster and Thiel.)

Iron (ferric) potassium sulphate, basic,  
 $4\text{Fe}_2\text{O}_3, \text{K}_2\text{O}, 7\text{SO}_3 + 9\text{H}_2\text{O} = 4(\text{Fe}_2\text{O}_3,$   
 $2\text{H}_2\text{O}, \text{SO}_3), \text{K}_2\text{SO}_4 + 7\text{H}_2\text{O}$ .

Insol. in boiling  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{HCl} + \text{Aq}$ ,  
 more readily in aqua regia. (Rammelsberg.)  
 $3\text{Fe}_2\text{O}_3, \text{K}_2\text{O}, 4\text{SO}_3 + 6\text{H}_2\text{O} = \text{K}(\text{FeO})_2(\text{SO}_4)_2$   
 $+ 3\text{H}_2\text{O}$ . Min. *Jarosite*.

$\text{Fe}_2\text{O}_3, \text{H}_2\text{O}, 2\text{SO}_3, 2\text{K}_2\text{SO}_4 + 5\text{H}_2\text{O}$ . Sol. in  
 6 pts. cold  $\text{H}_2\text{O}$ . Solution soon decomposes.  
 (Mauz, Pogg. 11. 78.)

Sol. in 12.5 pts.  $\text{H}_2\text{O}$  at  $10^\circ$ . (Anthon, Re-  
 pert. 78. 361.)

Formula is given as  $3\text{Fe}_2\text{O}_3, 5\text{K}_2\text{O}, 12\text{SO}_3 +$   
 $18\text{H}_2\text{O}$  by Marignac.

$3\text{Fe}_2\text{O}_3, 6\text{SO}_3, 2\text{K}_2\text{SO}_4 + 22\text{H}_2\text{O}$ . Sol. when  
 moist in  $\text{H}_2\text{O}$ . Solution soon decomposes.  
 Insol. in alcohol. (Soubeiran, A. ch. 44. 329.)

$3\text{Fe}_2\text{O}_3, 7\text{SO}_3, 5\text{K}_2\text{SO}_4 + 12\text{H}_2\text{O}$ , and  
 $+ 17\text{H}_2\text{O}$ . (Scheerer, Pogg. 87. 81.)

$2\text{Fe}_2\text{O}_3, 5\text{SO}_3, 3\text{K}_2\text{SO}_4 + 9\text{H}_2\text{O}$ . (S.)

$3\text{Fe}_2\text{O}_3, 8\text{SO}_3, 4\text{K}_2\text{SO}_4 + 20\text{H}_2\text{O}$  and  $24\text{H}_2\text{O}$ .  
 (S.)

Iron (ferric) potassium sulphate,  $\text{K}_2\text{SO}_4,$   
 $2\text{Fe}_2(\text{SO}_4)_3$ .

Insol. in  $\text{H}_2\text{O}$ , but is gradually decomp.  
 thereby. (Grimm and Ramdohr, A. 98. 127.)  
 $+ 2\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Weinland,  
 Z. anorg. 1913, 84. 364.)

$\text{K}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ . *Iron alum*.

Sol. in 5 pts.  $\text{H}_2\text{O}$  at  $12.5^\circ$ . (Anthon.)

Aqueous solution is decomp. by heating.  
 Insol. in alcohol.

Sp. gr. of aqueous solution. According to

G = Gerlach, at  $15^\circ$  (Z. anal. 26. 496); F =  
 Franks, at  $17.5^\circ$  (J. pr. (2) 5. 288), containing:

	5	10	15% $\text{K}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,
F	1.0268	1.0466	1.0672
G	1.025	1.0507	1.0773

	20	25	30% $\text{K}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ ,
F	1.0894	1.1136	1.1422
G	1.1050	1.1340	1.1645

35 %  $\text{K}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .  
 G 1.1667.

Melts in crystal  $\text{H}_2\text{O}$  at  $28^\circ$ . (Locke, Am.  
 Ch. J. 1901, 26. 183.)

$\text{Fe}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$ . Insol. in  $\text{H}_2\text{O}$ , but  
 slowly decomp. thereby. (Etard, C. R. 84.  
 1089.)

Iron (ferric) potassium sulphate sulphite.  
*See Sulphite sulphate, ferric potassium.*

Iron (ferrous) potassium zinc sulphate,  $\text{FeSO}_4,$   
 $2\text{K}_2\text{SO}_4, \text{ZnSO}_4 + 12\text{H}_2\text{O}$ .  
 Sol. in  $\text{H}_2\text{O}$ .

Iron (ferrous) rubidium sulphate,  $\text{FeSO}_4,$   
 $\text{Rb}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Tutton, Chem. Soc. 63. 337.)  
 1 l.  $\text{H}_2\text{O}$  dissolves 242 g. anhydrous salt  
 at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

Iron (ferric) rubidium sulphate,  $\text{Rb}_2\text{Fe}_2$   
 $(\text{SO}_4)_2 + 24\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

Temp.	G. per litre	Gram mols. of anhydrous salt per litre
25	97.4	0.294
30	202.4	0.617
35	Basic salt formed	...

(Locke, Am. Ch. J. 1901, 26. 180.)

Iron (ferrous) sodium sulphate,  $\text{FeSO}_4,$   
 $\text{Na}_2\text{SO}_4 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Marignac, Ann. Min. (5) 9.  
 25.)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  in 100 g.  
 $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Grams $\text{FeSO}_4$	Grams $\text{Na}_2\text{SO}_4$
21.8	24.34	22.51
24.92	23.62	22.04
34.95	23.91	21.83
40	24.01	22.62

(Koppel, Z. phys. Ch. 1905, 52. 406.)



Solubility of  $\text{FeNa}_3(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$	$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$
18.8	26.63	20.28	31°	33.99	14.41
23	28.82	18.40	35°	35.66	13.85
27	30.95	16.68	40°	39.98	11.92

(Koppel.)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$	$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$
18.8	27.23	22.16	28°	11.28	35.94
23	20.31	26.48	31°	6.95	44.75

(Koppel.)

Solubility of  $\text{FeNa}_2(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$  (anhydrous) in 100 g.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	grams $\text{FeSO}_4$	grams $\text{Na}_2\text{SO}_4$
35	6.16	46.58
40	6.27	46.99

(Koppel.)

See also under  $\text{FeSO}_4$ .

**Iron (ferric) sodium sulphate, basic,  $2\text{Na}_2\text{O} \cdot \text{Fe}_2\text{O}_3 \cdot 4\text{SO}_3 + 7\text{H}_2\text{O}$ .**

Only sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Skrabal, Z. anorg. 1904, 33. 319.)

+  $8\text{H}_2\text{O}$ . Min. *Urusite*. Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ .

$3\text{Na}_2\text{O} \cdot \text{Fe}_2\text{O}_3 \cdot 6\text{SO}_3 + 6\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Skrabal.)

$4\text{Fe}_2\text{O}_3 \cdot \text{Na}_2\text{O} \cdot 5\text{SO}_3 + 9\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; difficultly sol. in  $\text{HCl} + \text{Aq}$ . (Scheerer, Pogg. 45. 190.)

**Iron (ferric) sodium sulphate,  $[\text{Fe}(\text{SO}_4)_3] \cdot \text{Na}_2\text{O} + 3\text{H}_2\text{O}$ .**

Ppt. Nearly insol. in  $\text{H}_2\text{O}$ . (Weinland, Z. anorg. 1913, 84. 365.)

**Iron (ferrous) thallium sulphate,  $\text{FeSO}_4 \cdot \text{Tl}_2\text{SO}_4 + 6\text{H}_2\text{O}$ .**

Easily decomp. by solution in  $\text{H}_2\text{O}$ . (Willm, A. ch. (4) 5. 56.)

**Iron (ferric) thallium sulphate,  $\text{Tl}_2\text{Fe}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**

Not efflorescent. Very easily sol. in  $\text{H}_2\text{O}$ . 361.5 g. anhydrous, or 646 g. hydrated salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ , or 0.799 mol. of the anhydrous salt is sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ . Melts in crystal  $\text{H}_2\text{O}$  at  $37^\circ$ . (Locke, Am. Ch. J. 1901, 26. 175.)

**Iron (ferrous) zinc sulphate,  $\text{FeSO}_4 \cdot \text{ZnSO}_4 + 14\text{H}_2\text{O}$ .**

$2\text{FeSO}_4 \cdot 2\text{ZnSO}_4 \cdot \text{H}_2\text{SO}_4$ . (Étard, C. R. 87. 602.)

**Iron (ferric) zinc sulphate,  $\text{Fe}_2(\text{SO}_4)_3 \cdot \text{ZnSO}_4 + 24\text{H}_2\text{O}$ .**

(Bastick.)

**Iron (ferrous) sulphate nitric oxide,  $\text{FeSO}_4 \cdot \text{NO}$ .**

The solubility of  $\text{NO}$  in  $\text{FeSO}_4 + \text{Aq}$  is diminished by the presence of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , phosphoric acid and by the presence of certain salts. (Manchot, A. 1910, 372. 157.)

$\text{Fe}(\text{NO})\text{SO}_4 \cdot \text{FeSO}_4 + 13\text{H}_2\text{O}$ . Decomp. in the air. Sol. in water. (Manchot.)

**Lanthanum sulphate, basic,  $2\text{La}_2\text{O}_3 \cdot 3\text{SO}_3 + 3\text{H}_2\text{O}$ .**

Precipitate. (Frerichs and Smith.)

Formula is  $3\text{La}_2\text{O}_3 \cdot \text{SO}_3 + x\text{H}_2\text{O}$ . (Cleve, B. 11. 910.)

**Lanthanum sulphate,  $\text{La}_2(\text{SO}_4)_3$ .**

*Anhydrous*. Much less sol. in warm than in cold  $\text{H}_2\text{O}$ . 1 pt. is sol. in less than 6 pts.  $\text{H}_2\text{O}$ , if added in small portions thereto at  $2-3^\circ$ , and the temperature not allowed to rise to  $13^\circ$ ; but if heated to  $30^\circ$ ,  $\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$  separates out until the solution is solid. (Mosander.)

100 pts.  $\text{H}_2\text{O}$  dissolve 2.208 pts.  $\text{La}_2(\text{SO}_4)_3$  at  $16.5^\circ$ ; 2.130 pts. at  $18^\circ$ ; 1.641 pts. at  $34^\circ$ .

See also under  $+9\text{H}_2\text{O}$ .

The solubility of  $\text{La}_2(\text{SO}_4)_3$  in  $\text{H}_2\text{O}$  is diminished by the presence of  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ , or  $\text{Na}_2\text{SO}_4$ . (Barre, C. R. 1910, 151. 871.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$ .

Pts. per 100 pts. $\text{H}_2\text{O}$		Solid phase
$(\text{NH}_4)_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0.00	2.130	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
4.011	0.393	$\text{La}_2(\text{SO}_4)_3, (\text{NH}_4)_2\text{SO}_4 + 2\text{H}_2\text{O}$
8.727	0.279	"
18.241	0.253	"
27.887	0.476	"
36.112	0.277	"
47.486	0.137	$2\text{La}_2(\text{SO}_4)_3, 5(\text{NH}_4)_2\text{SO}_4$
53.823	0.067	$\text{La}_2(\text{SO}_4)_3, 5(\text{NH}_4)_2\text{SO}_4$
65.286	0.0117	"
73.782	0.0033	"

(Barre.)

Solubility in  $\text{K}_2\text{SO}_4 + \text{Aq}$  at  $16.5^\circ$ .

Pts. per 100 pts. $\text{H}_2\text{O}$		Solid phase
$\text{K}_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0.00	2.198	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0.247	0.727	$\text{La}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$
0.496	0.269	"
0.846	0.185	"
1.029	0.054	$\text{La}_2(\text{SO}_4)_3, 5\text{K}_2\text{SO}_4$
1.516	0.022	"

(Barre.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $18^\circ$ .

Pts. per 100 pts. $\text{H}_2\text{O}$		Solid phase
$\text{Na}_2\text{SO}_4$	$\text{La}_2(\text{SO}_4)_3$	
0.00	2.130	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0.395	0.997	$\text{La}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4$
0.689	0.353	"
0.774	0.299	"
1.136	0.129	"
2.480	0.044	"
3.802	0.019	"
5.548	0.016	"

(Barre.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 30. 830.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

+9 $\text{H}_2\text{O}$ . Sol. in 42.5 pts.  $\text{H}_2\text{O}$ , calculated as anhydrous salt, at  $23^\circ$ , and 115 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ . (Mossander.)

Solubility in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{La}_2(\text{SO}_4)_3$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{La}_2(\text{SO}_4)_3$
0	3.02
14	2.60
30	1.90
50	1.49
75	0.94
100	0.68

(Muthmann and Röllig, B. 1898, 31. 1723.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Normality $\text{H}_2\text{SO}_4$	In 100 g. of the liquid are dissolved		Solid phase
	g. oxide	g. sulphate	
0	1.43	2.483	$\text{La}_2(\text{SO}_4)_3 + 9\text{H}_2\text{O}$
0.505	1.69	2.934	"
1.10	1.796	3.118	"
2.16	1.818	3.156	"
3.39	1.42	2.465	"
4.321	1.11	1.927	"
6.685	0.5309	0.9217	"
9.68	0.2659	0.4617	"
12.60	0.2136	0.3709	"
15.15	0.177	0.3073	"

(Wirth, Z. anorg. 1912, 76. 189.)

**Lanthanum hydrogen sulphate,  $\text{La}(\text{SO}_4\text{H})_3$ .**

(Brauner, Z. anorg. 1904, 38. 330.)

**Lanthanum potassium sulphate,  $\text{La}_2(\text{SO}_4)_3, \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .**

$\text{La}_2(\text{SO}_4)_3, 5\text{K}_2\text{SO}_4$ . (Barre, C. R. 1910, 151. 872.)

$\text{La}_2(\text{SO}_4)_3, 3\text{K}_2\text{SO}_4$ . Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ . (Cleve.)

$\text{La}_2(\text{SO}_4)_3, 4\text{K}_2\text{SO}_4$ . As above. (Cleve.)  
 $2\text{La}_2(\text{SO}_4)_3, 9\text{K}_2\text{SO}_4$ . As above. (Cleve.)

**Lanthanum rubidium sulphate,**

$\text{La}_2(\text{SO}_4)_3, \text{Rb}_2\text{SO}_4$ .

(Baskerville, J. Am. Chem. Soc. 1904, 26. 67.)

+2 $\text{H}_2\text{O}$ . (Baskerville.)

$3\text{La}_2(\text{SO}_4)_3, 2\text{Rb}_2\text{SO}_4$ . (Baskerville.)

**Lanthanum sodium sulphate,  $\text{La}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.) (Barre, C. R. 1910, 151. 872.)

**Lead sulphate, basic,  $2\text{PbO}, \text{SO}_3$ .**

Not completely insol. in  $\text{H}_2\text{O}$ . Decomp. by acids, even dil.  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , with formation of  $\text{PbSO}_4$ . (Barfoed, 1869.)

0.050 millimole calc. as Pb is sol. in 1 l.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II. 1056.)

$5\text{PbO}, 3\text{SO}_3$ . (Frankland, Proc. Roy. Soc. 46. 364.)

$\text{Pb}_3\text{O}_4, 2\text{SO}_3$ . (Frankland.)

$3\text{PbO}, \text{PbSO}_4 + \text{H}_2\text{O}$ . Ppt. (Strömholm, Z. anorg. 1904, 38. 442.)

$\text{Pb}_4(\text{SO}_4)(\text{OH})_3$ . 0.106 millimole calc. as Pb is sol. in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II, 1056.)

**Lead sulphate,  $\text{PbSO}_4$ .**

Sol. in 22,816 pts.  $\text{H}_2\text{O}$  at  $11^\circ$ . (Fresenius, A. 59. 125.)

Sol. in 31,569 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Rodwell, C. N. 11. 50.)

Sol. in 13,000 pts.  $\text{H}_2\text{O}$ . (Kremers, Pogg. 85. 247.)

Calculated from electrical conductivity of  $\text{PbSO}_4 + \text{Aq}$ , 1 l.  $\text{H}_2\text{O}$  dissolves 46 mg.  $\text{PbSO}_4$  at  $18^\circ$ . (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

$4.23 \times 10^{-3}$  gr. are dissolved in 1 liter of sat. solution at  $20^\circ$ ;  $4.41 \times 10^{-3}$  at  $25^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 604.)

1 l.  $\text{H}_2\text{O}$  dissolves 41 mg.  $\text{PbSO}_4$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

0.126 millimole Pb is sol. in 1 liter  $\text{H}_2\text{O}$  at  $18^\circ$ . (Pleissner, C. C. 1907, II. 1056.)

40 mg. are dissolved in 1 l. of sat. solution at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

0.0824 g.  $\text{PbSO}_4$  is sol. in 1000 cc.  $\text{H}_2\text{O}$  at  $18^\circ$  and also at  $100^\circ$ . The fact that  $\text{PbSO}_4$  dissolves in  $\text{H}_2\text{O}$  is ascribed to hydrolysis, and in support of this it is shown that the solubility of hydrated oxide of lead,  $\text{PbO}, \text{H}_2\text{O}$ , in dil.  $\text{H}_2\text{SO}_4$  is the same as the solubility of  $\text{PbSO}_4$  in  $\text{H}_2\text{O}$ . (Sehnal, C. R. 1909, 143. 1395.)

1 l.  $\text{H}_2\text{O}$  dissolves 26 mg. at  $18^\circ$ ; 30 mg. at  $25^\circ$ ; 38 mg. at  $37^\circ$ . (Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34. 447.)

Solubility in  $H_2O$  at  $t^\circ$ .  
(Millimols per l.)

$t^\circ$	$PbSO_4$
18	0.126
25	0.144
37	0.183

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, **34**, 446.)

Sol. in hot conc.  $HCl$ +Aq. (Fresenius.)

Solubility of  $PbSO_4$  in  $HCl$ +Aq.

Sp. gr. of $HCl$ +Aq	% $HCl$ in $HCl$ +Aq	Pts. $HCl$ +Aq for 1 pt. $PbSO_4$
1.0519	10.602	681.89
1.0800	16.310	281.73
1.1070	22.010	105.65
1.1359	27.525	47.30
1.1570	31.602	35.03

(Rodwell, Chem. Soc. **15**, 59.)

Solubility of  $PbSO_4$  in  $HCl$ +Aq at  $t^\circ$ .  
(Millimols, per l.)

$t^\circ$	0.1N	0.2N	0.3N	0.4N
18	0.126	1.72	2.67	3.63
25	0.144	2.07	3.14	4.29
37	0.183	2.63	4.06	5.43

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, **34**, 446.)

Above measurements in  $HCl$ +Aq show solubility directly proportional to the hydrogen ions. (Beck and Stegmüller.)

Sol. in  $HNO_3$ +Aq, and more sol. in hot or conc. than in cold or dil.  $HNO_3$ +Aq.

Sol. in 172 pts.  $HNO_3$ +Aq of 1.144 sp. gr. at  $12.5^\circ$ . (Bischof.)

Pptd. from  $HNO_3$  solution by dil.  $H_2SO_4$ +Aq and not by  $H_2O$ . (Bischof, **1837**.)

Solubility of  $PbSO_4$  in  $HNO_3$ +Aq.

Sp. gr. of $HNO_3$ +Aq	% $HNO_3$ in $HNO_3$ +Aq	Pts. $HNO_3$ +Aq for 1 pt. $PbSO_4$
1.079	11.55	303.10
1.123	17.50	173.75
1.250	34.00	127.48
1.420	60.00	10282.78

(Rodwell, Chem. Soc. **15**, 59.)

Solubility in  $HNO_3$  at  $18^\circ$ .  
(Millimols per l.)

$HNO_3$	$PbSO_4$
0.1N	0.506
0.2N	0.844
0.3N	1.13
0.4N	1.44

(Beck and Stegmüller.)

Sol. in 36,504 pts. dil.  $H_2SO_4$ +Aq. (Fresenius.) See also under solubility in alcohol. Sl. sol. in conc.  $H_2SO_4$ , from which it is partially pptd. by  $H_2O$  or completely by alcohol. (Fresenius.)

100 pts. conc.  $H_2SO_4$  dissolve 6 pts.  $PbSO_4$ . (Schultz, Pogg. **133**, 137.)

Conc.  $H_2SO_4$  dissolves 0.005 pt.  $PbSO_4$ . (Ure.)

100 pts.  $H_2SO_4$  dissolve 0.13 pt.  $PbSO_4$ , and 100 pts. fuming  $H_2SO_4$  dissolve 4.19 pts. (Struve, Z. anal. **9**, 31.)

More sol. in commercial  $H_2SO_4$  than in the more conc. acid. (Hayes.)

100 pts.  $H_2SO_4$ +Aq of 1.841 sp. gr. dissolve 0.039 pts.  $PbSO_4$ ; of 1.793 sp. gr. dissolve 0.011 pt.  $PbSO_4$ ; of 1.540 sp. gr. dissolve 0.003 pt.  $PbSO_4$ .

Presence of  $SO_2$  does not increase the solubility;  $HNO_3$  increases the solubility somewhat, i. e., 100 pts.  $H_2SO_4$ +Aq of 1.841 sp. gr. with 5 pts.  $HNO_3$  of 1.352 sp. gr. dissolve 0.044 pt.  $PbSO_4$ ; 100 pts.  $H_2SO_4$  of 1.749 sp. gr. with 5 pts.  $HNO_3$  of 1.352 sp. gr. dissolve 0.014 pt.  $PbSO_4$ ; 100 pts.  $H_2SO_4$  of 1.512 sp. gr. with 5 pts.  $HNO_3$  of 1.352 sp. gr. dissolve only a trace.

Nitrous oxides do not increase the action. (Kolb, Dingl. **309**, 268.)

Solubility in dil.  $H_2SO_4$ +Aq at  $18^\circ$ .  
(G. per l.)

$H_2SO_4$	$PbSO_4$	$H_2SO_4$	$PbSO_4$
0	0.0382	0.0245	0.0194
0.0049	0.0333	0.0490	0.0130
0.0098	0.0306	0.4904	0.0052

(Pleissner, Arb. K. Gesund. Amt. 1907, **36**, 384.)

A trace of  $H_2SO_4$  has a considerable effect in reducing the solubility of  $PbSO_4$  in  $H_2O$ . (Sehnal, C. R. 1909, **148**, 1395.)

Solubility in dil.  $H_2SO_4$ +Aq at  $20^\circ$ .  
(G. per l.)

$H_2SO_4$	$PbSO_4$	$H_2SO_4$	$PbSO_4$
0	0.082	0.0980	0.013
0.0098	0.051	0.4900	0.006
0.0196	0.025	0.9800	0

(Sehnal.)

Pptd. from solution in  $H_2SO_4$  by  $HCl$ . (Bolley, A. **91**, 113.)

Not more insol. in dil.  $HC_2H_3O_2$ +Aq than in  $H_2O$ . (Bischof.)

Solubility in other acids is prevented by great excess of  $H_2SO_4$ . (Wackenroder.)

Sol. in warm  $NH_4OH$ +Aq, separating on cooling. Completely sol. in warm  $KOH$  or  $NaOH$ +Aq.

Decomp. by boiling with  $K_2CO_3$ ,  $Na_2CO_3$ , and  $(NH_4)_2CO_3$  + Aq.

Sol. in  $NH_4$  salts + Aq, but reprecipitated by  $H_2SO_4$  + Aq. (Fresenius, A. 59. 125.)

The best solvents of the  $NH_4$  salts are the nitrate, citrate, and tartrate; the two latter should be strongly alkaline with  $NH_4OH$  + Aq. (Wackenroder.)

Sol. in  $NH_4Cl$  + Aq at 12.5–25°.

Sl. decomp. by  $NaCl$  + Aq. (Bley.)

1 l. sat.  $NaCl$  + Aq dissolves 0.66 g.  $PbSO_4$ . (Becquerel.)

Sol. in 100 pts. cold conc.  $NaCl$  + Aq, and  $PbCl_2$  is deposited after a few hours. (Field.)

Solubility of  $PbSO_4$  in  $NaCl$  + Aq at 18°. (Millimols per l.)

$NaCl$	$PbSO_4$
0.1N	0.546
0.2N	0.904
0.3N	1.28
0.4N	1.68

(Beck and Stegmüller, Arb. K. Gesund. Amt. 1910, 34. 446.)

Sol. in  $FeCl_3$  + Aq. (Fresenius, Z. anal. 19. 419.)

Sol. in  $Na_2S_2O_3$  + Aq. (Löwe.)

Sol. in  $(NH_4)_2SO_4$  + Aq. (Rose.)

Solubility of  $PbSO_4$  +  $PbSO_4$ ,  $K_2SO_4$  in  $H_2O$ .

t°	$K_2SO_4$		Solid phase
	g. in 100 cc. of solution	Mol. in 100 cc. of solution	
0	0.195	0.0112	$K_2SO_4$ , $PbSO_4$ + $PbSO_4$
22	0.396	0.0227	"

(Brønsted, Z. phys. Ch. 1911, 77. 316.)

Sol. in 47 pts.  $NH_4C_2H_3O_2$  + Aq 1.036 sp. gr., and 969 pts.  $NH_4NO_3$  + Aq (1.269 sp. gr.); from the solution in  $NH_4C_2H_3O_2$  it is pptd. by  $H_2SO_4$  or  $K_2SO_4$ ; from solution in  $NH_4NO_3$  by  $K_2SO_4$ , but not by  $H_2SO_4$ . (Bischof.)

Sol. in acetates of  $NH_4$ ,  $Na$ ,  $K$ ,  $Ca$ ,  $Al$ , and  $Mg$ . (Mercer.)

Solubility in  $NH_4C_2H_3O_2$  + Aq. Excess of  $PbSO_4$  was boiled with solution of  $NH_4C_2H_3O_2$  + Aq of varying conc.

G. $NH_4C_2H_3O_2$ in 100 cc.	g. $PbSO_4$ contained in 5 cc. solution		
	Hot	Cooled	Cooled 24 hrs.
28	0.356	...	...
30	0.418	...	0.224
32	0.494	0.451	0.242
35	0.513	0.452	...
37	0.529	...	0.238
40	0.539	...	0.263
45	0.555	0.488	...

(Dunnington and Long, Am. Ch. J. 1899, 22. 218.)

Solubility in ammonium acetate + Aq at 25°.

$NH_4C_2H_3O_2$ Millimol. per l.	Solubility of $PbSO_4$	
	Millimols. per l.	g. per l.
0.0	0.134	0.041
103.5	2.10	0.636
207.1	4.55	1.38
414.1	10.10	3.06

(Noyes and Whitcomb, J. Am. Chem. Soc. 1905, 27. 756.)

Solubility in  $KC_2H_3O_2$  + Aq at 25°.

Solid phase,  $PbSO_4$  +  $PbK_2(SO_4)_2$ .

Composition of the solutions			
$KC_2H_3O_2$ %	$Pb(C_2H_3O_2)_2$ %	$KC_2H_3O_2$ %	$Pb(C_2H_3O_2)_2$ %
4.33	2.54	26.58	9.83
9.03	3.55	28.82	11.40
17.81	5.43	28.93	19.41
22.07	5.95		

(Fox, Chem. Soc. 1909, 95. 887.)

100 pts.  $H_2O$  containing a drop of  $HC_2H_3O_2$  and 2.05 pts.  $NaC_2H_3O_2$  dissolve 0.054 pt.  $PbSO_4$ ; containing 8.2 pts.  $NaC_2H_3O_2$  dissolve 0.900 pt.  $PbSO_4$ ; containing 41.0 pts.  $NaC_2H_3O_2$  dissolve 11.200 pts.  $PbSO_4$ . (Dibbitts, Z. anal. 1874, 13. 139.)

Solubility in  $NaC_2H_3O_2$  + Aq at 25°.

Composition of the solutions			
% $Na$ acetate	% $Pb$ acetate	% $Na_2SO_4$	% $H_2O$
6.69	0.78	0.34	92.19
11.76	2.73	1.26	84.25
16.90	5.70	2.49	74.91
19.92	8.24	3.60	68.24
21.51	10.75	4.68	63.10
6.95	0.81	0.35	91.90

The proportion of sulphate in solution in each case corresponded with the amount of  $Pb$  present, but was calculated to sodium sulphate, since  $Na_2SO_4 + 10H_2O$  cryst. from the solutions on cooling. The solid phase in these solutions was  $PbSO_4$ .

(Fox, Chem. Soc. 1909, 95. 887.)

Sol. in  $Mn(C_2H_3O_2)_2$ ,  $Zn(C_2H_3O_2)_2$ ,  $Ni(C_2H_3O_2)_2$ , and  $Cu(C_2H_3O_2)_2$ , but not in  $Hg(C_2H_3O_2)_2$  or  $AgC_2H_3O_2$  + Aq.

Solubility in  $KC_2H_3O_2$  + Aq is not less than that in  $NaC_2H_3O_2$  + Aq. (Dibbitts, Z. anal. 13. 137.)

Insol. in  $Pb(C_2H_3O_2)_2$  + Aq. (Smith.)

Sol. in basic lead acetate + Aq, but not in neutral  $Pb(C_2H_3O_2)_2$  + Aq. (Stammer, Z. anal. 23. 67.)

12.2 pts.  $Ca(C_2H_3O_2)_2$  in very dil. solution dissolve 1 pt.  $PbSO_4$ . (Stadel, Z. anal. 2. 180.)

Sol. in  $Al(C_2H_3O_2)_3$  + Aq. (Lennsen.)

Very easily and abundantly sol. in  $\text{NH}_4$  tartrate + Aq. (Wöhler, A. 34. 235.)

Even when native, easily sol. in  $\text{NH}_4$  citrate + Aq. (Smith.)

Insol. in alcohol (18%) and  $\text{H}_2\text{SO}_4$  when  $\text{NH}_4$  acetate, K tartrate, or  $\text{NH}_4$  succinate are present. Insol. in alcohol (18%) and  $\text{H}_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4$  when Na acetate, Na or  $\text{NH}_4$  oxalate are present. Sol. in  $\text{NH}_4$  dicitrate and K tricitrate in presence of  $\text{H}_2\text{SO}_4$ ; in  $\text{NH}_4$  succinate and  $\text{NH}_4$  acetate in presence of  $(\text{NH}_4)_2\text{SO}_4$ ; and in  $\text{NH}_4$  citrate in presence of  $\text{H}_2\text{SO}_4$  or  $(\text{NH}_4)_2\text{SO}_4$ . (Storer, C. N. 21. 17.)

Alcohol (59%) alone, or with ethylsulphuric acid or sugar, does not dissolve Pb by 3 months action. (Storer.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329); methyl acetate. (Naumann, B. 1909, 43. 3790); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Min. *Anglesite*. Sol. in cold citric acid + Aq. (Bolton, C. N. 37. 14.)

**Lead hydrogen sulphate,  $\text{PbSO}_4, \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ .

**Lead pyrosulphate,  $\text{Pb S}_2\text{O}_7$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Schultz.)

**Lead potassium sulphate,  $\text{PbSO}_4, \text{K}_2\text{SO}_4$ .**

When  $\text{PbSO}_4$  is added to potassium acetate + Aq at  $25^\circ$  a double salt,  $\text{PbK}_2(\text{SO}_4)_2$  is formed. This salt is insol. in the solution which contains only potassium acetate and lead acetate. (Fox, Chem. Soc. 1903, 96. 882.)

Decomp. by  $\text{H}_2\text{O}$ . Stable only in solutions of  $\text{K}_2\text{SO}_4$ , containing at least 0.56%  $\text{K}_2\text{SO}_4$ , at  $7^\circ$ ; 0.62% at  $17^\circ$ ; 1.09% at  $50^\circ$ ; 1.37% at  $75^\circ$ ; 1.69% at  $100^\circ$ . (Barre, C. R. 1909, 149. 294.)

**Lead sulphate chloride,  $\text{PbSO}_4, 2\text{PbCl}_2 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{NaCl}$  + Aq. (Becquerel, C. R. 30. 1523.)

**Lead sulphate fluoride,  $\text{PbSO}_4, 2\text{PbF}_2$ .**

Not decomp. by  $\text{H}_2\text{SO}_4$ . (Lonyet, C. R. 24. 434.)

**Lithium sulphate,  $\text{Li}_2\text{SO}_4$ .**

More sol. in cold than in hot  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 34.6 pts.  $\text{Li}_2\text{SO}_4$  at  $18^\circ$ . (Wittstein.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Li}_2\text{SO}_4$  at  $t^\circ$

$t^\circ$	Pts. $\text{Li}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Li}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Li}_2\text{SO}_4$
0	35.34	45	32.38	100	29.24
20	34.36	65	30.3	...	...

(Kremers, Pogg. 95. 468.)

Sat.  $\text{Li}_2\text{SO}_4$  + Aq contains at:

$-20^\circ$   $-16^\circ$   $-15^\circ$   $-12^\circ$   
18.4 22.5 22.6 24.4 %  $\text{Li}_2\text{SO}_4$ .

$-4^\circ$   $+15^\circ$   $+90^\circ$   
25.7 25.3 23.9 %  $\text{Li}_2\text{SO}_4$ .  
(Étard, A. ch. 1894, (7) 2. 547.)

Sat. solution boils at  $105^\circ$ . (Kremers.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $19.5^\circ$  containing:  
6.5 7.4 12.5 15.3%  $\text{Li}_2\text{SO}_4$ ,  
1.05 1.06 1.098 1.118

22.6 24.4 29.4 %  $\text{Li}_2\text{SO}_4$ .  
1.167 1.178 1.208

(Kremers, Pogg. 114. 47.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $15^\circ$  containing 5%  
 $\text{Li}_2\text{SO}_4 = 1.0430$ ; 10%  $\text{Li}_2\text{SO}_4 = 1.0877$ .  
(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $25^\circ$ .

Concentration of $\text{Li}_2\text{SO}_4$ + Aq	Sp. gr.
1—normal	1.0453
$\frac{1}{2}$ —"	1.0234
$\frac{1}{4}$ —"	1.0115
$\frac{1}{8}$ —"	1.0057

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq.

$\frac{1}{2}$ $\text{Li}_2\text{SO}_4$ g. in 1000 g. of solution	Sp. gr. $16^\circ/16^\circ$
0	1.000000
2.9198	1.002589
16.0461	1.014093

(Dijken, Z. phys. Ch. 1897, 24. 109.)

Sp. gr. of  $\text{Li}_2\text{SO}_4$  + Aq at  $20^\circ$ .

Normality of $\text{Li}_2\text{SO}_4$ + Aq	% $\text{Li}_2\text{SO}_4$	Sp. gr.
2.60	23.48	1.2330
1.96	18.53	1.1650
1.708	16.41	1.1449
1.320	13.01	1.1133
0.747	7.71	1.0678

(Forchheimer, Z. phys. Ch. 1900, 24. 24.)

Insol. in  $\text{SO}_2$ . (Weber, B. 17. 2497.)

10 ccm. of sat.  $\text{Li}_2\text{SO}_4$  in absolute  $\text{H}_2\text{SO}_4$  contain approx. 2.719 g.  $\text{Li}_2\text{SO}_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $30^\circ$ .

Composition of the solution		Solid phase
% by wt. $\text{H}_2\text{SO}_4$	% by wt. $\text{Li}_2\text{SO}_4$	
5.05	22.74	$\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$
12.23	20.45	"
15.37	19.11	"
16.60	19.10	"
32.70	13.37	"
36.90	11.90	"
42.98	10.57	"
48.00	10.20	"
52.72	11.44	"
54.54	12.92	"
55.08	13.69	$\text{Li}_2\text{SO}_4$
56.30	13.87	"
61.46	17.10	"
61.82	17.00	"
62.14	17.97	"
62.49	18.89	$\text{Li}_2\text{SO}_4, \text{H}_2\text{SO}_4$
65.70	16.55	"
69.40	13.75	"
77.30	11.31	"
78.23	11.64	"
81.20	13.28	"
81.70	13.85	"
82.30	15.50	"
83.43	15.65	"

(Van Dorp, Z. phys. Ch. 1910, **73**, 289.)

Solution in  $\text{H}_2\text{SO}_4$  contains 17.2%  $\text{Li}_2\text{SO}_4$  at  $30^\circ$ . (Van Dorp, Z. phys. Ch. 1913, **86**, 112.)

Solubility of  $\text{Li}_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  in  $\text{H}_2\text{O}$  at  $25^\circ$ .

Solid phase,  $\text{Th}(\text{SO}_4)_2$ .  
G. in 100 g.  $\text{H}_2\text{O}$ .

$\text{Li}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	$\text{Li}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$
0.0	1.722	11.13	11.05
2.57	4.13	13.18	12.54
4.93	6.20	16.12	14.52
6.98	7.95	20.49	16.92
9.23	9.68	16.92	18.87

(Barre, Bull. Soc. 1912, (4) **11**, 647.)

Easily sol. (Kastner), sl. sol. (Berzelius) in alcohol.

Solubility of  $\text{Li}_2\text{SO}_4$  in alcohol + Aq at  $30^\circ$ .Solid phase  $\text{Li}_2\text{SO}_4, \text{H}_2\text{O}$ .

G. per 100 g. sat. solution			
$\text{C}_2\text{H}_5\text{OH}$	$\text{Li}_2\text{SO}_4$	$\text{C}_2\text{H}_5\text{OH}$	$\text{Li}_2\text{SO}_4$
0	25.1	47.28	3.04
11.75	16.16	58.59	1.22
21.19	11.52	69.39	0.4
29.40	8.17	80.74	0
33.31	6.66	94.11	0

(Schreinemakers and van Dorp, Chem. Weekbl. 1906, **3**, 557.)

Insol. in methyl acetate (Naumann, B. 1909, **42**, 3790); ethyl acetate (Naumann, B. 1904, **37**, 3801); acetone. (Eidmann, C. C. 1899, **11**, 1014; Naumann, B. 1904, **37**, 4329.)  
+  $\text{H}_2\text{O}$ . Very sl. efflorescent. (Rammelsberg.)

Aq. solution contains 25.1%  $\text{Li}_2\text{SO}_4$  at  $30^\circ$ . (Schreinemakers, C. C. 1910, **1**, 1801); 24.3 g. at  $50^\circ$ . (Schreinemakers and Cocheret, Chem. Weekbl. 1905, **2**, 771.)

Lithium hydrogen sulphate,  $\text{LiHSO}_4$ .

Decomp. by  $\text{H}_2\text{O}$ .  
Cryst. from  $\text{H}_2\text{SO}_4$ . (Gmelin.)  
 $\text{LiH}(\text{SO}_4)_2$ . Cryst. from  $\text{H}_2\text{SO}_4$ . (Schults, Pogg. **133**, 137.)  
 $\text{Li}_2\text{SO}_4, 7\text{H}_2\text{SO}_4$ . (Bergius, Z. phys. Ch. 1910, **72**, 355.)

Lithium potassium sulphate,  $\text{Li}_2\text{SO}_4, \text{K}_2\text{SO}_4$ .

This is the only compd. of  $\text{Li}_2\text{SO}_4$  and  $\text{K}_2\text{SO}_4$  which exists below  $100^\circ$ . (Spielrein, C. R. 1913, **157**, 48.)

$\text{K}_2\text{Li}_2(\text{SO}_4)_2$ . (Knobloch.) Has the formula  $\text{K}_2\text{Li}_2(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ , according to Rammelsberg.

Lithium sodium sulphate,  $\text{Na}_2\text{Li}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .

$\text{Na}_2\text{Li}_2(\text{SO}_4)_2 + 9\text{H}_2\text{O}$ .  
 $\text{Na}_2\text{Li}_2(\text{SO}_4)_2 + 5\text{H}_2\text{O}$ . (Rammelsberg.)  
Do not exist. (Troost.)  
 $\text{Li}_2\text{SO}_4, \text{Na}_2\text{SO}_4 + 5.5\text{H}_2\text{O}$ . Exists from  $0^\circ$ – $16^\circ$ .  
+  $3\text{H}_2\text{O}$ . Exists from  $32^\circ$ – $100^\circ$ .  
 $\text{Li}_2\text{SO}_4, 3\text{Na}_2\text{SO}_4 + 12\text{H}_2\text{O}$ . Exists from  $16^\circ$ – $24^\circ$ .  
 $4\text{Li}_2\text{SO}_4, \text{Na}_2\text{SO}_4 + 5\text{H}_2\text{O}$ . Exists from  $24^\circ$ – $32^\circ$ .  
(Spielrein, C. R. 1913, **157**, 47.)

Lithium thallic sulphate,  $\text{LiTl}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .

(Meyer and Goldschmidt, C. C. 1903, **1**, 495.)

**Lithium titanium sulphate,**

Less hygroscopic than K compound.  
(Mazzuchelli and Pontanelli, C. C. 1909, II. 420.)

**Lithium uranyl sulphate,  $\text{Li}_2\text{SO}_4 \cdot \text{UO}_2\text{SO}_4 + 4\text{H}_2\text{O}.$** 

(de Coninck, Chem. Soc. 1905, 88. (2) 530.)

**Magnesium sulphate basic,**

Sl. sol. in cold or hot  $\text{H}_2\text{O}.$

Sol. in  $\text{HCl} + \text{Aq.}$  (Thugutt, Z. anorg. 1892, 2. 150.)

**Magnesium sulphate,  $\text{MgSO}_4.$** 

*Anhydrous.* Very slowly sol. in  $\text{H}_2\text{O}.$  sol. in hot conc.  $\text{H}_2\text{SO}_4$ , less in  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq.}$

$+ \text{H}_2\text{O}.$  Min. *Kieserite.* Easily sol. in warm, but slowly dissolved by cold  $\text{H}_2\text{O}.$

100 g. sat. solution at  $83^\circ$  contain 40.2 g.  $\text{MgSO}_4.$  (Geiger, Dissert. 1904.)

$+ 6\text{H}_2\text{O}.$  and  $+ 7\text{H}_2\text{O}.$  The latter exists in two modifications; (a) hexagonal, and (b) the ordinary or rhombic salt.

$\text{MgSO}_4 + \text{Aq.}$  which on cooling or keeping in closed vessels has deposited  $\text{MgSO}_4 + 6\text{H}_2\text{O}.$  always contains for 100 pts.  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$20^\circ$
40.75	42.23	43.87 pts. $\text{MgSO}_4.$

If only hexagonal  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  has been deposited, then the mother liquor contains for 100 pts.  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$20^\circ$
34.67	38.71	42.84 pts. $\text{MgSO}_4.$

Solutions prepared from rhombic  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  contain for 100 pts.  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$20^\circ$
26.0	30.9	35.6 pts. $\text{MgSO}_4.$
(Löwel.)		

These results may be given in tabular form as follows:

Temp.	A sat. aqueous solution of $\text{MgSO}_4 + 7\text{H}_2\text{O}$ (b) contains for 100 pts. $\text{H}_2\text{O}$	
	Anhydrous $\text{MgSO}_4$	$7\text{H}_2\text{O}$ (b) salt
$0^\circ$	26.0	73.31
$10^\circ$	30.9	93.75
$20^\circ$	35.6	116.54

Temp.	A sat. aqueous solution of $\text{MgSO}_4 + 7\text{H}_2\text{O}$ (a) contains for 100 pts. $\text{H}_2\text{O}$	
	Anhydrous $\text{MgSO}_4$	$7\text{H}_2\text{O}$ (a) salt
$0^\circ$	34.67	111.74
$10^\circ$	38.71	133.67
$20^\circ$	42.84	159.61

Temp.	A sat aqueous solution of $\text{MgSO}_4 + 6\text{H}_2\text{O}$ contains for 100 pts. $\text{H}_2\text{O}$		
	Anhydrous $\text{MgSO}_4$	$6\text{H}_2\text{O}$ salt	$7\text{H}_2\text{O}$ salt
$0^\circ$	40.75	122.22	146.02
$10^\circ$	42.32	129.44	155.53
$20^\circ$	43.87	137.72	167.97

It is seen from table that at the same temp. the  $6\text{H}_2\text{O}$  salt is more sol. than the  $7\text{H}_2\text{O}$  (b) salt, and the latter is more sol. than  $7\text{H}_2\text{O}$  (a) salt; that the solubility of the  $7\text{H}_2\text{O}$  (b) salt increases rapidly from  $0^\circ$  to  $20^\circ$ ; that the  $6\text{H}_2\text{O}$  salt is not much more sol. at  $20^\circ$  than at  $0^\circ$ , and at  $20^\circ$  the  $7\text{H}_2\text{O}$  (b) salt is nearly as sol. as the  $6\text{H}_2\text{O}$  salt. (Löwel, A. ch. (3) 43. 405.)

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts.  $\text{MgSO}_4.$  G L = according to Gay-Lussac (A. ch. (2) 11. 311); T = according to Tobler (A. 98. 198).

$t^\circ$	G L	T	$t^\circ$	G L	T
0	25.8	24.7	50	49.7	..
10	30.5	..	55	..	52.4
20	35.0	..	60	55.9	..
25	..	37.1	70	60.4	..
30	39.8	..	80	65.1	..
40	45.2	..	90	70.3	..

100 pts.  $\text{H}_2\text{O}$  at  $105.5^\circ$  dissolve 135.2 pts.  $\text{MgSO}_4.$  (Griffiths.)

$\text{MgSO}_4 + \text{Aq}$  sat. at  $17.5^\circ$  has sp. gr. = 1.2932, and contains 55.57 %  $\text{MgSO}_4 + 7\text{H}_2\text{O}.$  or 100 pts.  $\text{H}_2\text{O}$  dissolve 125.06 pts.  $\text{MgSO}_4 + 7\text{H}_2\text{O}.$  or 60 pts.  $\text{MgSO}_4$  at  $17.5^\circ.$  (Karsten.)

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 53.8 pts., and 125 pts. at ord. temp. (Otto-Graham.)

Sol. in 2 pts. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}.$  (Fourcroy.)

The aqueous solution contains for 100 pts.  $\text{H}_2\text{O}$  92.217 pts.  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  at  $15^\circ.$  (Michel and Kraft.)

1 pt.  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  is sol. in 0.933 pt.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach); in 0.92 pt.  $\text{H}_2\text{O}$  at  $23^\circ$  (Schiff.)

100 pts.  $\text{H}_2\text{O}$  dissolve 28.067 pts.  $\text{MgSO}_4$  at  $0^\circ.$  (Piaff, A. 99. 224.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{MgSO}_4$  at  $t^\circ.$

$t^\circ$	Pts. $\text{MgSO}_4$
0	26.37
17.9	33.28
24.1	35.98

(Diacon, J. B. 1886. 62.)

100 pts.  $\text{MgSO}_4 + \text{Aq}$  sat. at  $18-20^\circ$  contain 25.67-26.38 pts.  $\text{MgSO}_4.$  (v. Hauer, J. pr. 98. 137.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ , using  $MgSO_4 + 7H_2O$ .

$t^\circ$	Pts. $MgSO_4$	$t^\circ$	Pts. $MgSO_4$	$t^\circ$	Pts. $MgSO_4$
0	26.9	37	44.2	74	61.4
1	27.4	38	44.7	75	61.9
2	27.9	39	45.2	76	62.3
3	28.3	40	45.6	77	62.8
4	28.8	41	46.1	78	63.2
5	29.3	42	46.5	79	63.7
6	29.7	43	47.0	80	64.2
7	30.2	44	47.5	81	64.6
8	30.6	45	48.0	82	65.1
9	31.1	46	48.4	83	65.6
10	31.5	47	48.9	84	66.0
11	32.0	48	49.3	85	66.5
12	32.4	49	49.8	86	67.0
13	32.9	50	50.3	87	67.5
14	33.4	51	50.7	88	68.0
15	33.8	52	51.2	89	68.4
16	34.3	53	51.7	90	68.9
17	34.7	54	52.2	91	69.4
18	35.2	55	52.7	92	69.9
19	35.7	56	53.2	93	70.4
20	36.2	57	53.6	94	70.9
21	36.7	58	54.1	95	71.4
22	37.1	59	54.5	96	71.9
23	37.6	60	55.0	97	72.4
24	38.0	61	55.5	98	72.8
25	38.5	62	55.9	99	73.3
26	39.0	63	56.4	100	73.8
27	39.5	64	56.8	101	74.3
28	39.9	65	57.3	102	74.8
29	40.4	66	57.7	103	75.2
30	40.9	67	58.2	104	75.7
31	41.4	68	58.6	105	76.2
32	41.8	69	59.1	106	76.7
33	42.3	70	59.6	107	77.2
34	42.8	71	60.0	108	77.7
35	43.3	72	60.5	108.4	77.9
36	43.7	73	61.0	...	...

(Mulder, calculated from his own and other observations, Scheik. Verhandel. 1864. 52).

100 pts.  $H_2O$  dissolve 72.4 pts.  $MgSO_4 + 7H_2O$  at  $0^\circ$ , 178 pts. at  $40^\circ$ ; and 212.6 pts. at  $49^\circ$ . (Tilden, Chem. Soc. 45. 409.)

Supersat.  $MgSO_4 + Aq$  is brought to crystallisation by addition of crystal of  $MgSO_4 + 7H_2O$ , or an isomorphous substance as  $ZnSO_4 + 7H_2O$ ,  $NiSO_4 + 7H_2O$ ,  $FeSO_4 + 7H_2O$ , or  $CoSO_4 + 7H_2O$ . (Thomson, Chem. Soc. 35. 199.)

Sat.  $MgSO_4 + Aq$  contains at:

$2^\circ$      $7^\circ$      $23^\circ$      $67^\circ$      $81^\circ$   
20.9   22.5   26.0   35.6   38.6%  $MgSO_4$ ,

$94^\circ$      $130^\circ$      $145^\circ$      $164^\circ$      $188^\circ$   
41.5   45.3   38.0   29.3   20.4%  $MgSO_4$ .

Readily forms supersat. solutions.

(Étard, A. ch. 1894, (7) 2. 551.)

M.-pt. of  $MgSO_4 + 7H_2O$  is  $70^\circ$ . (Tilden, Chem. Soc. 45. 409.)

$MgSO_4 + Aq$  with sp. gr. 1.50 contains 44.4 %  $MgSO_4$ ; sp. gr. 1.42, 39%; sp. gr. 1.30, 30%  $MgSO_4$ . (Dalton.)

Sp. gr. of  $MgSO_4 + Aq$  sat. at  $15^\circ = 1.275$  (Michel and Kraft); at  $8^\circ = 1.267$  (Anthon); at  $18.75^\circ = 1.293$  (Karsten.).

Sp. gr. of  $MgSO_4 + Aq$  at  $15^\circ$ .

% $MgSO_4$	Sp. gr.	% $MgSO_4$	Sp. gr.
5	1.054	30	1.326
10	1.108	35	1.384
15	1.161	40	1.446
20	1.215	45	1.511
25	1.269	50	1.580

(Calculated from Anthon by Schiff, A. 107. 303.)

Sp. gr. of  $MgSO_4 + Aq$  at  $23^\circ$ .

% $MgSO_4 + 7H_2O$	Sp. gr.	% $MgSO_4 + 7H_2O$	Sp. gr.
1	1.0048	28	1.1426
2	1.0096	29	1.1481
3	1.0144	30	1.1536
4	1.0193	31	1.1592
5	1.0242	32	1.1648
6	1.0290	33	1.1704
7	1.0339	34	1.1760
8	1.0387	35	1.1817
9	1.0437	36	1.1875
10	1.0487	37	1.1933
11	1.0537	38	1.1991
12	1.0587	39	1.2049
13	1.0637	40	1.2108
14	1.0688	41	1.2168
15	1.0739	42	1.2228
16	1.0790	43	1.2288
17	1.0842	44	1.2349
18	1.0894	45	1.2410
19	1.0945	46	1.2472
20	1.0997	47	1.2534
21	1.1050	48	1.2596
22	1.1103	49	1.2659
23	1.1156	50	1.2722
24	1.2109	51	1.2786
25	1.1261	52	1.2850
26	1.1316	53	1.2915
27	1.1371	54	1.2980

(Schiff, A. 113. 185.)



Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $12^\circ$ .

% $\text{MgSO}_4 + 7\text{H}_2\text{O}$	Sp. gr.	% $\text{MgSO}_4 + 7\text{H}_2\text{O}$	Sp. gr.
1	1.0046	21	1.1071
2	1.0096	22	1.1125
3	1.0146	23	1.1179
4	1.0196	24	1.1234
5	1.0246	25	1.1289
6	1.0296	26	1.1344
7	1.0346	27	1.1399
8	1.0396	28	1.1454
9	1.0446	29	1.1510
10	1.0497	30	1.1566
11	1.0548	31	1.1622
12	1.0599	32	1.1679
13	1.0650	33	1.1736
14	1.0702	34	1.1793
15	1.0754	35	1.1850
16	1.0807	36	1.1908
17	1.0859	37	1.1965
18	1.0911	38	1.2023
19	1.0964	39	1.2082
20	1.1018	40	1.2140

(Oudemans, Z. anal. 7. 419.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $15^\circ$ .

% $\text{MgSO}_4$	Sp. gr.	% $\text{MgSO}_4$	Sp. gr.
1	1.01031	14	1.15083
2	1.02062	15	1.16222
3	1.03092	16	1.17420
4	1.04123	17	1.18618
5	1.05154	18	1.19816
6	1.06229	19	1.21014
7	1.07304	20	1.22212
8	1.08379	21	1.23465
9	1.09454	22	1.24718
10	1.10529	23	1.25972
11	1.11668	24	1.27225
12	1.12806	25	1.28478
13	1.13945	25.248	1.28802

(Gerlach, Z. anal. 8. 287.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $23.5^\circ$ . a=no. of  $\frac{1}{2}$  mols. in grms. dissolved in 1000 g.  $\text{H}_2\text{O}$ ; b=sp. gr. if a is  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt.=123; c=sp. gr. if a is  $\text{MgSO}_4$ ,  $\frac{1}{2}$  mol. wt.=60.

a	b	c	a	b	c
1	1.056	1.059	5	1.203	1.260
2	1.103	1.114	6	1.229	...
3	1.141	1.166	7	1.252	...
4	1.174	1.214	8	1.273	...

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $15^\circ$ .

% $\text{MgSO}_4$	Sp. gr.	% $\text{MgSO}_4$	Sp. gr.
5	1.0510	20	1.2200
10	1.1052	25	1.2861
15	1.1602	...	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $0^\circ$ . S=pts.  $\text{MgSO}_4$  in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
13.800	1.1586	7.4046	1.0826
11.7458	1.1329	5.0447	1.0557
9.6218	1.1072	2.5907	1.0284

(Charpy, A. ch. (6) 29. 26.)

Sat.  $\text{MgSO}_4 + \text{Aq}$  boils at  $105^\circ$  (Griffiths);  $108.4^\circ$  (Mulder).

Crust forms at  $103.5^\circ$  (solution containing 48.4 pts.  $\text{MgSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ ); highest temp. observed,  $105^\circ$ . (Gerlach, Z. anal. 26. 426.)

B.-pt. of  $\text{MgSO}_4 + \text{Aq}$  containing pts.  $\text{MgSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{MgSO}_4$	B.-pt.	Pts. $\text{MgSO}_4$	B.-pt.	Pts. $\text{MgSO}_4$
100.5°	8.8	102.5°	34.7	104.5°	51.3
101.0	16.7	103.0	39.5	105	54.6
101.5	23.5	103.5	43.8	108	75(?)
102.0	29.5	104.0	47.7	...	...

(Gerlach, Z. anal. 26. 432.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $9.5^\circ$ .

Mass of salt per unit mass of solution	Density of solution (g. per cc.)
0.00191	1.00170
0.00380	1.00346
0.00569	1.00526
0.00758	1.00705
0.01132	1.01060

(McGregor, C. N. 1887, 55.6.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{MgSO}_4 + \text{Aq}$	Sp. gr.
1—normal	1.0584
$\frac{1}{2}$ " "	1.0297
$\frac{1}{3}$ " "	1.0152
$\frac{1}{4}$ " "	1.0076

(Wagner, Z. phys. Ch. 1890, 5. 38.)

Sp. gr. at  $16^\circ/4^\circ$  of  $\text{MgSO}_4 + \text{Aq}$  containing 11.022%  $\text{MgSO}_4 = 1.11471$ ; containing 8.343%  $\text{MgSO}_4 = 1.06558$ . (Schönrock, Z. phys. Ch. 1893, 11. 782.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq.}$ 

G.-equivalents $\text{MgSO}_4$ per liter	$t^\circ$	Sp. gr. $t^\circ/t^\circ$
0.002548	17.989	1.0001625
0.005093	18.020	1.000324
0.01015	17.995	1.000639
0.02023	17.980	1.001274
0.05023	18.047	1.003117
0.09950	18.033	1.006122
0.19773	18.014	1.012035
0.29459	17.997	1.017806
0.48671	17.994	1.029101
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0.5022	17.90	1.03000
5.0220	17.95	1.26970
<hr/>		
0.002616	14.096	1.0001672
0.005230	14.109	1.0003311
0.01042	14.098	1.000659
0.02077	14.092	1.001306
0.12462	14.199	1.007682
0.24567	14.092	1.014980

(Kohlrausch, W. Ann. 1894, 53. 27.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq.}$ 

$\frac{1}{2}$ $\text{MgSO}_4$ g. in 1000 g. of solution	Sp. gr. $16^\circ/16^\circ$
0	1.000000
0.5368	1.000570
1.0917	1.001157
"	1.001141
2.1076	1.002234
4.1367	1.004372
9.0608	1.009523
18.0846	1.018954
37.1342	1.038983
52.1362	1.054867

(Dijken, Z. phys. Ch. 1897; 24. 108.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $18.2^\circ$ , when  $p$  = per cent strength of the solution;  $d$  = observed density; and  $w$  = volume conc. in grams per cc.  $\left(\frac{pd}{100} = w.\right)$

$p$	$d$	$w$
26.25	1.2903	1.3374
25.91	1.2860	1.3319
24.53	1.2693	1.3101
21.60	1.2330	1.2650
18.41	1.1950	1.2187
13.79	1.1423	1.1562
12.63	1.1291	1.1413
11.29	1.1147	1.1246
8.08	1.0803	1.0859
2.01	1.0204	1.0191

(Barnes, J. phys. Chem. 1898, 2. 542.)

Sp. gr. of  $\text{MgSO}_4 + \text{Aq}$  at  $20^\circ$ .

Normality of $\text{MgSO}_4 + \text{Aq}$	% $\text{MgSO}_4$	Sp. gr.
2.73	25.46	1.2879
1.86	18.61	1.2019
0.934	10.14	1.1049

(Forchheimer, Z. phys. Ch. 1900, 34. 24.)

Sp. gr. of dil.  $\text{MgSO}_4 + \text{Aq}$  at  $20.004^\circ$ .  
Conc. = g. equiv. per l. at  $20.004^\circ$ .  
Sp. gr. compared with  $\text{H}_2\text{O}$  at  $20.004^\circ = 1$ .

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,006,4
0.0002	1.000,012,9
0.0003	1.000,019,4
0.0004	1.000,025,9
0.0005	1.000,032,4
0.0010	1.000,064,8
0.0020	1.000,129,4
0.0050	1.000,322,4
0.0100	1.000,642,1

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35. 1684.)

More sol. in  $\text{HCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Rich-ter.)

In sat.  $\text{HCl} + \text{Aq}$ , anhydrous  $\text{MgSO}_4$  is scarcely sol.;  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  dissolves, but is precipitated by a current of  $\text{HCl}$  gas. (Hengen, B. 10. 259.)

Margueritte (C. R. 43. 50) denies the precipitation.

For solubility in  $\text{H}_2\text{SO}_4$ , see  $\text{MgH}_2(\text{SO}_4)_2$ .

Completely pptd. from  $\text{MgSO}_4 + \text{Aq}$  by conc.  $\text{H}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Persoz.)

Somewhat sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$  with separation of a double sulphate.

Rapidly sol. in  $\text{KCl} + \text{Aq}$  with separation of  $\text{K}_2\text{SO}_4$ .

Sol. in sat.  $\text{NaCl} + \text{Aq}$  without pptn. of the latter.

Easily sol. in sat.  $\text{KNO}_3 + \text{Aq}$  without causing any pptn.

Sol. in sat.  $\text{NaNO}_3 + \text{Aq}$ . (Karsten.)

Rapidly sol. in sat.  $\text{CuSO}_4 + \text{Aq}$ ; when saturation is reached, a double salt separates out. (Karsten.)

100 pts. sat.  $\text{MgSO}_4 + \text{NiSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 30.93 pts. of the two salts; 100 pts. sat.  $\text{MgSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 35.45 pts.; 100 pts. sat.  $\text{MgSO}_4 + \text{NiSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 35.62 pts. (v. Hauer, J. pr. 98. 137.)

100 pts.  $\text{H}_2\text{O}$  dissolve 14.1 pts.  $\text{MgSO}_4$  and 9.8 pts.  $\text{K}_2\text{SO}_4$ , if sat.  $\text{MgSO}_4 + \text{Aq}$  is sat. with  $\text{K}_2\text{SO}_4$ ; 32.4 pts.  $\text{MgSO}_4$  and 8.2 pts.  $\text{K}_2\text{SO}_4$ , if sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$  is sat. with  $\text{MgSO}_4$ , all at  $15^\circ$ . (Mulder, J. B. 1866.)

100 pts.  $\text{H}_2\text{O}$  dissolve 25.95 pts.  $\text{MgSO}_4$  and 5.21 pts.  $\text{Na}_2\text{SO}_4$  at  $0^\circ$ . (Diacon, J. B. 1866. 62.)

100 pts.  $H_2O$  dissolve 15.306 pts.  $MgSO_4$  and 13.086 pts.  $Na_2SO_4$  at  $0^\circ$ . (Pfaff, A. 99. 224.)

See also under  $MgNa_2(SO_4)_2 + 4H_2O$ .

Solubility of mixtures of  $MgSO_4$  and  $MgNa_2(SO_4)_2 + 4H_2O$  at  $t^\circ$ .

$t^\circ$	g. per 100 g. $H_2O$	
	$Na_2SO_4$	$MgSO_4$
22	23.3	31.4
24.5	27.2	24.2
30	36.1	19.1
35	33.9	18.44

(Roozeboom, 1888, Z. phys. Ch. 2. 518.)

See also under  $MgNa_2(SO_4)_2 + 4H_2O$ .

Slowly sol. in sat.  $ZnSO_4 + Aq$  without pptn. until saturation, when a double salt separates out.

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 828.)

100 pts. dil. alcohol containing at  $15^\circ$ :

10 20 40 % alcohol  
contain 39.3 21.3 1.62%  $MgSO_4 + 7H_2O$ .  
(Schiff, A. 118. 365.)

At higher temp. the solubility increases proportional to the temp. (Gerardin, A. ch. (4) 5. 145.)

100 pts. absolute methyl alcohol dissolve 1.18 pts.  $MgSO_4$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10. 783.)

100 pts. absolute methyl alcohol dissolve 41 pts.  $MgSO_4 + 7H_2O$  at  $17^\circ$ ; 100 pts. absolute methyl alcohol dissolve 29 pts.  $MgSO_4 + 7H_2O$  at  $3-4^\circ$ ; 100 pts. 93% methyl alcohol dissolve 9.7 pts.  $MgSO_4 + 7H_2O$  at  $17^\circ$ ; 100 pts. 50% methyl alcohol dissolve 4.1 pts.  $MgSO_4 + 7H_2O$  at  $3-4^\circ$ . (de Bruyn, R. t. c. 11. 112.)

100 pts. absolute ethyl alcohol dissolve 1.3 pts.  $MgSO_4 + 7H_2O$  at  $3^\circ$ . (de Bruyn.)

Insol. in  $CS_2$ . (Arcetowski, Z. anorg. 1894, 6. 257.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790.); ethyl acetate (Naumann, B. 1910, 43. 314.); acetone. (Naumann, B. 1904, 37. 4329.)

100 g. 95% formic acid dissolve 0.34 g.  $MgSO_4$  at  $19^\circ$ . (Aschan, Ch. Ztg. 1913, 37. 1117.)

100 g. sat. solution of  $MgSO_4$  and sugar in  $H_2O$  contains 46.52 g. sugar + 14.0 g.  $MgSO_4$ , or 100 g.  $H_2O$  dissolve 119.6 g. sugar + 36.0 g.  $MgSO_4$ . (Köhler, Z. Ver. Zuckerind., 1897, 47. 447.)

**Magnesium hydrogen sulphate,  $MgH_2(SO_4)_2$ .**

Decomp. by  $H_2O$ . Sol. in  $H_2SO_4$ . Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

$MgH_2(SO_4)_2$ . Boiling  $H_2SO_4$  dissolves about 2%  $MgSO_4$ , from which this compound crystallises. (Schultz, Pogg. 133. 137.)

**Magnesium pyrosulphate,  $MgS_2O_7$ .**

Decomp. by  $H_2O$ .

**Magnesium manganous sulphate,  $MgSO_4 \cdot 2MnSO_4 + 15H_2O$ .**

Min. *Fausserite*.

**Magnesium manganous zinc sulphate,  $MgSO_4 \cdot MnSO_4 \cdot ZnSO_4 + 21H_2O$ .**

Sol. in  $H_2O$ . (Vohl, A. 99. 124.)

**Magnesium nickel sulphate,  $MgSO_4 \cdot 3NiSO_4 + 28H_2O$ .**

Sol. in  $H_2O$ . (Schiff.)

**Magnesium nickel potassium sulphate,  $MgSO_4 \cdot NiSO_4 \cdot 2K_2SO_4 + 12H_2O$ .**

Sol. in  $H_2O$ . (Vohl, A. 94. 57.)

**Magnesium potassium sulphate,  $MgK_2(SO_4)_2 + 6H_2O$ .**

100 pts.  $H_2O$  dissolve 22.7 pts. anhydrous salt at  $16.5^\circ$ . (Mulder.)

100 pts.  $H_2O$  dissolve at:

$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$35^\circ$	
14.1	19.6	25.0	30.4	33.3	pts. anhydrous salt,
$45^\circ$	$55^\circ$	$60^\circ$	$65^\circ$	$75^\circ$	
40.5	47.0	50.2	53.0	59.8	pts. anhydrous salt.

(Tobler, A. 95. 193.)

100 g.  $H_2O$  dissolve 30.52 g.  $MgK_2(SO_4)_2 + 6H_2O$  at  $15^\circ$ . (Lothian, Pharm. J. 1909, 82. 292.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	Sat. solution contains		Mols. $K_2SO_4$ : mols. $MgSO_4$ in the solution	100 pts. $H_2O$ dissolve	
	% $K_2SO_4$	% $MgSO_4$		$K_2SO_4$	$MgSO_4$
10	9.4	9.8	1:1.52	11.63	12.13
20	10.9	10.8	1:1.43	13.92	13.79
30	12.4	11.8	1:1.38	16.36	15.56
40	13.8	13.1	1:1.37	18.88	17.92
50	14.7	14.8	1:1.46	20.85	20.99
60	15.2	16.3	1:1.55	22.19	23.79
70	15.6	16.8	1:1.52	23.07	24.85
80	16.0	17.1	1:1.56	23.91	25.56
80	16.6	18.1	1:1.58	25.42	27.72
90	17.2	18.2	1:1.54	26.62	28.17

(Precht, B. 1882, 16. 1668.)

Sp. gr. of aqueous solution at 15° containing:

2 4 6 8% hydrous salt,  
1.0129 1.0261 1.0394 1.053

10 12 14 16% hydrous salt,  
1.0668 1.0808 1.095 1.1094

18 20 22% hydrous salt.  
1.124 1.1388 1.1539

(Schiff, A. 113. 183, calculated by Gerlach,  
Z. anal. 8. 287.)

Sp. gr. of  $\text{MgK}_2(\text{SO}_4)_2 + \text{Aq}$  at 18°.

G-equiv. of salt per l.	Sp. gr.
1.0010	1.0633
0.8345	1.0531
0.6688	1.0427
0.3744	1.0243
0.0998	1.0040
0.02004	1.0015
0.01004	1.0004

These results lead the author to conclude that in dil. solutions the double salt is decomp. into its constituents. (McKay, *Elektrochem. Zeit.* 1899, 6. 115.)

Min. *Picromerite*.

+4H<sub>2</sub>O. (van der Heide, B. 26. 414.)

2MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>. Min. *Langbeinite*.

Deliquescent. Absorbs 56.26% H<sub>2</sub>O from air to form K<sub>2</sub>SO<sub>4</sub>, MgSO<sub>4</sub>+6H<sub>2</sub>O. (Mallet, *Chem. Soc.* 1900, 77. 220.)

4MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>+5H<sub>2</sub>O. (van't Hoff and Kassatkin, B. A. B. 1889. 951.)

**Magnesium potassium zinc sulphate**, MgSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Vohl, A. 94. 57.)

**Magnesium potassium sulphate chloride**, MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, MgCl<sub>2</sub>+6H<sub>2</sub>O.

Min. *Kainite*.

**Magnesium rubidium sulphate**, MgSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Tutton, *Chem. Soc.* 63. 337.)

1 l. H<sub>2</sub>O dissolves 202 g. anhydrous salt at 25°. (Locke, *Am. Ch. J.* 1902, 27. 459.)

2MgSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>. Deliquescent. (Mallet, *Chem. Soc.* 1900, 77. 223.)

**Magnesium sodium sulphate**, MgSO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>+4H<sub>2</sub>O.

Min. *Blödite*, *Simonyite*.

Blödite is efflorescent; Simonyite, deliquescent.

+5H<sub>2</sub>O. Min. *Löwile*.

+6H<sub>2</sub>O. Decomp. on air. Sol. in 3 pts. cold H<sub>2</sub>O.

Na<sub>2</sub>Mg(SO<sub>4</sub>)<sub>4</sub>. Min. *Vanthonite*. (van't Hoff, B. A. B. 1902. 414.)

MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O. Min. *Astrakanite*.

100 mols. H<sub>2</sub>O hold mols. salt in solution at t°.

t°	MgSO <sub>4</sub>	Na <sub>2</sub> SO <sub>4</sub>
22	4.70	2.95
24.5	3.68	3.45
30	3.60	3.60
35	3.69	3.69
47	3.60	3.60

(Rooseboom, R. t. c. 1887, 6. 333.)

Solubility of mixtures of MgNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O and Na<sub>2</sub>SO<sub>4</sub> at t°.

t°	g. per 100 g. H <sub>2</sub> O	
	Na <sub>2</sub> SO <sub>4</sub>	MgSO <sub>4</sub>
18.5	43.0	45.5
22	35.2	48.9
24.5	32.5	50.3
30	25.9	55.0
35	23.5	59.4

(Rooseboom, Z. phys. Ch. 1888, 2. 518.)

See also under MgSO<sub>4</sub>.

**Magnesium thallous sulphate**, MgSO<sub>4</sub>, Tl<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O, but decomp. by repeated re-crystallisations. (Werther.)

**Magnesium uranyl sulphate**,

MgSO<sub>4</sub>, (UO<sub>2</sub>)SO<sub>4</sub>+5H<sub>2</sub>O.

(de Coninck, *Chem. Soc.* 1905, 88. (2) 530.)

**Magnesium zinc sulphate**, MgSO<sub>4</sub>, ZnSO<sub>4</sub>+14H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Pierre, A. ch. (3) 16. 244.) +10H<sub>2</sub>O. (Pierre.)

3ZnSO<sub>4</sub>, 5MgSO<sub>4</sub>+56H<sub>2</sub>O. (Schiff.)

There are only two compounds, 2(MgSO<sub>4</sub>, 7H<sub>2</sub>O), ZnSO<sub>4</sub>, 7H<sub>2</sub>O and MgSO<sub>4</sub>, 7H<sub>2</sub>O, ZnSO<sub>4</sub>, 7H<sub>2</sub>O. (Hollmann, Z. phys. Ch. 1901, 37. 212, and 1902, 40. 577.)

**Magnesium sulphate potassium chloride**, MgSO<sub>4</sub>, KCl+3H<sub>2</sub>O or MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, MgCl<sub>2</sub>+6H<sub>2</sub>O.

Min. *Kainite*.

100 pts. H<sub>2</sub>O dissolve 79.56 pts. at 18°. (Krause, *Arch. Pharm.* (3) 6. 326.)

Not sol. in a mixture of abs. alcohol and ether, which dissolves out MgCl<sub>2</sub>. (Lehmann, J. B. 1867. 416.)

Alcohol dissolves out MgCl<sub>2</sub>, also little H<sub>2</sub>O. Much H<sub>2</sub>O dissolves completely. (Zincken, *Miner. Jahrb.* 1865. 310.)

**Magnesium sulphate potassium chromate**, 2MgSO<sub>4</sub>, K<sub>2</sub>CrO<sub>4</sub>+9H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Etard, C. R. 85. 443.)

**Manganous sulphate, basic,  $3\text{MnO}_4 \cdot 2\text{SO}_4 + 3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ , but slowly decomp. thereby. (Gorgeu, C. R. 94. 1425.)

**Manganous sulphate,  $\text{MnSO}_4$ .**

*Anhydrous.*

Absorbs  $\text{H}_2\text{O}$  from the air to form  $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ .

1 pt.  $\text{MnSO}_4$  is sol. in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{H}_2\text{O}$
6.25	1.77	18.75	1.667	75	1.494
10	1.631	37.5	1.457	101.25	2.081

Or—

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{MnSO}_4$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
6.25	56.49	18.75	60.00	75	66.95
10	61.29	37.5	68.63	101.25	49.33

(Brandes, Pogg. 20. 575.)

Sol. in 2.5 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$ ; at  $62.5^\circ$  it is difficult to dissolve 1 pt.  $\text{MnSO}_4$  in 3 pts.  $\text{H}_2\text{O}$ , but the sat. solution at  $62.5^\circ$  does not become cloudy on heating to  $100^\circ$ . (Jahn.)

100 pts.  $\text{MnSO}_4 + \text{Aq}$  sat. at  $11-14^\circ$  contain 37.5 pts.  $\text{MnSO}_4$ . (v. Hauer, J. pr. 103. 114.)

Sat.  $\text{MnSO}_4 + \text{Aq}$  contains at:

-8°	-5°	+5°	18°	22°	
30.0	31.0	34.1	38.3	38.2%	MnSO <sub>4</sub>
23°	32°	45°	52°	70°	
39.1	41.7	44.2	36.4	41.1%	MnSO <sub>4</sub>
83°	110°	115°	123°	130°	140°
36.3	18.4	21.5	16.7	13.6	9.4% MnSO <sub>4</sub>

(Étard, A. ch. 1894, (7) 2. 553.)

Solubility in  $\text{H}_2\text{O}$  increases from  $0-55^\circ$ , and decreases from  $55-145^\circ$ . The increasing solubility is that of  $\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$ , and  $\text{MnSO}_4 + 2\text{H}_2\text{O}$  separates out at  $35^\circ$ , and is completely insol. at  $145^\circ$ . (Étard.)

If solubility  $S = \text{pts. anhydrous } \text{MnSO}_4$  in 100 pts. solution,  $S = 30.0 + 0.2828t$  from  $-8^\circ$  to  $57^\circ$ ;  $S = 48.0 - 0.4585t$  from  $57^\circ$  to  $150^\circ$ .

Practically insol. in  $\text{H}_2\text{O}$  at  $180^\circ$ . (Étard, C. R. 106. 208.)

Solubility varies according to the hydrate used. Above results of Étard show the solubility of  $\text{MnSO}_4 \cdot 7\text{H}_2\text{O}$  at  $0^\circ$ , and  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  at  $57^\circ$ . Anhydrous  $\text{MnSO}_4$  is stable only above  $117^\circ$ . (Linebarger.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts. anhydrous  $\text{MnSO}_4$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
120	67.18	141	41.18	155	26.49
132	63.16	146	38.83	170	16.15

(Linebarger, Am. Ch. J. 15. 225.)

$+ \text{H}_2\text{O}$ . Stable only between  $57^\circ$  and  $117^\circ$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{MnSO}_4$  from  $\text{MnSO}_4 + \text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
48	87.98	78	79.13	115	69.78
53	86.10	90	75.63	117	68.81
65	84.33	100	71.27	...	...
72	82.73	106	70.14	...	...

(Linebarger.)

Min. *Szmitite*.

Solubility of  $\text{MnSO}_4 + \text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnSO}_4$ per 100 pts. $\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{MnSO}_4$ per 100 pts. $\text{H}_2\text{O}$
41.5	61.06	75	49.45
50.1	58.01	84.8	44.87
67.1	51.37	95	38.71
...	...	99.6	34.27

Av. of varying results.

(Cottrell, J. phys. Ch. 1900, 4. 652.)

Linebarger's determinations are inaccurate. (Cottrell.)

$+ 2\text{H}_2\text{O}$ . Stable between  $40^\circ$  and  $57^\circ$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{MnSO}_4$  from  $\text{MnSO}_4 + 2\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
35	68.88	42	77.63	50	83.16
40	75.31	45	80.07	55	86.27

(Linebarger.)

$+ 3\text{H}_2\text{O}$ . Stable between  $30^\circ$  and  $40^\circ$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{MnSO}_4$  from  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$	$t^\circ$	Pts. $\text{MnSO}_4$
5	54.68	25	66.85	68	71.89
12	60.56	30	67.38	53	72.81
16	63.41	35	68.31	57	73.17
19	65.12	40	70.63	..	...

(Linebarger.)

$+ 4\text{H}_2\text{O}$ . Sl. efflorescent. Less sol. in boiling than in cold  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  at  $4.4^\circ$  dissolve 31 pts.  $\text{MnSO}_4 + 4\text{H}_2\text{O}$ . (Jahn.)

100 pts.  $H_2O$  at  $t^\circ$  dissolve pts.  $MnSO_4 + 4H_2O$ .

$t^\circ$	Pts. $MnSO_4 + 4H_2O$	$t^\circ$	Pts. $MnSO_4 + 4H_2O$
6.25	113.22	37.5	149
10	123	75	144
18.75	122	101.25	93

(Brandes, Pogg. 30. 575.)

Solubility of  $MnSO_4$  in 100 pts.  $H_2O$  at  $t^\circ$ , using  $MnSO_4 + 4H_2O$ .

$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$
0	55.4	35	71.9	70	61.5
1	55.9	36	72.2	71	61.5
2	56.5	37	72.4	72	61.5
3	57.1	38	72.7	73	61.5
4	57.7	39	72.9	74	61.5
5	58.2	40	73.1	75	61.5
6	58.8	41	73.3	76	61.5
7	59.4	42	73.5	77	61.5
8	60.0	43	73.7	78	61.5
9	60.5	44	73.9	79	61.5
10	61.1	45	74.0	80	61.5
11	61.7	46	74.2	81	61.5
12	62.2	47	74.4	82	61.5
13	62.7	48	74.6	83	61.5
14	63.3	49	74.7	84	61.4
15	63.8	50	74.8	85	61.3
16	64.3	51	74.9	86	61.2
17	64.8	52	75.1	87	61.0
18	65.3	53	75.2	88	60.8
19	65.8	54	75.3	89	60.6
20	66.3	55	74.7	90	60.3
21	66.7	56	74.0	91	60.0
22	67.2	57	72.9	92	59.6
23	67.6	58	71.5	93	59.2
24	68.1	59	69.5	94	58.6
25	68.5	60	65.9	95	57.9
26	68.9	...	...	96	57.2
27	69.3	63.5	61.3	97	56.3
28	69.7	64	61.5	98	55.4
29	70.0	65	61.5	99	54.3
30	70.4	66	61.5	100	52.9
31	70.7	67	61.5	101	51.2
32	71.0	68	61.5	102	49.3
33	71.3	69	61.5	102.5	47.4
34	71.6	...	...	...	...

(Mulder, Scheik. Verhandel. 1864. 137.)

100 pts.  $H_2O$  dissolve pts.  $MnSO_4$  from  $MnSO_4 + 4H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$
2.2	57.88	25	72.23	48	84.33
7.3	61.78	30	74.67	52	86.16
11	64.01	35.5	78.81	56	88.19
15	67.12	40	79.63	..	...
20	69.93	45	83.06	..	...

(Linebarger.)

Stable in aqueous solution between  $25^\circ$  and  $31^\circ$ . (Schieber, M. 1898, 19. 281.)Solubility of  $MnSO_4 + 4H_2O$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$ per 100 pts. $H_2O$	$t^\circ$	Pts. $MnSO_4$ per 100 pts. $H_2O$
16.0	63.97	35.0	67.87
17.7	64.16	35.5	68.09
18.5	64.19	39.9	68.81
25.0	65.32	49.9	72.48
30.0	66.43	50.0	72.62
32.2	66.83	...	...

(Cottrell, J. phys. Ch. 1900, 4. 651.)

Linebarger's determinations are inaccurate. (Cottrell.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	g. $MnSO_4$ for 100 g. $H_2O$
30.15	66.38
35	68.22

(Richards and Fraprie, Am. Ch. J. 1901, 26. 77.)

+  $5H_2O$ . Sol. in 1 pt.  $H_2O$  at  $18.75^\circ$ . (Jahn, A. 23. 110.)Stable from  $8^\circ$  to  $18^\circ$ .100 pts.  $H_2O$  dissolve pts.  $MnSO_4$  from  $MnSO_4 + 5H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$
0	58.05	20	75.16	40	84.63
2.5	62.41	25	78.63	42	85.27
4	64.22	30	79.16	45	86.16
7	66.83	32	80.38	47.7	86.95
10	68.05	34	82.04	53	88.89
15	72.33	37	83.91	54	89.08

(Linebarger.)

Stable in aqueous solution between  $15^\circ$  and  $20^\circ$ . (Schieber, M. 1898, 19. 281.)Solubility of  $MnSO_4 + 5H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$ per 100 pts. $H_2O$	$t^\circ$	Pts. $MnSO_4$ per 100 pts. $H_2O$
5	58.06	16	61.59
9	59.23	25	64.78
12	60.19	30	67.76
12.3	60.16	31.1	67.92
15	61.08	35.5	71.61

(Cottrell, J. phys. Ch. 1900, 4. 651.)

Linebarger's determinations are inaccurate. (Cottrell.)

Solubility in  $H_2O$  at  $25^\circ = 65.09$  g.  $MnSO_4$  for 100 g.  $H_2O$ . (Richards and Fraprie, Am. Ch. J. 1901, 26. 77.)

+ $6H_2O$ . Stable from  $-5^\circ$  to  $+8^\circ$ .

100 pts.  $H_2O$  dissolve pts.  $MnSO_4$  from  $MnSO_4 + 6H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$
-4	55.87	9	70.88	30	76.24
0	64.21	15	72.45	34	77.02
3	66.87	20	74.35	35	77.23
5	67.49	25	75.38	38	7.481

(Linebarger.)

+ $7H_2O$ . Efflorescent.

Sol. in less than 0.5 pt.  $H_2O$  at  $18.75^\circ$ . (Jahn.)

Stable between  $-10^\circ$  and  $-5^\circ$ .

100 pts.  $H_2O$  dissolve pts.  $MnSO_4$  from  $MnSO_4 + 7H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$	$t^\circ$	Pts. $MnSO_4$
-10	50.11	0	53.61	10	59.91
-8	50.93	5	54.83	15	64.34
-5	51.53	7	56.62	..	..

(Linebarger.)

Stable in aqueous solution below  $0^\circ$ . (Schieber, M. 1898, 19. 281.)

Solubility of  $MnSO_4 + 7H_2O$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $MnSO_4$ per 100 pts. $H_2O$	$t^\circ$	Pts. $MnSO_4$ per 100 pts. $H_2O$
-10	47.96	9	59.33
0	56.23	12	61.78
5	56.38	14.3	63.93

(Cottrell, l. c.)

M.-pt. of  $MnSO_4 + 7H_2O$  is  $54^\circ$ . (Tilden, Chem. Soc. 45. 409.)

Sp. gr. of  $MnSO_4 + Aq$  at  $15^\circ$ .

% $MnSO_4 + 4H_2O$	Sp. gr.	% $MnSO_4 + 4H_2O$	Sp. gr.
1	1.006	29	1.208
2	1.013	30	1.2150
3	1.020	31	1.224
4	1.025	32	1.231
5	1.0320	33	1.244
6	1.038	34	1.250
7	1.044	35	1.2579
8	1.050	36	1.268
9	1.056	37	1.276
10	1.0650	38	1.285
11	1.072	39	1.295
12	1.079	40	1.3038
13	1.085	41	1.313
14	1.093	42	1.322
15	1.1001	43	1.331
16	1.106	44	1.340
17	1.114	45	1.3495
18	1.121	46	1.360
19	1.129	47	1.370
20	1.1363	48	1.380
21	1.144	49	1.389
22	1.150	50	1.3986
23	1.160	51	1.410
24	1.166	52	1.420
25	1.1751	53	1.430
26	1.183	54	1.440
27	1.190	55	1.4514
28	1.200	..	..

(Gerlach, Z. anal. & 288.)

Sp. gr. of  $MnSO_4 + Aq$  at  $23^\circ$ . a=no. of  $\frac{1}{2}$  mols. in grms. dissolved in 1000 g.  $H_2O$ ; b=sp. gr. if a is  $MnSO_4 + 5H_2O$ ,  $\frac{1}{2}$  mol. wt.=120.5; c=sp. gr. if a is  $MnSO_4$ ,  $\frac{1}{2}$  mol. wt.=75.5.

a	b	c	a	b	c
1	1.068	1.071	6	1.306	3.576
2	1.128	1.139	7	1.341	1.429
3	1.181	1.202	8	1.371	...
4	1.227	1.262	9	1.399	...
5	1.269	1.320	10	1.426	...

(Favre and Valson, C. R. 79. 968.)

Above table recalculated by Gerlach (Z. anal. 28. 475.)

% $MnSO_4 + 5H_2O$	Sp. gr.	% $MnSO_4 + 5H_2O$	Sp. gr.
10	1.0630	40	1.2900
20	1.1325	50	1.3800
30	1.2070	...	...

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at  $15^\circ$ . a = %; b = sp. gr. if a is  $\text{MnSO}_4$ ; c = sp. gr. if a is  $\text{MnSO}_4 + 4\text{H}_2\text{O}$ ; d = sp. gr. if a is  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ ; e = sp. gr. if a is  $\text{MnSO}_4 + 7\text{H}_2\text{O}$ .

a	b	c	d	e
5	1.0500	1.0340	1.0310	1.0270
10	1.1035	1.0690	1.0630	1.0545
15	1.1605	1.1055	1.0965	1.0830
20	1.2215	1.1435	1.1315	1.1130
25	1.2870	1.1835	1.1685	1.1440
30	1.3575	1.2255	1.2070	1.1765
35	...	1.2695	1.2470	1.2105
40	...	1.3155	1.2885	1.2455
45	...	1.3640	1.3315	1.2815
50	...	...	1.3760	1.3185
55	...	...	...	1.3565

(Gerlach, Z. anal. 28. 475.)

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at  $0^\circ$ . S = pts.  $\text{MnSO}_4$  in 100 pts. solution.

S	Sp. gr.	S	Sp. gr.
16.7450	1.1834	8.8295	1.0928
14.0462	1.1519	6.0172	1.0622
11.5804	1.1239	3.0865	1.0315

(Charpy, A. ch. (6) 29. 26.)

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at room temp. containing:

11.45	18.8	22.08	% $\text{MnSO}_4$ .
1.1469	1.2513	1.3062	

(Wagner, W. Ann. 1883, 18. 271.)

Sp. gr. of  $\text{MnSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{MnSO}_4 + \text{Aq}$	Sp. gr.
1—normal	1.0728
$\frac{1}{5}$ —"	1.0365
$\frac{1}{10}$ —"	1.0179
$\frac{1}{15}$ —"	1.0087
$\frac{1}{18}$ —"	1.0041

(Wagner, Z. phys. Ch. 1890, 5. 39.)

Sp. gr. at  $16^\circ/4'$  of  $\text{MnSO}_4 + \text{Aq}$  containing 30.819%  $\text{MnSO}_4 = 1.36267$ . (Schönrock, Z. phys. Ch. 1893, 11, 781.)

Sat.  $\text{MnSO}_4 + \text{Aq}$  boils at  $102.4^\circ$ ; crust forms at  $101.6^\circ$ , and solution contains 48.7 pts.  $\text{MnSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt. of  $\text{MnSO}_4 + \text{Aq}$  containing pts.  $\text{MnSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{MnSO}_4$	B.-pt.	Pts. $\text{MnSO}_4$
100.5°	17.1	102.0°	58.9
101.0	32.1	102.4	68.4
101.5	46.2	...	...

(Gerlach, Z. anal. 26. 434.)

Sol. in about 20 pts. boiling  $\text{H}_2\text{SO}_4$ , and more sol. in boiling  $\text{H}_2\text{SO}_4 + \text{Aq}$  of 1.6 sp. gr. (Schultz, Pogg. 123. 137.)

Completely pptd. from solution by  $\text{HC}_2\text{H}_3\text{O}_2$ . (Persoz.)

For solubility in  $(\text{NH}_4)_2\text{SO}_4$ , see under  $(\text{NH}_4)_2\text{SO}_4$ .

$\text{MnSO}_4 + \text{Aq}$  sat. at  $10^\circ$ , then sat. with  $\text{K}_2\text{SO}_4$  at same temp. contains for 100 pts.  $\text{H}_2\text{O}$  16.7 pts.  $\text{MnSO}_4$  and 44.3 pts.  $\text{K}_2\text{SO}_4$ . (Mulder.)

Solubility of  $\text{MnSO}_4 + \text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $35^\circ$ .

g. per 100 g. sat. solution		
$\text{MnSO}_4$	$\text{Na}_2\text{SO}_4$	Solid phase
39.45	0	$\text{MnSO}_4, \text{H}_2\text{O}$
33.92	5.23	"
33.06	7.97	$\text{MnSO}_4, \text{H}_2\text{O} + 9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4$
32.92	7.42	"
31.05	9.20	$9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4$
27.67	10.78	"
22.14	14.28	"
14.58	20.01	"
13.96	21.91	"
12.19	22.49	$9\text{MnSO}_4, 10\text{Na}_2\text{SO}_4 + \text{MnSO}_4, 3\text{Na}_2\text{SO}_4$
10.45	23.41	$\text{MnSO}_4, 3\text{Na}_2\text{SO}_4$
7.43	26.58	"
5.69	29.31	"
5.11	30.52	$\text{MnSO}_4, 3\text{Na}_2\text{SO}_4 + \text{Na}_2\text{SO}_4$
2.96	31.33	$\text{Na}_2\text{SO}_4$
0	33	"

(Sohreinemakers and Provije, Proc. Ak. Wet. Amsterdam, 1913, 15. 326.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 823.)

Anhydrous  $\text{MnSO}_4$  insol. in absolute alcohol.

1000 pts. alcohol of 0.872 sp. gr. dissolve 6.3 pts.  $\text{MnSO}_4$ .

Sol. in 50 pts. of 50% alcohol. Insol. in absolute alcohol. (Brandes, Pogg. 20. 556.)

100 pts. solution saturated at  $15^\circ$  in dil. alcohol containing:

0	10	50	60	% alcohol, contain
56.25	51.4	2.0	0.66	pts. $\text{MnSO}_4 + 5\text{H}_2\text{O}$ .

(Schiff, A. 118. 365.)

When  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is boiled with absolute alcohol none is dissolved, but  $\text{MnSO}_4 + 3\text{H}_2\text{O}$  is formed.

When  $\text{MnSO}_4 + 7\text{H}_2\text{O}$  is dissolved in 15–50% alcohol, the liquid separates into two layers, the lower containing less (12–14%) alcohol and more (47–49%) salt; the upper containing



more (50-55%) alcohol and less (1.3-2.2%) salt. If the alcohol has the above strength (15-50%) the separation takes place at ordinary temp., but with 13-14% or 60% or more alcohol, warming is necessary to effect the separation. (Schiff, A. 118. 363.)

Solubility of  $\text{MnSO}_4 + \text{H}_2\text{O}$  in alcohol + Aq at  $t^\circ$ .

Composition of two layers sat. with the solid salt at  $t^\circ$ .

$t^\circ$	Alcohol layer		Water layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
30	45.20	2.49	8.69	30.15
31	43.90	2.74	8.47	30.10
35	41.71	3.44	9.24	28.61
37	38.26	4.84	11.03	26.47
41	34.01	5.86	11.93	24.97
42	32.37	6.89	13.57	23.09
43	31.42	8.51	14.33	22.01

(Schreinemakers and Deuss, Z. phys. Ch. 1912, 79. 559.)

Composition of alcohol solutions sat. with  $\text{MnSO}_4 + \text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	% $\text{H}_2\text{O}$	% alcohol	% $\text{MnSO}_4$
50	63.74	0	36.26
	65.21	6.67	28.12
	65.23	16.02	18.75
	64.83	22.63	12.54
	59.41	36.47	4.12
35	61.4	0	38.6
	62.13	5.50	32.37
	62.06	6.46	31.48
	62.01	7.48	30.51
	*62.15	9.24	28.61
	*54.85	41.71	3.44
	50.69	47.73	1.58
	50.16	48.27	1.57
30	61.4	0	38.6
	61.43	2.26	36.31
	61.25	5.09	33.66
	60.78	5.96	*33.26
	*61.16	8.69	30.15
	*52.31	45.20	2.49
	44.83	54.19	0.98
	30.95	68.97	0.08
	9.19	90.80	0.01

\*The solutions also sat. with respect to one another.

(Schreinemakers and Deuss.)

Composition of the solutions sat. with respect to one another.

$t^\circ$	water layer		alcohol layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
50	†5.68	34.95	†53.64	0.97
	†7.69	30.99	†45.83	2.19
	†8.70	29.20	†41.93	3.11
	†11.85	24.84	†35.15	5.95
35	†8.38	29.52	†42.38	* 3.07
	*9.24	28.61	*41.71	3.44
	10.75	26.33	36.89	5.19
	15.09	21.85	30.06	9.03
30	†7.60	32.40	†50.97	1.74
	*8.69	30.15	*45.20	2.49
	10.46	27.58	40.71	3.93
	11.86	25.75	37.54	5.20
	16.18	20.86	29.89	9.64

(Schreinemakers and Deuss.)

†Metastable solutions.

\*Solutions also sat. with respect to  $\text{MnSO}_4 + \text{H}_2\text{O}$ .

Solubility of  $\text{MnSO}_4 + 4\text{H}_2\text{O}$  in alcohol + Aq.

g. $\text{H}_2\text{O}$	g. alcohol	$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$
55.86	30.03	14.11
52.25	43.59	4.16
49.41	47.66	2.94
45.34	53.00	1.66
42.56	56.24	1.20

(Linebarger, Am. Ch. J. 1892, 14. 380.)

Solubility of  $\text{MnSO}_4 + 5\text{H}_2\text{O}$  in alcohol + Aq.

Composition of the solution sat. with  $\text{MnSO}_4 + 5\text{H}_2\text{O}$ .

$t^\circ$	alcohol layer		water layer	
	% alcohol	% $\text{MnSO}_4$	% alcohol	% $\text{MnSO}_4$
10	37.06	5.44	13.78	25.25
15	44.56	2.79	9.25	29.79
17.6	47.11	2.22	8.53	30.88
21	53.55	1.10	6.10	35.05
25	53.09	1.23	6.81	33.72

Composition of solution sat. with solid substance at  $25^\circ$ .

% $\text{H}_2\text{O}$	% alcohol	% $\text{MnSO}_4$	Solid phase
60.7	0	39.3	$\text{MnSO}_4 + 5\text{H}_2\text{O}$
*59.47	6.81	33.72	"
*45.68	53.09	1.23	"
42.05	57.39	0.56	"
23.30	76.70	0.0	$\text{MnSO}_4 + \text{H}_2\text{O}$

\*The two liquids are sat. with respect to one another.

Composition of the two solutions sat. with respect to one another at 25°.

Water layer		Alcohol layer	
% alcohol	% MnSO <sub>4</sub>	% alcohol	% MnSO <sub>4</sub>
*3.81	*33.72	*53.09	1.23
8.48	31.51	49.76	1.83
15.02	22.61	32.75	8.01

\*Also sat. with MnSO<sub>4</sub>, 5H<sub>2</sub>O.  
(Sohreinemakers and Deuss.)

Insol. in absolute ether between 5° and 7°, and no crystal H<sub>2</sub>O is removed thereby. Insol. in boiling oil of turpentine, but 1 mol. crystal H<sub>2</sub>O is removed from MnSO<sub>4</sub>·4H<sub>2</sub>O (Brandes, Pogg. 20. 568.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.); ethyl acetate. Naumann, B. 1910, 43. 314; acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C.C. 1899, II. 1014.)

100 g. sat. solution in glycol contain 0.5 g. MnSO<sub>4</sub> (de Coninck, Bull. Ac. roy. Belg. 1906. 359.)

MnSO<sub>4</sub>·7H<sub>2</sub>O occurs as the min. *Mallardite*.

**Manganomanganic sulphate**, MnO, MnO<sub>2</sub>, 4SO<sub>3</sub>·9H<sub>2</sub>O.

Deliquescent. Decomp. by H<sub>2</sub>O. Sol. in little dil. H<sub>2</sub>SO<sub>4</sub>+Aq. (Freymy, C. R. 62. 475.)

**Manganic sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.

Extremely deliquescent. Sol. in H<sub>2</sub>O with evolution of heat, and decomposition into a basic sulphate. Behaves similarly with dilute acids. Sol. in traces in cold conc. H<sub>2</sub>SO<sub>4</sub>. Insol. in cold conc. HNO<sub>3</sub>+Aq. Sol. in conc. HCl+Aq. Decomp. by absolute alcohol. (Carius, A. 98. 53.)

**Manganyl sulphate**, MnO<sub>2</sub>, SO<sub>3</sub>.

Sol. in H<sub>2</sub>SO<sub>4</sub> but solution decomp. if below 40–60° Baumé. Solubility in 40° Baumé acid = 15%; 55°, 4–5%. Solution can be heated to 60–80° without decomp. (Bad. Anilin u. Sodafabrik, C. C. 1905, II. 1398.)

**Manganous hydrogen sulphate**.

MnSO<sub>4</sub> is sol. in 20 pts. boiling conc. H<sub>2</sub>SO<sub>4</sub>; more sol. in boiling H<sub>2</sub>SO<sub>4</sub>+Aq of 1.6 sp. gr. (Schultz.)

MnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, and +H<sub>2</sub>O. Sol. in H<sub>2</sub>O with decomp. (Schultz.)

MnH<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>. Sol. in H<sub>2</sub>O with decomp. (Schultz.)

**Manganous hydrogen sulphate**, Mn<sub>2</sub>H<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>·8H<sub>2</sub>O.

Deliquescent. Decomp. by H<sub>2</sub>O. Sol. in dil. H<sub>2</sub>SO<sub>4</sub>+Aq. (Francke, J. pr. (2) 36. 251.)

**Manganous hydrazine sulphate**, MnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.

1 pt. is sol. in 60 pts. H<sub>2</sub>O at 18°.

Stable in the air at 100°. (Curtius, J. pr. 1894, (2) 50. 331.)

**Manganous nickel potassium sulphate**,

MnSO<sub>4</sub>, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>+12H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Vohl, A. 94. 57.)

**Manganous potassium sulphate**, K<sub>2</sub>SO<sub>4</sub>, MnSO<sub>4</sub>+2H<sub>2</sub>O.

+4H<sub>2</sub>O. Efflorescent. (Pierre, A. ch. (3) 16. 239.)

2MnSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>. (Mallet, C. N. 1899, 80. 301.)

**Manganic potassium sulphate**, K<sub>2</sub>Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>·4H<sub>2</sub>O.

Decomp. by dissolving in H<sub>2</sub>O. (Mitscherlich.)

**Manganomanganic potassium sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, 5K<sub>2</sub>SO<sub>4</sub>=3Mn(SO<sub>4</sub>)<sub>2</sub>, 2MnSO<sub>4</sub>, 5K<sub>2</sub>SO<sub>4</sub>.

Decomp. by much H<sub>2</sub>O. Sol. in dil. or conc. H<sub>2</sub>SO<sub>4</sub>. Insol. in alcohol or ether. (Francke, J. pr. (2) 36. 166.)

**Manganous potassium zinc sulphate**, MnSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub>+12H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Vohl.)

**Manganous rubidium sulphate**, MnSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>+6H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Tutton, Chem. Soc. 63. 337.)

1 l. H<sub>2</sub>O dissolves 357 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

+2H<sub>2</sub>O. (Wyrouboff, Bull. Soc. Min. 1891, 14. 242.)

2MnSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub>. (Wyrouboff.)

**Manganic rubidium sulphate**, Mn<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>, Rb<sub>2</sub>SO<sub>4</sub>+24H<sub>2</sub>O.

Deliquescent. (Christensen, Z. anorg. 1901, 27. 333.)

**Manganous sodium sulphate**, MnSO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>·2H<sub>2</sub>O. Deliquescent in moist air. (Geiger.)

+4H<sub>2</sub>O. Sol. in 1.2 pts. boiling H<sub>2</sub>O. (Geiger.)

**Manganous sulphate ammonia**, MnSO<sub>4</sub>, 4NH<sub>3</sub>.

Decomp. by H<sub>2</sub>O. (Rose, Pogg. 20. 148.)

**Manganous sulphate cupric oxide**, MnSO<sub>4</sub>, 2CuO+3H<sub>2</sub>O.

(Mailhe, A. ch. 1902, (7) 27. 392.)

MnSO<sub>4</sub>, 3CuO+zH<sub>2</sub>O. (Recoura, C. R. 1901, 132. 1415.)

MnSO<sub>4</sub>, 24CuO+zH<sub>2</sub>O. (Recoura.)

**Manganous sulphate hydrazine,  $\text{MnSO}_4 \cdot 2\text{N}_2\text{H}_4$ .**

Very unstable.

Somewhat sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Fransen, Z. anorg. 1908, 60. 285.)

**Manganous sulphate hydroxylamine,  $\text{MnSO}_4 \cdot \text{NH}_2\text{OH} + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Feldt, B. 1894, 27. 405.)

**Mercurous sulphate, basic,  $2\text{Hg}_2\text{O} \cdot \text{SO}_4 + \text{H}_2\text{O}$ .**

Sol. in 25,000 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Gouy, C. R. 1900, 130. 1401.)

**Mercurous sulphate,  $\text{Hg}_2\text{SO}_4$ .**

Sol. in 500 pts. cold, and 300 pts. hot  $\text{H}_2\text{O}$ . (Wackenroder, A. 41. 319.)

Solubility in  $\text{H}_2\text{O}$  at  $18^\circ = 7.8 \times 10^{-4}$  g. mol. per liter. (Wilsmore, Z. phys. Ch. 1900, 35. 305.)

1 l.  $\text{H}_2\text{O}$  dissolves  $11.71 \times 10^{-4}$  g.-mol.  $\text{Hg}_2\text{SO}_4$  at  $25^\circ$ . (Drucker, Z. anorg. 1901, 28. 362.)

Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	In 100 pts. of the solution	
	$\text{Hg}_2\text{SO}_4$	$\text{H}_2\text{SO}_4$
16.5	0.055	0.008
33	0.060	0.018
50	0.065	0.037
75	0.074	0.063
91	0.084	0.071
100	0.092	0.071

(Barre, A. ch. 1911, (8) 24. 203.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ$  is 20% greater than at  $18^\circ$  and  $= 11.71 \times 10^{-4}$  g. mol. per l. By addition of increasing amts. of  $\text{H}_2\text{SO}_4$ , the solubility is somewhat, but not regularly, decreased,  $\text{K}_2\text{SO}_4$  lowers solubility less than  $\text{H}_2\text{SO}_4$ . (Drucker, Z. anorg. 1901, 28. 362.)

Easily sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  from which solution it is separated by dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Wackenroder, A. 41. 319.)

Abundantly sol. in hot, less sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Berzelius.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

$\text{H}_2\text{SO}_4$ normality	g.-mol. $\text{Hg}_2\text{SO}_4$ per litre
0.0400	$8.31 \times 10^{-4}$
0.1000	$8.78 \times 10^{-4}$
0.2000	$8.04 \times 10^{-4}$

(Drucker, Z. anorg. 1901, 28. 362.)

Partially decomp. by hot  $\text{NH}_4$  salts +  $\text{Aq.}$  (Miahle, A. ch. (3) 5. 179.)

5 times more sol. in sat.  $\text{CdSO}_4 + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Hulett, Phys. Rev. 1907, 25. 16.)

Sat.  $\text{ZnSO}_4$ , or  $\text{CdSO}_4 + \text{Aq}$  attack much less

than pure  $\text{H}_2\text{O}$ , yet the solubility of  $\text{Hg}_2\text{SO}_4$  in these solutions is greater, i. e., 0.8 g. in 1 l.  $\text{ZnSO}_4 + \text{Aq}$  and 1.1 g. in 1 l.  $\text{CdSO}_4 + \text{Aq}$  at  $20^\circ$ . (Gouy, C. R. 1900, 130. 1402.)

Solubility in  $0.2\text{N } \text{K}_2\text{SO}_4 + \text{Aq} = 9.05 \times 10^{-4}$  g. mol. per l. at  $25^\circ$ . (Drucker, Z. anorg. 1901, 28. 362.)

Solubility of  $\text{Hg}_2\text{SO}_4$  in  $\text{K}_2\text{SO}_4 + \text{Aq.}$

$t^\circ$	g. per 100 g. sat. solution		
	$\text{K}_2\text{SO}_4$	$\text{Hg}_2\text{SO}_4$	free $\text{H}_2\text{SO}_4$
15	2.90	0.0475	0.0080
	5.70	0.0703	0.0093
	8.22	0.0912	0.0098
	8.77	0.0994	
	9.44	0.1080	0.0110
33	2.94	0.0677	0.0250
	5.68	0.1015	0.0350
	8.30	0.1364	0.0441
	10.70	0.1724	0.0438
	11.90	0.1992	0.0420
75	3.10	0.1344	0.1681
	5.75	0.2120	0.2135
	8.50	0.2951	0.2514
	13.20	0.4610	0.2503
	17.30	0.6440	0.2225

(Barre, A. ch. 1911, (8) 24. 202.)

About 3 times as sol. in sat.  $\text{ZnSO}_4 + \text{Aq}$  as in distilled  $\text{H}_2\text{O}$ . (Wright, Phil. Mag. (5) 1885, 19. 29.)

**Mercuric sulphate, basic,  $2\text{HgO} \cdot \text{SO}_3$ .**

(Mailhe, A. ch. 1902, (7) 27. 394.)

$3\text{HgO} \cdot \text{SO}_3$ . (Mineral turpeth.)

Sol. in 2000 pts. cold and 600 pts. boiling  $\text{H}_2\text{O}$ . (Fourcroy, A. ch. 19. 307.)

Sol. in 43,478 pts.  $\text{H}_2\text{O}$  at  $16^\circ$  when pptd. cold, and in 32,258 pts. at  $16^\circ$  when pptd. at  $100^\circ$ . (Cameron, Z. anal. 19. 144.)

Sl. sol. in warm dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (Rose.)

Solubility in  $\text{H}_2\text{O}$  is increased by addition of  $\text{H}_2\text{SO}_4$  up to an acid content of 4.3 mol.  $\text{SO}_3$  to 93.7 mols.  $\text{H}_2\text{O}$ . (Hoitsma, Z. phys. Ch. 1895, 17. 665.)

Sol. in warm conc.  $\text{HCl}$  or  $\text{HBr} + \text{Aq.}$  (Ditte.)

Sol. in alkali chlorides +  $\text{Aq.}$  (Miahle.)

Sol. in dil.  $\text{HNO}_3$  or in  $\text{HCl} + \text{Aq.}$  More easily sol. in the warm acids. (Ray, Chem. Soc. 1897, 71. 1099.)

$3\text{HgO} \cdot 2\text{SO}_3 + 2\text{H}_2\text{O}$ . (Hoitsma, Z. phys. Ch. 1895, 17. 659.)

$4\text{HgO} \cdot 3\text{SO}_3$ . (Hopkins, Sill. Am. J. 18. 364.)

**Mercuric sulphate,  $\text{HgSO}_4$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $3\text{HgO} \cdot \text{SO}_3$ , and a sol. acid salt. Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Decomp. by all acids. (Berzelius.)

Sol. in warm conc. HCl or HBr + Aq; very al. sol. in boiling conc. HI + Aq. (Ditte, A. ch. (5) 17. 124.)

Very sl. sol. in hot conc. HF. (Ditte, A. ch. 1879, (5) 17. 125.)

Sol. in HCN + Aq. (Mohr.)

Sol. with decomp. in NaCl + Aq. (Miahle.)

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1893, 20. 829.)

Insol. in conc. alcohol.

Insol. in acetone. (Naumann, B. 1904, 37. 4329.); methyl acetate. (Naumann, B. 1909, 42. 3790.); ethyl acetate. (Naumann, B. 1910, 43. 314.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

Insol. in pyridine. (Schroeder, Dissert. 1901.)

+H<sub>2</sub>O. Decomp. by H<sub>2</sub>O. (Eisfeldt, Pharm. Centr. 1863. 812.)

**Mercuriomercuric sulphate**, Hg<sub>2</sub>O, 2HgO, SO<sub>3</sub>.

Insol. in cold H<sub>2</sub>O; not decomp. by boiling H<sub>2</sub>O. Decomp. by HCl + Aq. (Brooke, Pogg. 66. 63.)

Hg<sub>2</sub>SO<sub>4</sub>, HgSO<sub>4</sub>. (Baskerville, J. Am. Chem. Soc. 1897, 19. 875.)

**Mercuric hydrogen sulphate**, HgH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.

(Braham, C. N. 42. 163.)

**Mercuric potassium sulphate**, 3HgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 2H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Hirsol, J. B. 1860. 332.)

**Mercuric sulphate chloride ammonium chloride**, 2HgSO<sub>4</sub>, HgCl<sub>2</sub>, 2NH<sub>4</sub>Cl.

Decomp. with H<sub>2</sub>O. Ether dissolves out HgCl<sub>2</sub>. (Kosmann, A. ch. (3) 27. 238.)

**Mercuric sulphate cyanide**, HgSO<sub>4</sub>, Hg(CN)<sub>2</sub> + 5H<sub>2</sub>O.

Decomp. by conc. or warm acids. (Rupp, Arch. Pharm. 1912, 250. 280.)

**Mercuric sulphate hydrazine**, HgSO<sub>4</sub>, N<sub>2</sub>H<sub>4</sub>.

Ppt. (Hofmann and Marburg, A. 1899, 306. 216.)

**Mercuric sulphate hydrobromide**, HgSO<sub>4</sub>, 2HBr.

Sol. in H<sub>2</sub>O without separation of basic sulphate. (Ditte, A. ch. (5) 17. 122.)

3HgO, SO<sub>3</sub>, 6HBr. Sol. in H<sub>2</sub>O. (Ditte.)

**Mercuric sulphate hydrochloride**, HgSO<sub>4</sub>, HCl.

Not attacked by HCl. Sl. sol. in HNO<sub>3</sub>. (Baskerville, J. Am. Chem. Soc. 1901, 23. 895.)

HgSO<sub>4</sub>, 2HCl. Sol. in H<sub>2</sub>O without separation of a basic salt. Very sol. in warm H<sub>2</sub>SO<sub>4</sub>, solidifying on cooling if very conc., or crystallising if dil. (Ditte.)

Very deliquescent.

Very sol. in H<sub>2</sub>O. (Baskerville, J. Am. Chem. Soc. 1901, 23. 895.)

+H<sub>2</sub>O. (Baskerville, J. Am. Chem. Soc. 1901, 23. 895.)

3HgO, SO<sub>3</sub>, 6HCl. Sol. in H<sub>2</sub>O. (Ditte.)

**Mercuric sulphate hydroxylamine**, HgSO<sub>4</sub>, 2NH<sub>2</sub>OH + H<sub>2</sub>O.

Decomp. by cold H<sub>2</sub>O. (Adams, Am. Ch. J. 1902, 28. 209.)

**Mercuric sulphate iodate iodide**, 6(3HgO, 2SO<sub>3</sub>), 6HgI<sub>2</sub>, Hg(IO<sub>3</sub>)<sub>2</sub>.

Decomp. by H<sub>2</sub>O and acids. (Brückner, M. 1907, 28. 961.)

**Mercuric sulphate iodide, basic**, 3HgO, 2SO<sub>3</sub>, HgI<sub>2</sub>.

3(3HgO, 2SO<sub>3</sub>), 2HgI<sub>2</sub> + 10H<sub>2</sub>O.

2(3HgO, 2SO<sub>3</sub>), HgI<sub>2</sub> + 10H<sub>2</sub>O. Very sol. in hot conc. HNO<sub>3</sub>.

3HgO, 2SO<sub>3</sub>, HgSO<sub>4</sub>, HgI<sub>2</sub> + 10H<sub>2</sub>O. (Ditte, C. R. 1905, 140. 1167.)

**Mercuric sulphate iodide**, HgSO<sub>4</sub>, HgI<sub>2</sub>.

Decomp. by H<sub>2</sub>O, not by alcohol or ether. (Riegel, J. B. pr. Pharm. 11. 396.)

3HgSO<sub>4</sub>, HgI<sub>2</sub>. Decomp. by cold or hot H<sub>2</sub>O. Sol. in H<sub>2</sub>SO<sub>4</sub> + Aq. (Ditte, C. R. 1905, 140. 1165.)

4HgSO<sub>4</sub>, HgI<sub>2</sub> + 15H<sub>2</sub>O, and + 18H<sub>2</sub>O. Decomp. by cold or hot H<sub>2</sub>O.

Sol. in H<sub>2</sub>SO<sub>4</sub>. (Ditte.)

**Mercuric sulphate phosphide.**

See Dimercuriophosphonium mercuric sulphate.

**Mercuric sulphate sulphide, basic**, 2HgO, SO<sub>3</sub>, HgS.

Somewhat sol. in HCl, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub>. (Jacobson, Pogg. 1846, 68. 412.)

4HgO, 3SO<sub>3</sub>, 2HgS + 4H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>SO<sub>4</sub>. (Estrup, Z. anorg. 1909, 62. 169.)

**Mercuric sulphate sulphide**, 2HgSO<sub>4</sub>, HgS.

Sl. sol. in hot HCl, H<sub>2</sub>SO<sub>4</sub>, or HNO<sub>3</sub> + Aq. Easily sol. in hot aqua regia. (Jacobson, Pogg. 68. 410.)

2HgSO<sub>4</sub>, HgS. (Palm, C. C. 1863. 122.)

HgSO<sub>4</sub>, 2HgS. (Barfoed, J. B. 1864. 282.)

Sol. in aqua regia. (Denigès, Bull. Soc. 1915, (4) 17. 355.)

HgSO<sub>4</sub>, 3HgS. Insol. in H<sub>2</sub>O. Easily sol. in aqua regia; decomp. by HNO<sub>3</sub> into—

3HgSO<sub>4</sub>, HgS. Insol. in all acids except aqua regia. (Spring, A. 199. 116.)

**Molybdenum sesquisulphate (?)**.

Basic. Insol. in H<sub>2</sub>O.

Neutral. Decomp. by H<sub>2</sub>O into acid and basic salts.

Acid. Sol. in H<sub>2</sub>O. (Berzelius.)

**Molybdenum disulphate (?)**Sol. in  $H_2O$ .**Molybdenum sulphate,  $Mo_2O_5, 2SO_3$ .**

Very slowly sol. in cold, more quickly sol. in hot  $H_2O$ . (Bailhache, C. R. 1901, 132. 476.)  
 $7MoO_3, 2MoO_3, 7SO_3 + Aq$ . (Péchar, C. R. 1901, 132. 630.)

**Molybdic sulphate,  $MoO_3, SO_3$ .**Deliquescent. Sol. in  $H_2O$ . (Schultz-Sellack, B. 4. 14.)

$MoO_3, 3SO_3 + 2H_2O$ . Deliquescent. Partially sol. in  $H_2O$ . (Anderson, Bers. J. B. 22. 161.)

Does not exist. (Schultz-Sellack.)

**Molybdenum sulphate ammonia,** $5NH_3, MoO_3SO_3, 7MoO_3 + 8H_2O$ . $3NH_3, MoO_3SO_3, 7MoO_3 + 10H_2O$ .

Both very sol. in water but less sol. in  $H_2O$  containing ammonium salts. (Péchar, C. R. 1901, 132. 630.)

**Neodymium sulphate, basic,  $Nd_2O_3, SO_3$ .**Insol. in  $H_2O$ .

Nearly insol. in dil. acids. (Wöhler, B. 1913, 46. 1730.)

Insol. in  $H_2O$ . (Matignon, C. R. 1902, 134. 658.)**Neodymium sulphate,  $Nd_2(SO_4)_3 + 8H_2O$ .**Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	pts. $Nd_2(SO_4)_3$
0	9.50
16	7.05
30	5.04
50	3.72
80	2.70
100	2.21

(Muthmann and Rolig, B. 1898, 31. 1728.)

**Neodymium hydrogen sulphate,  $Nd(SO_4)H$ .**

(Brauner, Z. anorg. 1904, 33. 331.)

**Neodymium potassium sulphate.**

Cryst. modification more sol. in cold than in hot  $H_2O$ . (Boudouard, C. R. 1898, 126. 901.)

**Nickel sulphate, basic.**Very sl. sol. in  $H_2O$ . (Berzelius.)

$6NiO, 5SO_3 + 4H_2O$ . (Athanasesco, C. R. 103. 271.)

$7NiO, 7H_2O, SO_3 + 3H_2O$ . Nearly insol. in  $H_2O$ . (Habermann, M. 5. 432.)

$5NiO, SO_3; 5NiO, 2SO_3; \text{ and } 5NiO, 3SO_3$ . (Pickering, Chem. Soc. 1907, 91. 1985.)

 $6NiO, SO_3$ . (Strömholm, C. C. 1906, 1. 1222.)**Nickel sulphate,  $NiSO_4$ .**100 pts.  $H_2O$  dissolve pts.  $NiSO_4$  at  $t^\circ$ :

2°	16°	20°	23°	31°
30.4	37.4	39.7	41	45.3 pts. $NiSO_4$ .
41°	50°	53°	60°	70°
49.1	52	54.4	57.2	61.9 pts. $NiSO_4$ .

(Tobler, A. 98. 123.)

100 pts. of sat. solution contain: at 11-14°, 28.84; at 18-20°, 30.77 pts. anhydrous salt. (v. Hauer, W. A. B. 58, 2. 221.)

100 pts.  $H_2O$  at 112.5° dissolve 185.71 pts.  $NiSO_4$ . (Griffiths.)

$NiSO_4 + 7H_2O$  is sol. in 3 pts.  $H_2O$  at 12.5°. (Tupputi.)

100 pts.  $H_2O$  at 15.5° dissolve 75.6 pts.  $NiSO_4 + 7H_2O$ .

Sat.  $NiSO_4 + Aq$  contains at:

-3°	+2°	5°	11°	17°	54°
21.7	22.7	23.1	25.2	26.6	33.6% $NiSO_4$ .
68°	74°	92°	97°	110°	117°
38.2	38.7	42.4	44.2	46.5	48.8
49.4% $NiSO_4$ .					

(Étard, A. ch. 1894, (7) 2. 552.)

See also below under hydrated salts.

Sp. gr. of  $NiSO_4 + Aq$  containing g.  $NiSO_4 + 7H_2O$  in 1000 g.  $H_2O$  at 23.5°.

140.5 g. (= $\frac{1}{4}$ mol.)	281	421.5	562
1.073	1.136	1.190	1.238
602.5	843	983.5	1124
1.280	1.317	1.349	1.378

Containing  $NiSO_4$  (anhydrous):

77.5 g. (= $\frac{1}{2}$ mol.)	155	232.5	310	387.5	465
1.079	1.153	1.224	1.292	1.358	1.421

(Gerlach, Z. anal. 23. 468.)

Sp. gr. of  $NiSO_4 + Aq$  at 0°. S = pts.  $NiSO_4$  in 100 pts. solution;  $S_1$  = mols.  $NiSO_4$  in 100 mols. solution.

S	$S_1$	Sp. gr.
4.2930	0.581	1.0522
3.9591	0.476	1.0431
3.2845	0.392	1.0357
2.5043	0.297	1.0271
1.6131	0.189	1.0173
0.8327	0.097	1.0089

(Charpy, A. ch. (6) 29. 26.)

Sp. gr. of  $NiSO_4 + Aq$  at room temp. containing:

10.62	18.19	25.35% $NiSO_4$ .
1.0925	1.1977	1.3137

(Wagner, W. Ann. 1883, 18. 272.)

Sp. gr. of  $NiSO_4 + Aq$  at 25°.

Concentration of $NiSO_4 + Aq$	Sp. gr.
1-normal	1.0773
$\frac{1}{2}$ " "	1.0391
$\frac{1}{3}$ " "	1.0198
$\frac{1}{4}$ " "	1.0017

(Wagner, Z. phys. Ch. 1890, 6. 39.)

For solubility of  $\text{NiSO}_4 + \text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$ , see under  $\text{NiSO}_4 + 7\text{H}_2\text{O}$  and  $\text{NiNa}_2(\text{SO}_4)_2$ .

100 pts. sat.  $\text{NiSO}_4 + \text{ZnSO}_4 + \text{Aq}$  at  $18-20^\circ$  contain 35.45 pts. of the two salts. (v. Hauer.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

$\text{HC}_2\text{H}_3\text{O}_2$  precipitates it completely from aqueous solution. (Persoz.)

100 pts. absolute methyl alcohol dissolve 0.5 pt.  $\text{NiSO}_4$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)

Solubility of  $\text{NiSO}_4 \cdot 3\text{CH}_3\text{O} + 3\text{H}_2\text{O}$  in methyl alcohol at  $14^\circ$ .

P = % anhydrous  $\text{NiSO}_4$  in the sat. solutions.

Alcohol % by wt.	P	In 1000 mol. of the solution		
		Mol. $\text{NiSO}_4$	Mol. $\text{CH}_3\text{O}$	Mol. $\text{H}_2\text{O}$
100	3.72	7.75	969	23.2
97.5	0.77	1.65	950	48.5
95	0.455	0.96	908	91
92.5	0.50	1.0	871	128
90	0.70	1.6	830	168
89	1.01	2.0	814	184
88	1.25	2.4	800	198
87	1.48	2.9	781	216
86	1.73	3.2	767	230
85	1.93	3.6	755	241

(de Bruyn, R. t. c. 1903, 22, 418.)

This salt is more sol. in ethyl alcohol than in methyl alcohol.

See also under hydrated salts.

For solubility of  $\text{NiSO}_4$  in ethyl alcohol, see under hydrated salts.

100 g. sat. solution in glycol contain 9.7 g.  $\text{NiSO}_4$  at ord temp. (de Coninck, Bull. Ac. Roy. Belg. 1905, 359.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate, (Naumann, B. 1904, 37, 3602.)

Very sl. sol. in acetone. (Krug and M'Elroy.)

Insol. in acetone. (Naumann, B. 1904, 37, 4329; Eidmann, C. C. 1899, II, 1014.)

$+ \text{H}_2\text{O}$ . Very sl. sol. in abs. methyl alcohol. After standing in contact with it for 8-9 months, the solution contains 1.34%  $\text{NiSO}_4$ . (de Bruyn, R. t. c. 1903, 22, 414.)

$+ 2\text{H}_2\text{O}$ . Cryst. from sat.  $\text{NiSO}_4 + \text{Aq}$  at  $131^\circ$ . (Steele and Johnson.)

$+ 4\text{H}_2\text{O}$ . Solubility in methyl alcohol + Aq at  $10^\circ$ . Time = 24 hrs. P = % anhydrous salt in the sat. solutions.

Alcohol of 100% 80% 50% 20% water  
P 7.38 0.66 1.43 14.8 25.1

(de Bruyn, R. t. c. 1903, 22, 414.)

$+ 6\text{H}_2\text{O}$ . Two modifications.  $\alpha$ -blue, tetragonal;  $\beta$ -green, monoclinic.

Solubility of  $\alpha$ -  $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

Salt used	$t^\circ$	g. $\text{NiSO}_4$ in 100 g. $\text{H}_2\text{O}$	Salt remaining
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	32.3	43.57	$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)
"	33.0	43.35	"
"	34.0	43.84	"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	35.6	43.79	"
$\text{NiSO}_4 + 6\text{H}_2\text{O}$	44.7	48.05	"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	44.7	47.97	"
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	50.0	50.15	"
"	51.0	50.66	"
"	52.0	52.34	"
"	53.0	52.34	"

(Steele and Johnson.)

Solubility of  $\beta$ -  $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

Salt used	$t^\circ$	g. $\text{NiSO}_4$ per 100 g. $\text{H}_2\text{O}$	Salt remaining
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	54.5	52.50	$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (green)
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	57.0	53.40	"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$			"
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	60.0	54.84	"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$			"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	69.0	58.38	"
"			"
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)	70.0	59.44	"
$\text{NiSO}_4 + 6\text{H}_2\text{O}$ (blue)			"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	80.0	63.17	"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$			"
$\text{NiSO}_4 + 7\text{H}_2\text{O}$	89.0	67.90	"
"			"
"	99.0	76.71	"

(Steele and Johnson, Chem. Soc. 1904, 85, 118.)

Tr. point from  $\alpha$ - to  $\beta$ - salt =  $53.3^\circ$ . (Steele and Johnson.)

100 pts. absolute methyl alcohol dissolve 31.6 pts.  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  at  $17^\circ$ ; 100 pts. 93.5% methyl alcohol dissolve 7.8 pts.  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  at  $18^\circ$ ; 100 pts. 50% methyl alcohol dissolve 1.9 pts.  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10, 786.)

$\alpha$ -Salt. Solubility in methyl alcohol + Aq at  $14^\circ$ . Time = 5 to 6 hrs.

Alcohol % by wt.	% $\text{NiSO}_4$	In 1000 mol. of the solution		
		Mol. $\text{NiSO}_4$	Mol. $\text{CH}_3\text{O}$	Mol. $\text{H}_2\text{O}$
100	12.4	26	794	180
97.5	10.6	22.3	808	170
95	6.5	14	817	169
92.5	3.06	5.9	838	156
90	1.18	2.3	821	177
85	0.315	0.67	757	242
80	0.25	0.4	688	312
60	0.46	0.8	453	546
40	2.43	3.5	265	732
20	14.7	21	105	874
0 (water)	26.0	39	0	961

(de Bruyn, R. t. c. 1903, 22, 412.)

$\beta$ -salt. Solubility in methyl alcohol+Aq at 14°. Time=24 hrs.

Alcohol % by wt.	% NiSO <sub>4</sub>	In 1000 mol. of the solution		
		Mol. NiSO <sub>4</sub>	Mol. CH <sub>3</sub> O	Mol. H <sub>2</sub> O
100	15.7	33.8	763	203
97.5	12.4	26	781	193
95	10.0	20.3	784	196
92.5	5.61	11.1	800	189
90	2.35	4.5	810	185
89	1.79	...	...	...
88	1.29	...	...	...
87	0.97	...	...	...
86	0.735	...	...	...
85	0.61	1.3	755	244
80	0.415	0.7	682	317
60	0.75	1.3	453	546
40	3.11	4.0	264	732
20	14.1	21.0	105	874
0 (water)	27.2	40.0	0	960

(de Bruyn.)

+7H<sub>2</sub>O.  
Solubility in 100 pts. H<sub>2</sub>O at t°, using  
NiSO<sub>4</sub>+7H<sub>2</sub>O.

t°	Pts. NiSO <sub>4</sub>	t°	Pts. NiSO <sub>4</sub>	t°	Pts. NiSO <sub>4</sub>
0	29.3	33	45.5	66	63.6
1	29.7	34	46.0	67	64.1
2	30.1	35	46.5	68	64.7
3	30.5	36	47.0	69	65.3
4	31.0	37	47.5	70	65.9
5	31.5	38	48.0	71	66.5
6	32.0	39	48.5	73	67.0
7	32.5	40	49.0	72	67.6
8	33.0	41	49.6	74	68.2
9	33.5	42	50.1	75	68.8
10	34.0	43	50.6	76	69.3
11	34.5	44	51.2	77	69.9
12	35.0	45	51.7	78	70.5
13	35.5	46	52.3	79	71.1
14	36.0	47	52.8	80	71.7
15	36.5	48	53.4	81	72.3
16	37.0	49	53.9	82	72.9
17	37.5	50	54.5	83	73.5
18	38.0	51	55.0	84	74.1
19	38.5	52	55.6	85	74.6
20	39.0	53	56.1	86	75.2
21	39.5	54	56.7	87	75.8
22	40.0	55	57.3	88	76.4
23	40.5	56	57.9	89	77.0
24	41.0	57	58.4	90	77.6
25	41.5	58	59.0	91	78.2
26	42.0	59	59.6	92	78.8
27	42.5	60	60.2	93	79.4
28	43.0	61	60.7	94	80.1
29	43.5	62	61.3	95	80.7
30	44.0	63	61.9	96	81.3
31	44.5	64	62.4	97	81.9
32	45.0	65	63.0	98	82.5

Solubility in 100 pts. H<sub>2</sub>O at t°.—Continued.

t°	Pts. NiSO <sub>4</sub>	t°	Pts. NiSO <sub>4</sub>	t°	Pts. NiSO <sub>4</sub>
99	83.1	103	85.6	107	88.1
100	83.7	104	86.2	108	88.7
101	84.3	105	86.8	108.4	88.7
102	84.9	106	87.5	...	...

(Mulder, calculated from his own and Tobler's determinations, Scheik. Verhandel. 1864. 70.)

Solubility in H<sub>2</sub>O at t°.

Salt used	t°	g. NiSO <sub>4</sub> in 100 g H <sub>2</sub> O	Salt remaining
NiSO <sub>4</sub> +7H <sub>2</sub> O	-5	25.74	NiSO <sub>4</sub> +7H <sub>2</sub> O
"	0	27.22	"
"	9	31.55	"
"	15	34.19	"
"	22.6	37.90	"
"	22.8	38.88	"
"	30.0	42.46	"
NiSO <sub>4</sub> +6H <sub>2</sub> O	30.0	42.47	"
NiSO <sub>4</sub> +7H <sub>2</sub> O	32.3	44.02	"
"	33.0	45.74	"
"	34.0	45.5	"

(Steele and Johnson, Chem. Soc. 1904, 85. 116.)

M.-pt. of NiSO<sub>4</sub>+7H<sub>2</sub>O=98-100°. (Tilden, Chem. Soc. 45. 409.)

Tr. point from a-6H<sub>2</sub>O salt to 7H<sub>2</sub>O salt=31.5°. (Steele and Johnson.)

Exists also in an unstable, more soluble modification. (Fedorow, C. C. 1903, II. 95.)

Solubility of NiSO<sub>4</sub>.7H<sub>2</sub>O+Na<sub>2</sub>SO<sub>4</sub>.10H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
0	22.46	10.09
5	25.28	15.245
10	28.26	20.64

(Koppel, Z. phys. Ch. 1905, 52. 401.)

See also under NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>.

100 pts. absolute methyl alcohol dissolve 46 pts. NiSO<sub>4</sub>+7H<sub>2</sub>O at 17°; 100 pts. absolute methyl alcohol dissolve 24.7 pts. NiSO<sub>4</sub>+7H<sub>2</sub>O at 4°; 100 pts. 93.5% methyl alcohol dissolve 10.1 pts. NiSO<sub>4</sub>+7H<sub>2</sub>O at 4°; 100 pts. 50% methyl alcohol dissolve 2 pts. NiSO<sub>4</sub>+7H<sub>2</sub>O at 4°. (de Bruyn, Z. phys. Ch. 18. 786.)

Solubility in methyl alcohol + Aq at 14°. Time, 5 to 6 hrs.

Alcohol % by wt.	% NiSO <sub>4</sub>	In 1000 mol. of solution		
		Mol. NiSO <sub>4</sub>	Mol. CH <sub>3</sub> O	Mol. H <sub>2</sub> O
100	16.8	35.7	714	250
97.5	13.9	29	734	237
95	11.6	23.6	742	234.5
92.5	8.12	16.2	760	224
90	5.78	11.2	758	231
85	1.52	3	744	253
84	1.06	...	...	...
83	0.985	...	...	...
82	0.83	...	...	...
81	0.665	...	...	...
80	0.653	1.2	687	312
60	0.805	1.3	453	546
45	1.73	...	...	...
40	2.78	4	264	732
35	4.55	...	...	...
30	6.33	...	...	...
20	13.7	20	105	875
0 (water)	26.4	39.5	0	960.5

(de Bruyn, R. t. c. 1903, 22. 411.)

100 g. absolute ethyl alcohol dissolve 1.3 g. NiSO<sub>4</sub> + 7H<sub>2</sub>O at 4°, and 2.2 g. at 17°. (de Bruyn, Z. phys. Ch. 10. 786.)  
Min. *Morenosite*.

**Nickel hydrazine sulphate, NiH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.**

1 pt. is sol. in 275.5 pts. H<sub>2</sub>O at 18°. Sl. sol. in hot H<sub>2</sub>O. Sol. in HNO<sub>3</sub> with decomp.; insol. in HCl. Sol. in NH<sub>4</sub>OH + Aq. (Curtius, J. pr. 1894, (2) 80. 331.)

**Nickel potassium sulphate, NiSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub> + 6H<sub>2</sub>O.**

Sol. in 8-9 pts. H<sub>2</sub>O. (Tupputi.)

100 pts. H<sub>2</sub>O dissolve at:

0° 10° 14° 20° 30°  
5.3 8.9 10.5 13.8 18.6 pts. anhydrous salt,

26° 49° 55° 60° 75°  
20.4 27.7 32.4 35.4 45.6 pts. anhydrous salt.

(Tobler, A. 95. 193.)

Saturated solution contains at:

20° 40° 60° 80°  
8.7 12.3 17.6 22.0% anhydrous salt.

(v. Hauer, J. pr. 74. 433.)

1 l. H<sub>2</sub>O dissolves 68.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Nickel potassium zinc sulphate, NiSO<sub>4</sub>, 2K<sub>2</sub>SO<sub>4</sub>, ZnSO<sub>4</sub> + 12H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Vohl, A. 94. 51.)

**Nickel rubidium sulphate, NiSO<sub>4</sub>, Rb<sub>2</sub>SO<sub>4</sub> + 6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Tutton, Chem. Soc. 63. 337.)  
1 l. H<sub>2</sub>O dissolves 59.8 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Nickel sodium sulphate, NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.**

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
20	29.31	26.87
25	27.33	25.33
30	24.64	22.58
35	23.66	21.67
40	21.88	20.65

(Koppel, Z. phys. Ch. 1905, 52. 401.)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O + NiSO<sub>4</sub> · 7H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>	t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18.5	30.70	25.805	30	34.98	19.825
20	31.59	25.355	35	36.01	16.435
25	33.11	23.07	40	37.935	14.295

(Koppel.)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O + Na<sub>2</sub>SO<sub>4</sub> · 10H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
18.5	26.14	29.455
20	24.07	31.365
25	18.81	37.13
30	9.87	44.25

(Koppel.)

Solubility of NiNa<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O + Na<sub>2</sub>SO<sub>4</sub> (anhydrous) in 100 g. H<sub>2</sub>O at t°.

t°	grams NiSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
35	7.13	49.595
40	7.245	49.03

(Koppel.)

**Nickel thallium sulphate, NiSO<sub>4</sub>, Tl<sub>2</sub>SO<sub>4</sub> + 6H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O. Can be recryst. from little H<sub>2</sub>O without decomp. (Werther, J. pr. 92. 132.)

1 l. H<sub>2</sub>O dissolves 46.1 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Nickel zinc sulphate, NiSO<sub>4</sub>, ZnSO<sub>4</sub> + 13H<sub>2</sub>O.**

Sol. in 3-4 pts. cold H<sub>2</sub>O. Insol. in alcohol. (Tupputi, 1811.)

Completely sol. in NH<sub>4</sub>OH + Aq.  
2NiSO<sub>4</sub>, 2ZnSO<sub>4</sub>, H<sub>2</sub>SO<sub>4</sub>. (Etard, C. R. 87. 602.)



**Nickel sulphate ammonia,  $\text{NiSO}_4 \cdot 6\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$  with separation of hydroxide. (Rose, Pogg. 20. 151.)

$\text{NiSO}_4 \cdot 5\text{NH}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. (André, C. R. 106. 936.)

$\text{NiSO}_4 \cdot 4\text{NH}_3 + 2\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Can be recrystallized out of little  $\text{H}_2\text{O}$ . Insol. even in dil. alcohol. (Erdmann.)

**Nickel sulphate cupric oxide,  $\text{NiSO}_4 \cdot 2\text{CuO} + 6\text{H}_2\text{O}$ .**

(Mailhe, Bull. Soc. 1902, (3) 27. 172.)

$2\text{NiSO}_4 \cdot 3\text{CuO} + 10\text{H}_2\text{O}$ , and  $+12\text{H}_2\text{O}$ . (Mailhe.)

$5\text{NiSO}_4 \cdot 16\text{CuO} + x\text{H}_2\text{O}$ . (Recoura, C. R. 1901, 132. 1415.)

$\text{NiSO}_4 \cdot 20\text{CuO} + x\text{H}_2\text{O}$ . (Recoura.)

**Nickel sulphate, hydrazine,  $\text{NiSO}_4 \cdot 3\text{N}_2\text{H}_4$ .**

Ppt. (Curtius, J. pr. 1894, (2) 50. 343.)

**Nickel sulphate hydroxylamine,  $\text{NiSO}_4 \cdot 6\text{NH}_2\text{OH}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Uhlenhut, A. 1899, 307. 334.)

**Nitrosyl sulphate,  $\text{H}(\text{NO})\text{SO}_4$ .**

See Nitrosulphonic acid.

**Osmious sulphate.**

Easily sol. in  $\text{H}_2\text{O}$  and alcohol.

**Osmic sulphate.**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Palladous sulphate, basic,  $\text{PdSO}_4 \cdot 7\text{PdO} + 6\text{H}_2\text{O}$ , and  $10\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Kane.)

**Palladous sulphate,  $\text{PdSO}_4 \cdot 2\text{H}_2\text{O}$ .**

Deliquescent in moist air; very sol. in  $\text{H}_2\text{O}$ , but decomp. by much  $\text{H}_2\text{O}$ , with separation of a basic salt. (Kane.)

**Phosphoryl sulphate,  $(\text{PO})_2(\text{SO}_4)_2$  (?).**

Possible composition of Weber's (B. 20. 86)  $\text{P}_2\text{O}_5 \cdot 3\text{SO}_3$  (?).

$3\text{P}_2\text{O}_5 \cdot 2\text{SO}_3$ . Immediately decomp. by  $\text{H}_2\text{O}$ . (Adie, G. N. 1891, 63. 102.)

**Platinic sulphate,  $\text{Pt}(\text{SO}_4)_3$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, or ether; also in  $\text{H}_3\text{PO}_4$ ,  $\text{HCl}$ , and  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)

$\text{H}_2\text{PtO}_4 \cdot \text{SO}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Blondel, A. ch. 1905, (8) 6. 109.)

$\text{PtO}_2 \cdot \text{SO}_3 + 4\text{H}_2\text{O}$ . Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$ .

$\text{PtSO}_4(\text{OH})_2 \cdot 4\text{Pt}(\text{OH})_4 + 3\text{H}_2\text{O}$ . Ppt. (Prost, Bull. Soc. (2) 46. 156.)

$\text{Pt}_2\text{SO}_4\text{O}_{11} + 16\text{H}_2\text{O}$ . As above. (Prost.)

**Platinum hydroxylamine sulphate,  $\text{Pt}(\text{NH}_2\text{OH})_2\text{SO}_4$ .**

Only sl. sol. in  $\text{H}_2\text{O}$ ; sol. in dil  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Uhlenhut, A. 1900, 311. 123.)

**Platinic potassium sulphate, basic.**

Insol. in boiling  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in boiling  $\text{HCl} + \text{Aq}$ . Sl. decomp. by aqua regia. (E. Davy.)

$\text{Pt}_{10}(\text{SO}_4)_2\text{O}_{10} \cdot 3\text{K}_2\text{SO}_4 + 34\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Prost, Bull. Soc. (2) 46. 156.)

$\text{Pt}_{12}(\text{SO}_4)_2\text{O}_{12} \cdot 5\text{K}_2\text{SO}_4 + 34\text{H}_2\text{O}$ . As above. (Prost.)

**Platinum rubidium sulphate,  $\text{Pt}_2\text{Rb}_2(\text{SO}_4)_4 + 17\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Prost, Bull. Soc. (2) 46. 156.)

**Platinum sulphate sulphocarbamide,  $\text{PtSO}_4 \cdot 4\text{CS}(\text{NH}_2)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$  without decomp. (Kurnakow. J. pr. 1894, (2) 50, 489.)

**Potassium sulphate,  $\text{K}_2\text{SO}_4$ .**

Not hygroscopic in the ordinary sense of the word. 100 pts.  $\text{K}_2\text{SO}_4$  over  $\text{H}_2\text{O}$  at  $14-20^\circ$  absorb 58 pts.  $\text{H}_2\text{O}$  in 22 days, and finally deliquesce completely. (Mulder.)

12 pts.  $\text{K}_2\text{SO}_4$  mixed with 100 pts.  $\text{H}_2\text{O}$  lower the temp.  $3.3^\circ$ . (Rüdorff, B. 2. 68.)

100 pts.  $\text{H}_2\text{O}$  dissolve with absorption of heat at  $0^\circ$ :

8.36 pts.  $\text{K}_2\text{SO}_4$ . (Gay-Lussac.)

8.46 " (Mulder.)

8.5 " (Gerardin.)

7.31 " (Möller, Pogg. 117. 386.)

7.3-7.9 " (Nordenkiöld, Pogg. 136. 314.)

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 8.36 pts.  $\text{K}_2\text{SO}_4$ ; at  $12.72^\circ$ , 10.57 pts.; at  $49.06^\circ$ , 16.91 pts.; at  $63.90^\circ$ , 19.29 pts.; at  $101.50^\circ$ , 26.33 pts. (Gay Lussac, A. ch. (2) 11. 311.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{K}_2\text{SO}_4$	$t^\circ$	Pts. $\text{K}_2\text{SO}_4$
0	7.8	47.0	16.0
15.65	10.3	70.2	20.3
28.1	12.8	98.0	23.9

(Nordenkiöld, Pogg. 136. 341.)

100 pts. sat.  $\text{K}_2\text{SO}_4$  at  $101.7^\circ$  contain 17.5 pts.  $\text{K}_2\text{SO}_4$ , or 100 pts.  $\text{H}_2\text{O}$  at  $101.25^\circ$  dissolve 21.212 pts.  $\text{K}_2\text{SO}_4$ . (Griffiths.)

100 pts.  $\text{H}_2\text{O}$  at  $102.8^\circ$  dissolve 29 pts.  $\text{K}_2\text{SO}_4$ . (Penny); at  $15^\circ$ , 7.3-6.25 pts. (Ure's Dict.); at  $100^\circ$ , 20 pts. (Ure's Dict.); at  $100^\circ$ , 24.2 pts. (Wenzel.)

Sol. in 9.081 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach); in 16 pts. at  $15^\circ$  and 5 pts. at  $100^\circ$  (Bergmann); in 18 pts. cold, and 5 pts. boiling  $\text{H}_2\text{O}$  (Fourcroy); in 15 pts. cold, and 5 pts. boiling  $\text{H}_2\text{O}$  (Reid); in 12 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ , and 4 pts. boiling  $\text{H}_2\text{O}$  (M. R. and P.); in 12 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abt.).

$\text{K}_2\text{SO}_4$  sat. at  $15^\circ$  has sp. gr. = 1.0774, and contains 10.055 pts.  $\text{K}_2\text{SO}_4$  in 100 pts.  $\text{H}_2\text{O}$ . (Michel and Kraft, A. ch. (3) 41. 478.)

100 pts.  $\text{H}_2\text{O}$  dissolve 9.26 pts.  $\text{K}_2\text{SO}_4$  at  $15.6^\circ$ , and sat. solution has sp. gr. = 1.177. (Page and Keightley, Chem. Soc. (2) 10. 566.)

Solubility in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $K_2SO_4$	$t^\circ$	Pts. $K_2SO_4$	$t^\circ$	Pts. $K_2SO_4$
0	8.5	35	13.1	70	19.8
1	8.6	36	13.3	71	20.0
2	8.7	37	13.4	72	20.2
3	8.8	38	13.6	73	20.4
4	9.0	39	13.8	74	20.6
5	9.1	40	14.0	75	20.8
6	9.2	41	14.2	76	21.0
7	9.3	42	14.3	77	21.2
8	9.4	43	14.5	78	21.4
9	9.5	44	14.7	79	21.6
10	9.7	45	14.9	80	21.8
11	9.8	46	15.1	81	22.0
12	9.9	47	15.3	82	22.2
13	10.0	48	15.5	83	22.4
14	10.2	49	15.6	84	22.6
15	10.3	50	15.8	85	22.8
16	10.4	51	16.0	86	23.0
17	10.5	52	16.2	87	23.2
18	10.7	53	16.4	88	23.4
19	10.8	54	16.6	89	23.6
20	10.9	55	16.8	90	23.9
21	11.1	56	17.0	91	24.1
22	11.2	57	17.2	92	24.3
23	11.3	58	17.4	93	24.5
24	11.5	59	17.6	94	24.7
25	11.6	60	17.8	95	25.0
26	11.7	61	18.0	96	25.2
27	11.9	62	18.2	97	25.5
28	12.0	63	18.4	98	25.7
29	12.2	64	18.6	99	25.9
30	12.3	65	18.8	100	26.2
31	12.5	66	19.0	101	26.4
32	12.6	67	19.2	102	26.6
33	12.8	68	19.4	102.25	26.75
34	13.0	69	19.6	...	...

(Mulder, calculated from his own and other experiments, Scheik. Verhandel. 1864. 50.)

If solubility  $S$  = pts. anhydrous salt in 100 pts. of solution,  $S = 7.5 + 0.1070t$  from  $0^\circ$  to  $163^\circ$ . Solubility from  $163^\circ$  to  $220^\circ$  is constant at 25. (Étard, C. R. 106. 208.)

Solubility of  $K_2SO_4$  in 100 pts.  $H_2O$  at  $t^\circ$ .

$t^\circ$	Pts. $K_2SO_4$	$t^\circ$	Pts. $K_2SO_4$	$t^\circ$	Pts. $K_2SO_4$
16	9.76	39	14.21	120	26.5
20	10.30	54	17.39	143	28.8
28	12.59	98	23.91	170	32.9
36	13.28	..	...	...	...

(Tilden and Shenstone, Phil. Trans. 1864. 23.)

Solubility of  $K_2SO_4$  in  $H_2O$ . 100 pts.  $H_2O$  dissolve at:

4.3°    18.4°    69.9°  
8.16°    10.8    19.7 pts.  $K_2SO_4$ .

(Andrae, J. pr. (2) 29. 456.)

100 ccm.  $H_2O$  dissolve 12.04 g.  $K_2SO_4$  at  $25^\circ$ . (Trevor, Z. phys. Ch. 7. 468.)

Sat.  $K_2SO_4$  + Aq contains at:

21°    23°    60°    99°    130°  
10.1    10.3    14.5    19.1    21.1%  $K_2SO_4$ ,  
130°    152°    175°    195°    220°  
21.3    22.8    24.5    23.8    24.6%  $K_2SO_4$ .  
(Étard, A. ch. 1894, (7) 2. 549.)

Solubility of  $K_2SO_4$  in  $H_2O$  at  $t^\circ$ .

G.  $K_2SO_4$  per 100 g.  $H_2O$

$t^\circ$	$K_2SO_4$	Sp. gr.	$t^\circ$	$K_2SO_4$	Sp. gr.
0.40	7.47	1.0589	58.95	18.01	1.1089
15.70	10.37	1.0770	74.85	20.64	1.1157
31.45	13.34	1.0921	89.70	22.80	1.1194
42.75	15.51	1.1010	101.1°	24.21	1.1207

\* = b-pt.

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203. A, 189.)

100 g.  $H_2O$  dissolve 0.133 gram-equivalent  $K_2SO_4$  at  $25^\circ$  (Van't Hoff and Meyerhoffer, Z. phys. Ch. 1904, 49. 315.)

1 l. sat  $K_2SO_4$  + Aq at  $25^\circ$  contains 0.617 mols.  $K_2SO_4$ . (Herz, Z. anorg. 1911, 73. 274.)

Solubility of  $K_2SO_4$  in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $K_2SO_4$
4.78	7.82
30.05	11.43
54.20	14.77
68.90	16.40

(Le Blanc and Schmandt, Z. phys. Ch. 1911, 77. 614.)

100 g.  $H_2O$  dissolve 12.10 g.  $K_2SO_4$  at  $25^\circ$ . (Amadori, Rend. Acc. Linc. 1912, (5) 21. II. 667.)

Solubility of  $K_2SO_4$  in  $H_2O$  at various pressures. Figures denote pts.  $K_2SO_4$  contained in 100 pts. sat.  $K_2SO_4$  + Aq at  $t^\circ$  and A pressure in atmospheres.

A	$0^\circ$	$15^\circ$	$15.5^\circ$	$16.2^\circ$
1	6.81	9.14	9.24	9.35
20	7.14	...	9.44	9.54
30	7.14	...	...	...

(Möller, Pogg. 117. 386.)

Sat.  $K_2SO_4$  + Aq boils at  $101.5^\circ$ , and contains 26.33 pts.  $K_2SO_4$  to 100 pts.  $H_2O$  (Gay-Lussac); at  $101.7^\circ$ , and contains 21.2 pts.  $K_2SO_4$  to 100 pts.  $H_2O$  (Griffiths); at  $102.25^\circ$ , and contains 26.75 pts.  $K_2SO_4$  to 100 pts.  $H_2O$  (Mulder); boils at  $103^\circ$  (Kremers).

Crust forms at  $101.7^\circ$ , and solution contains 25.3 pts.  $K_2SO_4$  to 100 pts.  $H_2O$ ; highest

temp. observed, 102.1°. (Gerlach, Z. anal. 26. 426.)

B-pt. of  $K_2SO_4$ +Aq containing pts.  $K_2SO_4$  to 100 pts.  $H_2O$ .

B-pt.	Pts. $K_2SO_4$	B-pt.	Pts. $K_2SO_4$
100.5°	7	102°	30.0
101.0	14.5	102.1	31.6
101.5	22.1	...	...

(Gerlach, Z. anal. 26. 430.)

Sp. gr. of  $K_2SO_4$  at 19.5°.

% $K_2SO_4$	Sp. gr.	% $K_2SO_4$	Sp. gr.
2.401	1.0193	9.264	1.0763
4.744	1.0383	10.945	1.0909
6.968	1.0568	...	...

(Kremers, Pogg. 95. 120.)

Sp. gr. and B-pt. of  $K_2SO_4$ +Aq at 12.5°.

Pts. $K_2SO_4$ to 100 pts. $H_2O$	Sp. gr.	B-pt.	Pts. $K_2SO_4$ to 100 pts. $H_2O$	Sp. gr.	B-pt.
1	1.0079	100.38°	6	1.0456	101.12°
2	1.0151	100.63°	7	1.0524	101.25°
3	1.0231	100.75°	8	1.0599	101.25°
4	1.0305	100.88°	9	1.0676	101.38°
5	1.0391	101°	10	1.0735	101.5°

(Brandes and Gruner, 1837.)

$K_2SO_4$ +Aq sat. at 8° has 1.072 sp. gr. (Anthon, A. 24. 211.)

$K_2SO_4$ +Aq saturated at 12° contains 10.38%  $K_2SO_4$  and has sp. gr. 1.0716 (Struve, Zeit. Ch. (2) 5. 323); saturated at 15° contains 11.01%  $K_2SO_4$  and has sp. gr. 1.0831 (Gerlach); saturated at 18.75° contains 10.74%  $K_2SO_4$  and has sp. gr. 1.0798 (Karsten).

Sp. gr. of  $K_2SO_4$ +Aq at 15°.

% $K_2SO_4$	Sp. gr.	% $K_2SO_4$	Sp. gr.	% $K_2SO_4$	Sp. gr.
1	1.0082	5	1.0410	8	1.0664
2	1.0163	6	1.0495	9	1.0750
3	1.0245	7	1.0579	9.92	1.0830
4	1.0328	...	...	...	...

(Gerlach, Z. anal. 8. 287.)

Sp. gr. of  $K_2SO_4$ +Aq at 18°.

% $K_2SO_4$	Sp. gr.
5	1.0395
10	1.0615

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $K_2SO_4$ +Aq at 15°/15°. a=pts.  $K_2SO_4$  in 100 pts. of the solution; b=pts.  $K_2SO_4$  in 100 pts.  $H_2O$ .

a	b	Sp. gr.
1	1.010	1.00808
3	3.093	1.02447
5	5.263	1.04091
7	7.527	1.05776
9	9.890	1.07499
9.92	11.013	1.08305

(Gerlach, Z. anal. 28. 493.)

Sp. gr. of  $K_2SO_4$ +Aq at 20° containing 0.5 mol.  $K_2SO_4$  to 100 mols.  $H_2O$ =1.03758; containing 1 mol.  $K_2SO_4$  to 100 mols.  $H_2O$ =1.06744. (Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of  $K_2SO_4$ +Aq at 25°.

Concentration of $K_2SO_4$ +Aq	Sp. gr.
1-normal	1.0664
$\frac{1}{2}$ "	1.0338
$\frac{1}{3}$ "	1.0170
$\frac{1}{4}$ "	1.0064

(Wagner, Z. phys. Ch. 1890, 5. 37.)

$K_2SO_4$ +Aq. containing 6.7%  $K_2SO_4$  has sp. gr. 20°/20°=1.0549. (Le Blanc and Rohland, Z. phys. Ch. 1896, 19. 278.)

Sp. gr. of  $K_2SO_4$ +Aq at 20.1°, when p=per cent strength of solution; d=observed density; w=volume conc. in gr. per cc. ( $\frac{pd}{100}=w$ .)

p.	d.	w.
9.83	1.0800	0.10615
8.172	1.0657	0.08708
6.779	1.0539	0.07144
5.021	1.0394	0.05218
3.127	1.0238	0.03202
2.508	1.0186	0.02554
1.448	1.0100	0.01463
1.079	1.0070	0.01067
1.047	1.0066	0.01053
0.455	1.0018	0.00456

(Barnes, J. phys. Chem. 1898, 2. 543.)

Sp. gr. of  $K_2SO_4$ +Aq at 18°.

$\frac{1}{2}$ $K_2SO_4$ g.-equiv. per l.	Sp. gr. at 18°
0.8327	1.0567
0.7975	1.0539
0.6688	1.0456
0.5029	1.0344
0.5016	1.0340
0.2508	1.0173
0.01001	1.0006

(McKay, Elektrochem. Zeit. 1899, 6. 115.)

Sp. gr. of sat.  $K_2SO_4 + Aq$  at  $t^\circ$ .

$t^\circ$	g. $K_2SO_4$ sol. in 100 g. $H_2O$	Sp. gr.
0	7.35	1.068
10	9.22	1.069
20	11.11	1.081
30	12.97	1.089
40	14.76	1.097
50	16.50	1.106
60	18.17	1.114
70	19.75	1.121

(Tschernaj, J. Russ. phys. Chem. Soc. 1912, 44, 1565.)

Sol. in conc. acids; not pptd. by glacial  $HC_2H_3O_2$ . Insol. in  $KOH + Aq$  of 1.35 sp. gr. (Liebig, A. 11, 282.)Solubility of  $K_2SO_4$  in  $H_2SO_4 + Aq$  at  $18^\circ$ .

Mols. per 100 mols. solution		Solid phase
$K_2SO_4$	$H_2SO_4$	
1.10	0	$K_2SO_4$
1.59	0.95	"
2.49	2.70	"
2.75	3.17	$K_2SO_4, KHSO_4$
2.75	3.74	"
2.83	5.08	"
2.80	5.79	$K_2SO_4, 3KHSO_4$
2.61	5.61	$K_2SO_4, 6KHSO_4$
2.25	6.19	" + $KHSO_4$
1.08	7.94	$KHSO_4$
0.77	9.2	"
0.44	22.7	"

(Stortenbecker, R. t. c. 1902, 21, 407.)

Solubility in  $H_2SO_4 + Aq$  at  $0^\circ$ .

1000 g. of the solution contain		Solid phase
Mols $H_2SO_4$	Mols $K_2SO_4$	
...	0.393	$K_2SO_4$
0.37	0.53	"
0.75	0.64	"
1.08	0.74	$K_2SO_4 + K_2H(SO_4)_2$
1.13	0.73	$K_2H(SO_4)_2$
1.44	0.71	"
1.66	0.69	"
1.89	0.66	$K_2H(SO_4)_2 + Ka$
1.88	0.69	"
2.15	0.59	$Ka + Kb$
2.12	0.61	"
2.29	0.54	$Kb$
2.30	0.53	$Kb + KHSO_4$
2.33	...	"
2.48	0.43	$KHSO_4$
3.08	0.28	"
4.43	0.12	"
5.27	0.09	"

These results show that at  $0^\circ$  there existbetween  $K_2H(SO_4)_2$  and  $KHSO_4$ , two acid sulphates,  $Ka$  and  $Kb$ .  $Ka$  is probably  $K_2SO_4, 3KHSO_4$  and  $Kb$  is probably  $K_2SO_4, 6KHSO_4$ .

(D'Ans, Z. anorg. 1909, 63, 228.)

3.1 mols.  $K_2SO_4$  are sol. in absolute  $H_2SO_4$  at  $25^\circ$ . (Bergius, Z. phys. Ch. 1910, 73, 353.)Solubility in  $H_2SO_4 + Aq$  at  $25^\circ$ .

Millimols $H_2SO_4$ in 10 cm.	Millimols $K_2SO_4$ in 10 cm.
3.97	6.17
7.57	8.92
14.35	10.82
	14.86

(Hertz, Z. anorg. 1912, 73, 276.)

Solubility in  $H_2SO_4 + Aq$  at  $25^\circ$ .

In 1000 g. of the solution		Solid phase
Mols $SO_3$	Mols $K_2SO_4$	
6.42	0.171	$KHSO_4$
6.60	0.190	"
6.91	0.266	$KHSO_4 + KH_2(SO_4)_2, H_2O$
7.26	0.182	"
7.62	0.157	"
7.88	0.167	"
8.00	0.201	"
8.10	0.250	$KH_2(SO_4)_2, H_2O$
8.15	0.352	"
8.16	0.364	$KH_2(SO_4)_2, H_2O + KH_2(SO_4)_2$
8.29	0.341	"
8.33	0.322	"
8.45	0.325	"
8.62	0.346	"
8.57	0.384	$KH_2(SO_4)_2$
8.71	0.412	"
8.82	0.583	$KH_2(SO_4)_2$
8.65	0.880	$KH_2(SO_4)_2 + KHSO_4$
8.63	0.899	$KHSO_4$ (metastable solution)
8.70	0.882	"
8.96	0.561	"
9.80	0.365	"
9.78	0.430	"
9.80	0.665	$KHSO_4$
9.66	0.904	"
9.66	0.937	"

(D'Ans, Z. anorg. 1913, 80, 239.)

Pptd. from  $K_2SO_4 + Aq$  by  $NH_4OH + Aq$ . (Sullivan.)

Solubility of  $K_2SO_4$  in  $NH_4OH + Aq$  at  $20^\circ$ .

G. $NH_3$ in 100 ccm. $H_2O$	G. $K_2SO_4$ in 100 ccm. $H_2O$
0	10.804
6.08	4.100
15.37	0.828
24.69	0.140
31.02	0.042

(Girard, Bull. Soc. (2) 43. 522.)

1 l. sat. solution in  $H_2O$  contains 105.7 g.  $K_2SO_4$  at  $20^\circ$ ; in  $NH_4OH + Aq$  (5.2%  $NH_3$ ), 45.2 g. (Konowalow, J. Russ. Phys. Chem. Soc. 1894, 31. 985.)

Solubility of  $K_2SO_4$  in  $KOH + Aq$  at  $25^\circ$ .

In 1000 g. of the solution	
Mols $K_2SO_4$	Mols $(KOH)_2$
0.617	0.0
0.433	0.258
0.280	0.433
0.137	1.13
0.035	2.86
0.009	3.42
0.0	4.809

(D'Ans and Schreiner, Z. anorg. 1910, 67. 438.)

Sol. in sat.  $NH_4Cl + Aq$  without pptn. (See  $NH_4Cl$ .)

Sl. sol. in sat.  $KCl + Aq$  without pptn. 100 g. sat  $KCl + Aq$  at  $25^\circ$  dissolve 0.0167 g. equiv.  $K_2SO_4$  at  $25^\circ$ . (Van't Hoff and Meyerhoffer Z. phys. Ch. 1904. 49. 315.)

Sl. sol. in sat.  $KNO_3 + Aq$  without causing pptn.

1 l. of the solution contains 50.7 g.  $K_2SO_4 + 216.5$  g.  $KNO_3 = 267.2$  g. mixed salts at  $15^\circ$ . Sp. gr.  $K_2SO_4 + KNO_3 + Aq = 1.165$ .

1 l. of the solution contains 47.66 g.  $K_2SO_4 + 308.5$  g.  $KNO_3 = 356.2$  g. mixed salts at  $25^\circ$ . Sp. gr. of  $K_2SO_4 + KNO_3 + Aq = 1.210$ . (Euler, Z. phys. Ch. 1904, 49. 313.)

See also under  $KNO_3$ .

Sol. in sat.  $NaNO_3 + Aq$  without causing pptn. at first, but soon  $KNO_3$  is pptd. (Karsten.) (See  $NaNO_3$ .)

Sol. in  $(NH_4)_2SO_4 + Aq$  with pptn. of  $(NH_4)_2SO_4$ . (Rüdruff, B. 6. 485.) (See  $(NH_4)_2SO_4$ .)

More sol. in aqueous solutions of other salts, as  $Na_2SO_4$ ,  $MgSO_4$ ,  $CuSO_4$ , etc., than in pure  $H_2O$ . (Pfaff, A. 99. 227.)

Sol. in sat.  $Na_2SO_4 + Aq$ ,  $MgSO_4 + Aq$ ,  $NaCl + Aq$ . (See  $MgSO_4$  and  $NaCl$ .)

Solubility of  $K_2SO_4$  in  $Na_2SO_4 + Aq$ .

Temp. $= 34^\circ$		Temp. $= 60^\circ$	
% $Na_2SO_4$	% $K_2SO_4$	% $Na_2SO_4$	% $K_2SO_4$
0	11.9	0	15.3
7.1	10.7	6.6	13.9
31.4	4.3	27.1	8.2
33.1	0	31.3	0

(Nacken, B. A. B. 1910. 1016.)

100 g.  $H_2O$  sat. with both  $K_2SO_4$  and  $Th_2SO_4$  dissolve:

4.74 g.  $Th_2SO_4 + 10.3$  g.  $K_2SO_4$  at  $15^\circ$ .  
11.5 g. " + 16.4 g. " "  $62^\circ$ .  
18.52 g. " + 26.2 g. " "  $100^\circ$ .

(Rabe, Z. anorg. 1902, 31. 156.)

Sl. sol. in sat.  $ZnSO_4$  or  $CuSO_4 + Aq$  with separation of double salt.

100 pts.  $H_2O$  dissolve 8.5 + 0.12t pts.  $K_2SO_4$ . On addition of a K salt,  $K_2SO_4$  is pptd. The amount of  $K_2SO_4$  remaining in solution plus the amt. of K in the salt added is a constant. (Blares, C. R. 112. 939.)

Solubility of  $K_2SO_4 + Th(SO_4)_2$  at  $16^\circ$ .Solid phase,  $Th(SO_4)_2$ .

Pta. per 100 pts $H_2O$		Pta. per 100 pts $H_2O$	
$K_2SO_4$	$Th(SO_4)_2$	$K_2SO_4$	$Th(SO_4)_2$
0.000	1.390	1.487	0.870
0.424	1.667	1.633	0.635
1.004	2.193	1.844	0.370
1.152	3.191	2.512	0.128
1.224	2.514	3.092	0.070
1.283	2.222	4.050	0.027
1.348	1.706	4.825	0.003
1.378	1.637	...	...

(Barre, C. R. 1911, 150. 1555.)

Difficultly sol. in 20%  $KC_2H_3O_2 + Aq$ . (Stromeyer.)

Solubility in K acetate + Aq at  $25^\circ$ .

Composition of the solutions		
% K acetate	% $K_2SO_4$	% $H_2O$
6.11	6.65	87.24
8.68	5.09	86.23
11.29	3.99	84.72
15.59	2.35	82.06
20.12	1.23	78.65
29.95	0.39	69.66

The solid phase in these solutions is  $K_2SO_4$ .

(Fox, Chem. Soc. 1909, 95. 885.)

100 g. hydroxylamine dissolve 3.5 g.  $K_2SO_4$  at  $17-18^\circ$ . (de Bruyn, Z. phys. Ch. 1892, 10. 782.)

Easily sol. in liquid HF. (Franklin, Z. anorg. 1905. 46. 2)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Neither dissolved nor attacked by liquid  $\text{NO}_2$ . (Frankland, Chem. Soc. 1901, 79. 1361.)

Insol. in absolute alcohol.

Insol. in alcohol, the sp. gr. of which is 0.905. (Anthon.)

Solubility in dil. alcohol increases with the temp.

100 pts. alcohol of 0.939 sp. gr. (53% by vol., 45% by weight) dissolve at:

4° 8° 60°  
0.16 0.21 0.92 pts.  $\text{K}_2\text{SO}_4$ .

(Gerardin, A. ch. (4) 5. 147.)

100 pts. of the sat. solution at 15° in alcohol of:

10 20 30 40% by weight,  
contain 3.9 1.46 0.56 0.21 pts.  $\text{K}_2\text{SO}_4$ .

(Schiff, A. 118. 362.)

Solubility in acetic acid + Aq at 25°.

Concentration of the acetic acid Mol./Liter	Solubility of $\text{K}_2\text{SO}_4$ Mol./Liter
0.000	0.6714
0.070	0.6619
0.137	0.6559
0.328	0.6350
0.578	0.6097
1.151	0.5556
2.183	0.4743

(Rothmund and Wilmore, Z. phys. Ch. 1902, 40. 620.)

Solubility in phenol + Aq at 25°.

Concentration of the phenol Mol./Liter	Solubility of $\text{K}_2\text{SO}_4$ Mol./Liter
0.000	0.6714
0.016	0.6650
0.021	0.6614
0.032	0.6598
0.040	0.6555
0.047	0.6522
0.064	0.6502
0.076	0.6494
0.127	0.6310
0.152	0.6251
0.236	0.6042
0.252	0.5956
0.308	0.5834
0.409	0.5572
0.464	0.5480
0.486	0.5425
0.495	0.5389
0.498 (saturated)	0.5377

(Rothmund and Wilmore, Z. phys. Ch. 1902, 40. 619.)

100 g. 95% formic acid dissolve 36.5 g.  $\text{K}_2\text{SO}_4$  at 21°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Solubility in organic substances + Aq at 25°.

Organic substance	Composition of the solutions		
	% organic substance	% $\text{K}_2\text{SO}_4$	% $\text{H}_2\text{O}$
Alcohol	1.35	9.17	89.48
	4.80	6.90	88.30
	7.80	4.96	87.24
	9.70	4.32	85.98
	12.34	3.57	84.09
	14.51	2.71	82.78
	15.26	2.66	82.08
	20.50	1.83	77.67
	26.91	0.97	72.12
	35.97	0.41	63.62
	43.90	0.22	55.88
	69.26	0.016	30.72
Pyridine	4.23	7.95	87.82
	13.90	4.77	81.33
	24.51	2.75	72.74
	34.19	1.47	64.34
	46.29	0.45	53.26
	55.93	0.12	43.95
	75.90	0.006	24.09
Ethylene glycol	3.16	9.67	87.17
	9.89	7.69	82.53
	18.47	5.74	75.79
	32.11	3.57	64.32
	49.03	1.83	49.14
Chloral hydrate	6.44	9.13	84.43
	9.09	8.41	82.50
	12.38	7.79	79.83
	13.20	7.31	79.49
	22.07	5.88	72.05
	33.15	4.54	62.31
	44.40	3.36	52.24
	47.30	2.92	49.78
	62.82	2.00	35.18
	70.28	1.75	27.97
Glycerol	80.36	1.40	18.24
	85.26	1.08	13.66
	8.96	8.87	82.17
	13.36	7.69	78.95
	20.34	6.47	73.19
Mannitol	24.15	5.83	70.02
	33.73	4.44	61.83
	40.40	3.65	55.95
	43.52	3.38	53.10
	50.18	2.69	47.13
	57.22	2.07	40.71
	67.94	1.53	30.53
	78.18	0.98	20.84
	98.28	0.73	0.99
	3.20	10.32	86.48
	5.82	10.07	84.11
	8.35	9.61	82.04
	11.26	9.19	79.55
	14.30	8.66	77.04
	17.22	8.35	74.43

Solubility in organic substances + Aq at 25°.—  
*Continued.*

Organic substance	Composition of the solutions		
	% organic substance	% K <sub>2</sub> SO <sub>4</sub>	% H <sub>2</sub> O
Sucrose	9.56	9.65	80.79
	18.55	8.65	72.80
	28.16	7.42	64.42
	37.24	6.35	56.41
	47.55	5.21	47.24
	57.00	4.24	38.76
Acetone	4.92	7.20	87.88
	10.06	5.02	84.92
	16.23	2.96	80.81
	24.31	1.50	74.19
	37.19	0.47	62.34
	46.29	0.20	53.51
	62.40	0.03	37.57

(Fox and Gage, Chem. Soc. 1910, 97. 381.)

Sol. in 76 pts. glycerine of 1.225 sp. gr. at ordinary temp. (Vogel, N. Repert. 16. 557.)

Insol. in acetone. (Krug and M'Elroy; Eidman, C. C. 1899, II. 1014.)

Insol. in CS<sub>2</sub>. (Arctowski, Z. anorg. 1894, 6. 257); benzonitrile. (Naumann, B. 1914, 47. 1370); methyl acetate. (Naumann, B. 1909, 42, 3790); ethyl acetate. (Naumann, B. 1904, 37. 3602.)

100 g. H<sub>2</sub>O dissolve 104 g. K<sub>2</sub>SO<sub>4</sub> + 219.0 g. sugar at 31.25°, or 100 g. sat. solution contain 3.8 g. K<sub>2</sub>SO<sub>4</sub> + 66.74 g. sugar. (Köhler, Z. Ver. Zuckerind. 1897, 47. 447.)

Min. *Glaserite*.

+ ½ H<sub>2</sub>O. 100 pts. H<sub>2</sub>O dissolve 9.82 pts. (Ogier, C. R. 82. 1055.)

**Tripotassium hydrogen sulphate, K<sub>3</sub>H(SO<sub>4</sub>)<sub>3</sub>.**

Sol. in H<sub>2</sub>O.

**Potassium hydrogen sulphate, KHSO<sub>4</sub>.**

1.07 pts. KHSO<sub>4</sub> (= 1 pt. K<sub>2</sub>S<sub>2</sub>O<sub>7</sub>) dissolve:

at 0° in 2.95 pts. H<sub>2</sub>O.

" 20° " 2.08 "

" 40° " 1.59 "

" 100° " 0.88 "

(Kremers, Pogg. 92. 497.)

Sp. gr. of KHSO<sub>4</sub> + Aq at 15° containing:

5 10 15 % KHSO<sub>4</sub>

1.0354 1.0726 1.1116

20 25 27 % KHSO<sub>4</sub>

1.1516 1.1920 1.2110

(Kohlrausch, W. Ann. 1879. 1.)

Sat. solution boils at 105.5° (Griffiths); 108° (Kremers).

Alcohol dissolves out H<sub>2</sub>SO<sub>4</sub>.

K<sub>2</sub>SO<sub>4</sub> crystallises from dilute solutions.

100 g. 95% formic acid dissolve 14.6 g. KHSO<sub>4</sub> at 19.3°. (Aschan, Ch. Ztg. 1913, 37. 1117.)

Insol. in methyl acetate. (Naumann B. 1909, 42, 3790.)

Min. *Misinitz*.

+ 5½ H<sub>2</sub>O. Deliquescent. (Senderens, Bull. Soc. (3) 2. 278.)

**Potassium dihydrogen sulphate, K<sub>2</sub>H<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Phillips, Phil. Mag. 1. 429.)

Composition is 4K<sub>2</sub>O, 780<sub>2</sub> + 3H<sub>2</sub>O, according to Berthelot (A. ch. (4) 30. 442).

**Potassium trihydrogen sulphate, KH<sub>3</sub>(SO<sub>4</sub>)<sub>3</sub>.**

Sol. in H<sub>2</sub>O with rise of temperature. (Schultz, Pogg. 133. 137.)

+ 1½ H<sub>2</sub>O. (Lescœur, C. R. 78. 1044.)

**Potassium disulphate (pyrosulphate), K<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.**

When dissolved in exactly the necessary amount of hot H<sub>2</sub>O for solution, it crystallises on cooling without decomp. Decomp. by excess of H<sub>2</sub>O. (Jacquelin, A. ch. 70. 311.)

Insol. in methyl acetate. (Naumann, B. 1909. 42. 3790.)

**Potassium hydrogen disulphate, KHS<sub>2</sub>O<sub>7</sub>.**

Sol. in fuming H<sub>2</sub>SO<sub>4</sub> without decomposition.

**Potassium octosulphate, K<sub>2</sub>S<sub>8</sub>O<sub>22</sub>.**

Decomp. by H<sub>2</sub>O. (Weber.)

**Potassium praseodymium sulphate, 3K<sub>2</sub>SO<sub>4</sub>, Pr<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O.

Sol. in conc. HCl and HNO<sub>3</sub>. (Von Scheele Z. anorg. 1898, 18. 358.)

**Potassium rhodium sulphate, 3K<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.**

Does not exist. (Leidié, C. R. 107. 234.)

K<sub>2</sub>SO<sub>4</sub>, Rh<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 24H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Piccini, Z. anorg. 1901, 27. 66.)

**Potassium samarium sulphate, 9K<sub>2</sub>SO<sub>4</sub>, 2S<sub>2</sub>Sm<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> + 3H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O.

Sl. sol. in sat. K<sub>2</sub>SO<sub>4</sub> + Aq.

1 l. sat. K<sub>2</sub>SO<sub>4</sub> + Aq dissolves 0.5 g. Sm<sub>2</sub>O<sub>3</sub>. (Cleve, Bull. Soc. (2) 43. 166.)

**Potassium scandium sulphate, 3K<sub>2</sub>SO<sub>4</sub>, Sc<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.**

Very slowly sol. in cold, more easily sol. in warm H<sub>2</sub>O. Insol. in sat. K<sub>2</sub>SO<sub>4</sub> + Aq.

Sol. in H<sub>2</sub>O and in dil. K<sub>2</sub>SO<sub>4</sub> + Aq. (Meyer, Z. anorg. 1914, 86. 279.)

2K<sub>2</sub>SO<sub>4</sub>, Sc<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>. Sol. in K<sub>2</sub>SO<sub>4</sub> + Aq. (Cleve.)

Does not exist. (Nilson.)

**Potassium sodium sulphate, 3K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>.**

100 pts. H<sub>2</sub>O dissolve 40.8 pts. at 103.5°. (Penny, Phil. Mag. (4) 10. 401.)

5K<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>4</sub>. 100 pts. H<sub>2</sub>O at 100° dissolve 25 pts.; at 12.7° 10.1 pts.; at 4.4° 9.2 pts. (Gladstone, Chem. Soc. 6. 111.)

**Potassium strontium sulphate,  $K_2Sr_2(SO_4)_2$ .**

Decomp. by  $(NH_4)_2CO_3 + Aq.$  (Rose, Pogg. **33**, 604.)

$K_2SO_4, SrSO_4$ . This is the only double salt formed from these two components between  $0^\circ$  and  $100^\circ$ .

100 pts. of the sat. solution in equilibrium with  $SrSO_4$  and the double salt contain at:

17.5° 50° 75° 100°  
1.27 1.88 2.71 3.9 pts.  $K_2SO_4$ .

(Barre, C. R. 1909, 149, 292.)

**Potassium tellurium sulphate,  $KHSO_4, 2TeO_3, SO_3 + 2H_2O$ .**

(Metsner, A. ch. 1898, (7) 15, 203.)

**Potassium terbium sulphate.**

Easily sol. in  $H_2O$ . Sl. sol. in  $K_2SO_4 + Aq.$  (Delafontaine, Zeit. Chem. (2) 2, 230.)

**Potassium thallic sulphate,  $KTI(SO_4)_2 + 4H_2O$ .**

Decomp. by  $H_2O$ . (Fortini, Gazz. ch. it. 1905, **35**, (2) 453.)

$2K_2O, TI_2O_3, 4SO_3$ . Insol. in  $H_2O$ . Very difficultly sol. in warm dil.  $H_2SO_4 + Aq.$  (Strecker, A. **135**, 207.)

**Potassium thorium sulphate,  $K_2SO_4, Th(SO_4)_2 + 4H_2O$ .**

Sol. in hot  $H_2O$  containing a few drops HCl. (Barre, A. ch. 1911, (8) 24, 227.)

$2K_2SO_4, Th(SO_4)_2 + 2H_2O$ . Slowly sol. in cold, easily and abundantly in hot  $H_2O$ , and is gradually decomp. by boiling. Easily sol. in acids. Insol. in alcohol. (Berzelius.)

$3.5K_2SO_4, Th(SO_4)_2$ . Insol. in  $K_2SO_4 + Aq.$  of concentrations above 4.5%. (Barre.)

$4K_2SO_4, Th(SO_4)_2 + 2H_2O$ . (Chydenius.)

**Potassium tin (stannous) sulphate,  $K_2SO_4, SnSO_4$ .**

(Marignac.)

**Potassium tin (stannic) sulphate,  $K_2Sn(SO_4)_2$ .**

Easily sol. in  $H_2O$  with decomp.

Sol. in HCl. (Weinland, Z. anorg. 1907, **54**, 250.)

**Potassium tin (stannous) sulphate chloride,  $4K_2SO_4, 4SnSO_4, SnCl_2$ .**

Can be recrystallized from  $H_2O$ . (Marignac, Ann. Min. (5) 12, 62.)

**Potassium titanium sulphate,  $K_2SO_4, Ti(SO_4)_2 + 3H_2O$ .**

Difficultly sol. in  $H_2O$  or HCl + Aq. Decomp. by much  $H_2O$ . (Wallace, Pogg. **102**, 453.)

**Potassium titanyl sulphate,  $2K_2SO_4, 3TiO, SO_4 + 10H_2O$ .**

Very sol. in  $H_2O$  with decomp. Insol. in conc.  $H_2SO_4$ . (Rosenheim, Z. anorg. 1901, **26**, 251.)

$K_2SO_4, TiO_2SO_4 + 7H_2O$ . Very hygroscopic and sol. in  $H_2O$ . (Massachusetts and Pontanelli, C. C. 1909, II, 420.)

$K_2SO_4, (TiO)SO_4$ . (Spence, C. C. 1901, II, 747.)

**Potassium uranous sulphate,  $K_2SO_4, U(SO_4)_2 + H_2O$ .**

Very sl. sol. in  $H_2O$ . (Rammelsberg.)

**Potassium uranyl sulphate,  $K_2SO_4, (UO_2)SO_4 + 2H_2O$ .**

Sol. in 9 pts.  $H_2O$  at  $22^\circ$  and in 0.51 pt. at  $100^\circ$ . Insol. in alcohol. (Ebelmen, A. ch. (3) 5, 211.)

100 pts. of aqueous solution sat. at  $25^\circ$  contain 10.5 pts. salt; at  $70.5^\circ$  contain 23.93 pts. salt. (Rimbach, B. 1904, **37**, 478.)

$+ 3H_2O$ . (de Coninck, Chem. Soc. 1905, **88**, (2) 394.)

$2K_2SO_4, (UO_2)SO_4 + 2H_2O$ . Decomp. by  $H_2O$ .

Cannot be cryst. from rather conc.  $H_2SO_4$ , as it is completely decomp. by it. (Rimbach, B. 1905, **38**, 1572.)

$K_2O, 2UO_3, 3SO_3$ . Ppt. Identical with  $UO_3, OK, SO_3H$  of Scheller, (A. 1867, **144**, 238.) (Kohlschütter, A., 1900, **311**, 11.)

$2K_2SO_4, 3(UO_2)SO_4 + H_2O$ . Sol. in  $H_2O$ . Insol. in alcohol. (Berzelius.)

Does not exist. (Ebelmen.)

**Potassium vanadium sulphate,  $K_2O, V_2O_5, 2SO_3 + 6H_2O = K(VO_2)SO_4 + 3H_2O$ .**

(Friedheim, B. **24**, 1183.)

$= KVO, K_2SO_4, V_2O_5, 2SO_3 + 9H_2O$  of Münsing (Berlin, Dissert. 1889.)

$K_2SO_4, VSO_4 + 6H_2O$ . Sol. in  $H_2O$ . (Piccini, Z. anorg. 1902, **32**, 61.)

$K_2V_2(SO_4)_3 + 24H_2O$ . 100 pts.  $H_2O$  dissolve 198.4 pts. salt. at  $10^\circ$ . Sp. gr. of sat. solution at  $4^\circ/20^\circ = 1.782$ . (Piccini, Z. anorg. 1897, **13**, 446.)

**Potassium vanadyl sulphate,**

$K_2SO_4, (VO)_2(SO_4)_2$ .

Very slowly sol. in  $H_2O$ , still less sol. in dil. alcohol. (Gerland.)

$K_2SO_4, VO(SO_4) + 3H_2O$ . Easily sol. in  $H_2O$ . Sol. in alcohol + conc.  $H_2SO_4$ . (Koppel, Z. anorg. 1903, **35**, 178.)

$K_2SO_4, 2VO(SO_4)$ . Very hygroscopic. Very sol. in  $H_2O$  but goes into solution slowly. (Koppel and Behrendt, B. 1901, **34**, 3935.)

Easily sol. in  $H_2O$ . (Koppel, Z. anorg. 1903, **35**, 174.)

**Potassium yttrium sulphate,  $4K_2SO_4, Y_2(SO_4)_3$ .**

Sol. in 16 pts. cold  $H_2O$ , and in 10 pts. sat.  $K_2SO_4 + Aq.$  and more abundantly if the latter solution contains ammonium salts or free acid. (Berlin.)

$3K_2SO_4, 2Y_2(SO_4)_3$ . 100 ccm. cold sat.



$K_2SO_4 + Aq$  dissolve an amount of this salt corresponding to 4.685 g.  $Y_2O_3$ . (Cleve.)

**Potassium zinc sulphate,  $K_2SO_4, ZnSO_4 + 6H_2O$ .**

Sol. in 5 pts. cold  $H_2O$ . (Bucholz, N. J. Pharm. 9. 2. 26.)

100 pts.  $H_2O$  dissolve at:

0° 10° 15° 25° 36°  
12.6 18.7 22.5 28.8 39.9 pts. hydrous salt,

45° 50° 58° 65° 70°  
51.2 54.0 67.6 81.3 87.9 pts. hydrous salt.  
(Tobler, A. 95. 193.)

100 pts.  $H_2O$  at 15° dissolve 14.8 pts.  $K_2SO_4, ZnSO_4 + 8H_2O$ ; sp. gr. of sat.  $H_2O$  solution at 15° = 1.0939. (Schiff, A. 109. 326.)

1 l.  $H_2O$  dissolves 131.9 g. anhydrous salt at 25°. (Locke, Am. Ch. J. 1902, 27. 459.)

**Potassium zirconium sulphate,  $2K_2O, 6ZrO_2, 7SO_3 + 9H_2O$ .**

Decomp. by  $H_2O$ .

$3K_2O, 3ZrO_2, 7SO_3 + 9H_2O$ . Insol. in  $H_2O$ .  $Zr_2O_3(KSO_4)_2 + 8H_2O$ . Ppt. (Rosenheim, B. 1905, 33. 815.)

**Potassium sulphate vanadate.**

Very difficultly sol. in  $H_2O$ . Insol. in alcohol. (Berzelius.)

**Potassium sulphate antimony trifluoride.**

See Antimony trifluoride potassium sulphate.

**Praseodymium sulphate, basic,  $(PrO)_2SO_4$ .**

Insol. in  $H_2O$ . (Matignon, C. R. 1902, 134. 660.)

Insol. in  $H_2O$ . Nearly insol. in dil. acids. (Wöhler, B. 1913, 46. 1730.)

**Praseodymium sulphate,  $Pr_2(SO_4)_3$ .**

Sol. in  $H_2O$ ; very hygroscopic. 23.64 pts. are sol. in 100 pts.  $H_2O$  at 0° and 17.7 pts. at 20°. (von Scheele, Z. anorg. 1898, 18. 357-358.)

+5 $H_2O$ . Sol. in  $H_2O$ . (von Scheele, Z. anorg. 1898, 18. 357.)

Difficultly sol. in  $H_2O$ . (Kraus, Zeit. Kryst. 1901, 34. 400.)

1.50 pts.  $Pr_2(SO_4)_3$  are sol. in 100 pts.  $H_2O$  at 85°; 1.45 pts. at 90°; and 1.02 pts. at 95°. (Muthmann and Rölig, B. 1898, 31. 1729.)

+8 $H_2O$ . (Kraus, Zeit. Kryst. 1901, 34. 406.)

Sol. in  $H_2O$ . (von Scheele, Z. anorg. 1898, 18. 357.)

Solubility in  $H_2O$  at t°.

t°	Pts. $Pr_2(SO_4)_3$
0	19.79
18	14.10
35	10.31
55	7.09
75	4.13

(Muthmann and Rölig, B. 1898, 31. 1727.)

+15½ $H_2O$ . Sol. in  $H_2O$ . (von Scheele, Z. anorg. 1898, 18. 357.)

**Praseodymium hydrogen sulphate,  $Pr(SO_3H)_3$ .**

(Brauner, Z. anorg. 1904, 33. 330.)

Solubility in boiling conc.  $H_2SO_4$ . 100 g. of the solution contain 1.02 g. of the acid sulphate. (Matignon, C. R. 1902, 134. 659.)

**Radium sulphate.**

Less sol. in  $H_2O$  than corresponding Ba comp. (Curie, Dissert. 1903.)

**Rhodium sulphate,  $Rh_2(SO_4)_3 + 12H_2O$ .**

Easily sol. in  $H_2O$ . (Berzelius.)

Sl. sol. in, but not decomp. by  $H_2O$  when not more than 16 pts.  $H_2O$  are present to 1 pt. salt. Decomp. by hot  $H_2O$  to—  
 $Rh_2(SO_4)_3, Rh_2O_3$ . Insol. in  $H_2O$ . (Leidié, C. R. 107. 234.)

**Rhodium rubidium sulphate,  $Rh_2(SO_4)_3, Rb_2SO_4 + 24H_2O$ .**

Sol. in  $H_2O$ ; m.-pt., 108-109°. (Piccini, Z. anorg. 1901, 37. 65.)

**Rhodium thallium sulphate,  $Rh_2(SO_4)_3, Tl_2SO_4 + 24H_2O$ .**

Very sol.  $H_2O$ . (Piccini, Z. anorg. 1901, 37. 69.)

**Rhodium sodium sulphate,  $Rh_2Na_2(SO_4)_4$ .**

Insol. in  $H_2SO_4$  or aqua regia. (Seubert and Kobbe, B. 23. 2560.)

**Rubidium sulphate,  $Rb_2SO_4$ .**

100 pts.  $H_2O$  dissolve 42.4 pts. at 10°. (Bunsen.)

100 cc.  $H_2O$  at 17-18° dissolve 44.7 g.  $Rb_2SO_4$ . (Tutton, Chem. Soc. 1894, 65. 632.)

Sat.  $Rb_2SO_4 + Aq$  contains at:

3° 20°  
27.4 32.5%  $Rb_2SO_4$

37° 197° 170°  
37.3 43.9 49.2%  $Rb_2SO_4$

(Étard, A. ch. 1894, (7) 2. 550.)

Solubility of  $\text{Rb}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{Rb}_2\text{SO}_4$ per 100 g.		$t^\circ$	g. $\text{Rb}_2\text{SO}_4$ per 100 g.	
	$\text{H}_2\text{O}$	solution		$\text{H}_2\text{O}$	solution
0	36.4	27.3	60	67.4	40.3
10	42.6	29.9	70	71.4	41.7
20	48.2	32.5	80	75.0	42.9
30	53.5	34.9	90	78.7	44.0
40	58.5	36.9	100	81.8	45.0
50	63.1	38.7	102.4*	82.6	45.2

\* B.-pt. at 742.4 mm.

(Berkeley, calc. by Seidell, Solubilities, 2nd Ed., p. 587.)

Sp. gr. of  $\text{Rb}_2\text{SO}_4 + \text{Aq}$  sat. at  $10^\circ = 1.2978$ . (Erdmann, Arch. Pharm. 1894, 232. 16.)G.-equiv. salt per l. at  $18^\circ = 0.501$  1.01Sp. gr.  $6^\circ/6^\circ$  1.05587 1.11047"  $18^\circ/18^\circ$  1.05496 1.10896"  $30^\circ/30^\circ$  1.05433 1.10810G.-equiv. salt per l. at  $18^\circ = 2.043$  3.168Sp. gr.  $6^\circ/6^\circ$  1.21888 1.33276"  $18^\circ/18^\circ$  1.21613 1.32912"  $30^\circ/30^\circ$  1.21443 1.32750

(Clausen, W. Ann. 1914, (4) 44. 1071.)

10 ccm. of sat.  $\text{Rb}_2\text{SO}_4 + \text{absolute } \text{H}_2\text{SO}_4$  contain approx. 5.881 g.  $\text{Rb}_2\text{SO}_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

Insol. in methyl acetate (Naumann, B. 1909, 42. 3790); acetone (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

**Rubidium pyrosulphate,  $\text{Rb}_2\text{S}_2\text{O}_7$ .**Decomp. by  $\text{H}_2\text{O}$ .**Rubidium octosulphate,  $\text{Rb}_8\text{S}_8\text{O}_{22}$ .**Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17. 2497.)**Rubidium hydrogen sulphate,  $\text{RbHSO}_4$ .**Sol. in  $\text{H}_2\text{O}$ .**Rubidium tin (stannic) sulphate,  $\text{Rb}_2\text{Sn}(\text{SO}_4)_2$ .**Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ . (Weinland, Z. anorg. 1907, 54. 250.)**Rubidium thallic sulphate,  $\text{RbTi}(\text{SO}_4)_3$ .**

(Marshall, C. C. 1902, II. 1089.)

 $+4\text{H}_2\text{O}$ . (Fortini, Gazz. ch. it. 1905, 35. (2) 455.)**Rubidium thorium sulphate,  $\text{Rb}_2\text{SO}_4, \text{Th}(\text{S}_2\text{O}_7)_2 + 2\text{H}_2\text{O}$ .**Sl. sol. in  $\text{H}_2\text{O}$ . (Manuelli, Gazz. ch. it. 1903, 32. (2) 523.)**Rubidium titanium sulphate,  $\text{Rb}_2\text{SO}_4, \text{Ti}_2(\text{SO}_4)_3 + 24\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$  acidified with  $\text{H}_2\text{SO}_4$ . Decomp. in neutral aq. solution. (Piccini, Z. anorg. 1898, 17. 359.)Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ . Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ . (Stähler, B. 1905, 38. 2623.)**Rubidium uranyl sulphate,  $\text{Rb}_2(\text{UO}_2)(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ .**Somewhat less sol. in  $\text{H}_2\text{O}$  than K salt. (Rimbach, B. 1904, 37. 479.)**Rubidium vanadium sulphate,  $\text{Rb}_2\text{V}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .**0.177 gram mols. of anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$ . (Locke, Am. Ch. J. 1901, 26. 175.)Insol. in  $\text{H}_2\text{O}$ .Insol. in  $\text{H}_2\text{SO}_4$ . Decomp. by boiling with conc.  $\text{H}_2\text{SO}_4$ .Sol. in  $\text{HCl}$ . (Stähler, B. 1905, 38. 3980.)100 pts.  $\text{H}_2\text{O}$  dissolve 2.56 pts. salt at  $10^\circ$ .Sp. gr. of solution at  $4^\circ/20^\circ = 1.915$ . (Piccini, Z. anorg. 1897, 13. 446.)**Rubidium zinc sulphate,  $\text{Rb}_2\text{SO}_4, \text{ZnSO}_4 + 6\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Bunsen and Kopp, Pogg. 113. 337.)1 l.  $\text{H}_2\text{O}$  dissolves 101 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)**Rubidium zirconium sulphate,  $\text{Zr}_2\text{O}_3, (\text{RbSO}_4)_2 + 15\text{H}_2\text{O}$ .**

Ppt. (Rosenheim, B. 1905, 38. 815.)

**Ruthenic sulphate,  $\text{Ru}(\text{SO}_4)_3$ .**Deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . (Claus, A. 59. 246.)**Samarium sulphate, basic,  $(\text{SmO})_2\text{SO}_4$ .**Insol. in  $\text{H}_2\text{O}$  and in cold dil.  $\text{H}_2\text{SO}_4$ . (Matignon, C. R. 1905, 141. 1231.)**Samarium sulphate,  $\text{Sm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .**Difficultly sol. in  $\text{H}_2\text{O}$ .Much less sol. than  $\text{Di}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ . (Cleve.)2.05 pts. anhydrous salt are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $25^\circ$ . (Keyes and James, J. Am. Chem. Soc. 1914, 36. 635.)100 g.  $\text{Sm}_2(\text{SO}_4)_3 + \text{Aq}$  sat. at  $25^\circ$  contain 3.426 g. anhyd.  $\text{Sm}_2(\text{SO}_4)_3$ . (Wirth, Z. anorg. 1912, 76. 174.)Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .n = equiv. g. of  $\text{H}_2\text{SO}_4$  in 1-l. of solvent.c = g  $\text{Sm}_2\text{O}_3$  in 100 g. of solution.c<sub>1</sub> = g.  $\text{Sm}_2(\text{SO}_4)_3$  in 100 g. of solution.

n	c	c <sub>1</sub>	n	c	c <sub>1</sub>
0	2.029	3.426	2.16	1.43	2.416
0.1	2.038	3.441	6.175	0.416	0.7025
0.505	1.985	3.352	12.8	0.0666	0.1107
1.1	1.821	3.075	...	...	...

(Wirth, Z. anorg. 1912, 76. 174.)

Solubility in  $(\text{NH}_4)_2\text{SO}_4 + \text{Aq}$  at 25°.

Pts. $\text{Sm}_2(\text{SO}_4)_3$ per 100 pts. $\text{H}_2\text{O}$	Pts. $(\text{NH}_4)_2\text{SO}_4$ per 100 pts. $\text{H}_2\text{O}$	Solid phase
2.1	0.3	$\text{Sm}_2(\text{SO}_4)_3$
2.0	0.8	
2.8	1.1	
1.5	1.9	
1.2	2.7	
0.8	7.4	
0.8	9.5	
0.8	8.7	
0.8	18.8	
0.8	12.2	
0.8	12.3	
0.9	32.5	$\text{Sm}_2(\text{SO}_4)_3, (\text{NH}_4)_2\text{SO}_4, 7\text{H}_2\text{O}$
1.0	46.3	
0.9	40.3	
1.3	77.5	
0.2	77.2	
0.3	77.3	
0.6	76.8	$(\text{NH}_4)_2\text{SO}_4$

(Keyes and James, J. Am. Chem. Soc. 1914, 36, 637.)

Solubility in  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 25°.

Pts. $\text{Na}_2\text{SO}_4$ per 100 pts. $\text{H}_2\text{O}$	Pts. $\text{Sm}_2(\text{SO}_4)_3$ per 100 pts. $\text{H}_2\text{O}$	Solid phase
0.1	2.0	$\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 6\text{H}_2\text{O}$
0.5	0.11	
1.9	0.03	
6.44	0.016	
7.00	0.008	
9.02	0.016	
10.51	0.012	
11.48	0.012	
13.58	0.010	
14.71	0.010	
14.47	0.009	
20.02	0.012	
23.42	0.012	"
23.68	0.013	
25.93	0.015	
27.40	0.011	

These results seem to indicate that there is only one double salt formed by the union of  $\text{Sm}_2(\text{SO}_4)_3$  with  $\text{Na}_2\text{SO}_4$ . Formula of this salt is  $2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4, 6\text{H}_2\text{O}$ .

(Keyes and James, J. Am. Chem. Soc. 1914, 36, 635.)

Samarium hydrogen sulphate,  $\text{Sm}(\text{HSO}_4)_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Matignon, C. R. 1905, 141, 1230.)

Ppt. (Brauner, Z. anorg. 1904, 33, 331.)

Samarium sodium sulphate,  $\text{Sm}_2(\text{SO}_4)_3, \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ .

Sl. sol. in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Cleve, Bull. Soc. (2) 43, 166.)

$2\text{Sm}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 6\text{H}_2\text{O}$ . Only double salt formed at 25°. (Keyes and James, J. Am. Chem. Soc. 1914, 36, 365.)

Scandium sulphate, basic,  $\text{Sc}_2\text{O}(\text{SO}_4)_2$ .

(Crookes, Roy. Soc. Proc. 1908, 80, A, 518.)

Scandium sulphate,  $\text{Sc}_2(\text{SO}_4)_3$ .

Anhydrous. Easily sol. in  $\text{H}_2\text{O}$ .

+  $2\text{H}_2\text{O}$ .

+  $5\text{H}_2\text{O}$ ; 54.61 g. of pentahydrate are sol. in 100 cc.  $\text{H}_2\text{O}$  at 25°. (Wirth, Z. anorg. 1914, 87, 10.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at 25°.

$\text{H}_2\text{SO}_4 + \text{Aq}$ .	g. $\text{Sc}_2(\text{SO}_4)_3$ in 100 g. of the solution
0.00	28.52
0.5-n	29.29
1.0-n	19.87
4.86-n	8.363
9.73-n	1.315

In 22.35-n  $\text{H}_2\text{SO}_4$  the solid phase is  $\text{Sc}_2(\text{SO}_4)_3, 3\text{H}_2\text{SO}_4$  and 100 g. sat. solution contain 0.484 g.  $\text{Sc}_2(\text{SO}_4)_3$ .

(Wirth, Z. anorg. 1914, 87, 10.)

+  $6\text{H}_2\text{O}$ . Extremely sol. in  $\text{H}_2\text{O}$ , but not deliquescent.

Scandium hydrogen sulphate,  $\text{Sc}_2(\text{SO}_4)_3 + 3\text{H}_2\text{O}$ .

(Wirth.)

Scandium sodium sulphate,  $\text{Sc}_2(\text{SO}_4)_3, 3\text{Na}_2\text{SO}_4 + 12\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Cleve.)

+  $10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and in excess of  $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Meyers, Z. anorg. 1914, 88, 279.)

Silver (argentoargentite) sulphate,  $\text{Ag}_2\text{SO}_4, \text{Ag}_2\text{SO}_4 + \text{H}_2\text{O}$ .

Gradually sol. in conc., but not attacked by dil.  $\text{HNO}_3 + \text{Aq}$ . Not attacked by hot conc.  $\text{H}_2\text{SO}_4$ . (Lea, Sill. Am. J. 144, 322.)

Silver sulphate,  $\text{Ag}_2\text{SO}_4$ .

Sol. in 200 pts. cold, and less than 100 pts. boiling  $\text{H}_2\text{O}$ . (Wittstein.)

Sol. in 83 pts. boiling  $\text{H}_2\text{O}$  (Schnaubert); in 87.25 pts. boiling  $\text{H}_2\text{O}$  (Wensel); in 68.85 pts.  $\text{H}_2\text{O}$  at 100° (Kramers).

100 pts.  $\text{H}_2\text{O}$  at 15.5° dissolve 1.15 pts.  $\text{Ag}_2\text{SO}_4$ . (Ure's Dict.)

Sol. in 160 pts.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)

1 l.  $\text{H}_2\text{O}$  dissolves  $2.57 \times 10^{-3}$  g.-mol.  $\text{Ag}_2\text{SO}_4$  at 25°. (Drucker, Z. anorg. 1901, 23, 362.)

1 l.  $\text{H}_2\text{O}$  dissolves 7.707 g.  $\text{Ag}_2\text{SO}_4$  at 17°. (Euler, Z. phys. Ch. 1904, 49, 314.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.0267 mol.  $\text{Ag}_2\text{SO}_4$  at 25°. (Rothmund, Z. phys. Ch. 1909, 88, 539.)

1 l.  $\text{H}_2\text{O}$  dissolves 8.35 g.  $\text{Ag}_2\text{SO}_4$  at 25°.

(Hill and Simmons, Z. phys. Ch. 1909, 87, 603.)

1 l.  $H_2O$  dissolves 8.344 g.  $Ag_2SO_4$  at  $25^\circ$ .  
Sp. gr. of solution = 1.0052. (Harkins, J. Am. Chem. Soc. 1911, 33, 1812.)

#### Solubility in $H_2O$ at $t^\circ$ .

$t^\circ$	Pts. $Ag_2SO_4$ in 100 pts. of the solution
14.5	0.730
33	0.909
51.5	1.062
75	1.237
100	1.393

(Barre, A. ch. 1911, (8) 24, 211.)

More sol. in  $H_2SO_4 + Aq$  than in pure  $H_2O$ . Still more sol. in  $HNO_3 + Aq$  and still more in conc.  $H_2SO_4$ , from which it is pptd. by  $H_2O$ . (Schnaubart.)

#### Solubility in $H_2SO_4 + Aq$ at $25^\circ$ .

$\frac{1}{2}H_2SO_4 + Aq$ . Normality	Solubility of $Ag_2SO_4$ g.-mol. per litre
0.02	$2.60 \times 10^{-3}$
0.04	$2.64 \times 10^{-2}$
0.10	$2.71 \times 10^{-3}$
0.20	$2.75 \times 10^{-3}$

(Drucker, Z. anorg. 1901, 23, 362.)

Solubility of  $Ag_2SO_4$  in acids +  $Aq$  at  $25^\circ$ .  
C = concentration of acid in acid +  $Aq$  in milliequivalents per l.

S = Solubility of  $Ag_2SO_4$  in acid +  $Aq$  in milliequivalents per l.

Acid	C	S
$HNO_3$	0.0	53.98
	15.89	59.86
	31.78	65.32
	63.57	75.90
$H_2SO_4$	0.0	53.98
	29.02	54.88
	58.02	55.64
	105.26	56.82

(Swan, J. Am. Chem. Soc. 1911, 33, 1814.)

#### Solubility in $HNO_3 + Aq$ at $25^\circ$ .

Normality $HNO_3$	Sp. gr. of the solution	g. $Ag_2SO_4$ dissolved per l.
0.000	1.0054	8.350
1.0046	1.061	34.086
2.0452	1.1069	49.010
4.017	1.1871	71.166
4.209	1.1956	73.212
5.564	1.2456	84.609
8.487	1.3326	94.671
10.034	1.3676	90.806

(Hill and Simmons, Z. phys. Ch. 1909, 87, 603.)

Sol. in  $NH_4OH$ , and  $(NH_4)_2CO_3 + Aq$ .

100 pts.  $H_2O$  dissolve 0.58 pt. at  $16^\circ$ . 100 pts.  $(NH_4)_2SO_4 + Aq$  (15%) dissolve 0.85 pt.  $Ag_2SO_4$  at  $18^\circ$ . Other sulphates have little effect. (Eder, J. pr. (2) 17, 44.)

Determinations of the solubility of  $Ag_2SO_4$  in  $(NH_4)_2SO_4$  at temp. between  $16.5^\circ$  and  $100^\circ$  show that no double salt is formed by these two sulphates. (Etard, A. ch. 1911, (8) 24, 221.)

#### Solubility of $Ag_2SO_4$ in $(NH_4)_2SO_4 + Aq$ . G. per 100 g. $H_2O$ .

$(NH_4)_2SO_4$	$Ag_2SO_4$	$(NH_4)_2SO_4$	$Ag_2SO_4$
Temp. = $33^\circ$		Temp. = $51^\circ$	
8.85	1.101	8.90	1.362
15.90	1.331	16.27	1.680
22.22	1.500	22.43	1.887
27.25	1.585	32.10	2.061
30.80	1.619	35.38	2.095
35.88	1.627	39.03	2.062
39.46	1.600	42.37	2.055
43.22	1.557	45.05	2.026
Temp. = $75^\circ$		Temp. = $100^\circ$	
8.80	1.758	9.23	2.221
15.23	2.155	15.00	2.626
22.30	2.490	22.01	3.075
28.25	2.734	27.00	3.325
32.00	2.823	34.90	3.663
35.82	2.889	38.70	3.772
41.16	2.929	44.15	3.854
46.46	2.902	47.63	3.867

(Barre, A. ch. 1911, (8) 24, 149, 202, 210.)

#### Solubility of $Ag_2SO_4$ in $K_2SO_4 + Aq$ . G. per 100 g. $H_2O$ .

$K_2SO_4$	$Ag_2SO_4$	$K_2SO_4$	$Ag_2SO_4$
Temp. = $33^\circ$		Temp. = $51^\circ$	
3.22	0.863	3.20	1.023
5.62	0.940	5.61	1.127
8.37	1.046	8.40	1.247
10.41	1.117	10.55	1.340
11.80	1.177	13.16	1.450
...	...	14.37	1.524
Temp. = $75^\circ$		Temp. = $100^\circ$	
3.12	1.273	3.23	1.488
5.73	1.406	5.60	1.675
8.43	1.554	8.45	1.890
10.55	1.665	11.30	2.115
13.17	1.806	15.07	2.410
17.06	2.021	18.53	2.677

(Barre, A. ch. 1911, (8) 24, 149, 202, 210.)

Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$ .

$\frac{1}{2}K_2SO_4 + Aq$ Normality	Solubility of $Ag_2SO_4$ g.-mol. per litre
0.02	$2.46 \times 10^{-2}$
0.04	$2.36 \times 10^{-2}$
0.10	$2.31 \times 10^{-2}$
0.20	$2.32 \times 10^{-2}$

(Drucker, Z. anorg. 1901, 28. 362.)

Solubility in  $Na_2SO_4 + Aq$  at  $t^\circ$ .

$t^\circ$	$Ag_2SO_4$ in 100 pts. $H_2O$	$Na_2SO_4$ in 100 pts. $H_2O$
14.5	0.741 0.904 1.003	5.278 10.103 13.045
33	0.972 1.150 1.320 1.448 1.548 1.570 1.549 1.462 1.190 0.932	5.345 10.056 15.185 20.093 25.412 29.556 34.732 39.447 44.693 46.976
51	1.173 1.377 1.572 1.705 1.787 1.802 1.727 1.540 1.188 0.882	5.407 10.116 15.146 20.247 25.196 29.230 34.626 39.302 42.914 44.464
75	1.458 1.697 1.934 2.075 2.161 2.138 1.910 1.603 1.156	5.368 9.813 15.260 19.978 25.556 29.662 35.278 38.944 41.365
100	1.651 2.012 2.312 2.351 2.260 2.012 1.687 1.156	5.336 10.153 15.532 25.451 29.714 34.718 38.635 40.160

Up to  $33^\circ$ , the solubility of  $Ag_2SO_4$  in  $Na_2SO_4 + Aq$  increases with the concentration of  $Na_2SO_4$ ; above  $33^\circ$  the solubility of  $Ag_2SO_4$  rises to a maximum at a certain concentration of  $Na_2SO_4$  dependent on the temp. The

solubility curves for various temp. all end at a concentration of 40%  $Na_2SO_4$ , that is, the mixed crystals formed at this concentration are equally sol. at all temp.

(Barre, C. R. 1910, 150. 1323.)

Solubility in  $Na_2SO_4 + Aq$  at  $t^\circ$ .

$t^\circ$	100 pts. $H_2O$ dissolve	
	$Na_2SO_4$	$Ag_2SO_4$
18	0.0 0.25 0.51 0.74 1.00 1.48 2.01 2.50 3.04 4.00 4.99 10.10 13.04	0.766 0.712 0.662 0.675 0.665 0.670 0.673 0.689 0.703 0.736 0.768 0.932 1.028
33	0.0 0.25 0.51 0.75 0.98 1.50 2.01 2.48 3.00	0.917 0.861 0.835 0.825 0.816 0.820 0.832 0.849 0.867
51	0.00 0.25 0.49 0.68 1.02 1.51 1.90 2.46 2.92 3.95	1.081 1.032 1.010 0.000 0.995 1.002 1.017 1.034 1.053 1.103
75	0.00 0.20 0.47 0.80 0.98 1.52 1.96 2.50 2.98 4.08	1.267 1.215 1.208 1.206 1.210 1.222 1.238 1.269 1.296 1.366
100	0.00 0.50 1.01 1.44 1.94 3.02	1.404 1.341 1.363 1.382 1.418 1.494

(Barre, A. ch. 1911, (8) 24. 215.)

## Solubility in salts + Aq at 25°.

C = concentration of salt in salt + Aq in milliequivalents per l.

$d_1$  = sp. gr. 25°/4° of salt + Aq.

S = solubility of  $\text{Ag}_2\text{SO}_4$  in salt + Aq expressed in milliequivalents per l.

$d_2$  = sp. gr. 25°/4° of  $\text{Ag}_2\text{SO}_4$  + salt + Aq.

Salt	C	$d_1$	S	$d_2$
none	...	...	53.52	...
$\text{KNO}_3$	24.914	0.9986	57.70	1.0072
	49.774	1.0002	61.13	1.0092
	99.870	1.0034	67.93	1.0034
$\text{Mg}(\text{NO}_3)_2$	24.764	0.9985	59.44	1.0073
	49.595	0.9999	64.32	1.0094
	99.460	1.0026	72.70	1.0133
$\text{AgNO}_3$	24.961	1.0007	39.09	1.0065
	49.86	1.0044	28.45	1.0084
	99.61	1.0112	16.96	1.0137
$\text{K}_2\text{SO}_4$	25.024	0.9989	50.66	1.0064
	50.044	1.0006	49.35	1.0079
	100.0	1.0041	48.04	1.0112
	200.03	1.0110	48.30	1.0180
$\text{MgSO}_4$	20.22	0.9984	52.21	1.0061
	50.069	1.0002	50.93	1.0079
	100.04	1.0032	49.95	1.0105
	200.05	1.0092	49.60	1.0164

(Harkins, J. Am. Chem. Soc. 1911, **33**, 1813.)

Solubility of  $\text{Ag}_2\text{SO}_4$  in salts + Aq at 25°.

C = concentration of salt in salt + Aq in milliequivalents per l.

S = solubility of  $\text{Ag}_2\text{SO}_4$  in salt + Aq in milliequivalents per l.

Salt	C	S
$\text{KHSO}_4$	0.0	53.98
	52.64	52.18
	105.26	51.76
$\text{K}_2\text{SO}_4$	0.0	53.98
	27.18	50.90
	54.34	49.30

(Swan, J. Am. Chem. Soc. 1911, **33**, 1814.)

Decomp. by alkali thiosulphates + Aq. (Herschell.)

100 ccm.  $\text{Ag}_2\text{SO}_4$  +  $\text{Ag}_2\text{C}_2\text{H}_3\text{O}_2$  + Aq sat. at 17° contain 3.95 g.  $\text{Ag}_2\text{SO}_4$  and 8.30 g.  $\text{Ag}_2\text{C}_2\text{H}_3\text{O}_2$  and solution has sp. gr. = 1.0094. (Euler, C. C. 1904, I, 1316.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898 **20**, 829.)

## Solubility in organic compds. + Aq at 25°.

Solvent	Mol. $\text{Ag}_2\text{SO}_4$ sol. in 1 litre
Water	0.0267
0.5-N Methyl alcohol	0.0249
" Ethyl alcohol	0.0228
" Propyl alcohol	0.0218
" Tert. amyl alcohol	0.0204
" Acetone	0.0220
" Ether	0.0206
" Formaldehyde	0.0227
" Glycol	0.0259
" Glycerine	0.0263
" Mannitol	0.0297
" Glucose	0.0283
" Sucrose	0.0270
" Urea	0.0303
" Dimethylpyrone	0.0216
" Urethane	0.0227
" Formamide	0.0270
" Acetamide	0.0253
" Acetonitrile	0.0525
" Glycocoll	0.0433
" Acetic acid	0.0252
" Phenol	0.0379
" Chloral	0.0233
" Methylal	0.0205
" Methyl acetate	0.0212

(Rothmund, Z. phys. Ch. 1909, **69**, 539.)

Insol. in methyl acetate (Besold, Dissert. 1906; Naumann, B. 1909, **42**, 3790); ethyl acetate. (Naumann, B. 1904, **37**, 3601); liquid methylamine. (Franklin, J. Am. Chem. Soc. 1906, **28**, 1420); acetone. (Naumann, B. 1904, **37**, 4329; Erdmann, C. C. 1899, II, 1014.)

Very sol. in a hot mixture of  $\text{H}_2\text{SO}_4$  and monobromobenzene, less sol. in cold. (Couper, A. ch. (3) **52**, 311.)

Silver hydrogen sulphate,  $\text{AgHSO}_4$ .

Decomp. by  $\text{H}_2\text{O}$ ; sol. in  $\text{H}_2\text{SO}_4$ . (Stas.)  $\text{Ag}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $4\text{SO}_3 + 2\text{H}_2\text{O} = \text{Ag}_2\text{H}_4(\text{SO}_4)_3 + \text{H}_2\text{O}$ . As above. (Schultz, Pogg. **133**, 137.)  $2\text{Ag}_2\text{O}$ ,  $3\text{H}_2\text{O}$ ,  $5\text{SO}_3 + 2\text{H}_2\text{O} = \text{Ag}_4\text{H}_4(\text{SO}_4)_5 + 2\text{H}_2\text{O}$ . As above. (Schultz.)

Silver pyrosulphate,  $\text{Ag}_2\text{S}_2\text{O}_7$ .

Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17, 2497.)

Silver thallic sulphate,  $\text{AgTl}(\text{SO}_4)_2$ .

(Lepsius, Chem. Ztg. 1890, 1327.)

Silver tin (stannic) sulphate,  $\text{Ag}_2\text{Sn}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .

Ppt. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ . (Weinland, Z. anorg. 1907, **54**, 250.)

Silver sulphate acetylde,  $\text{Ag}_2\text{SO}_4 \cdot 2\text{Ag}_2\text{C}_2$ .

(Plimpton, Proc. Chem. Soc. 1892, **8**, 109.)

**Silver sulphate ammonia,  $\text{Ag}_2\text{SO}_4 \cdot 2\text{NH}_3$ .**

Completely sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 20. 153.)

$\text{Ag}_2\text{SO}_4 \cdot 4\text{NH}_3$ . Easily sol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$  without decomp. (Mitscherlich.)

**Silver sulphate mercuric oxide,  $\text{Ag}_2\text{SO}_4 \cdot \text{HgO}$ .**

Insol. in  $\text{H}_2\text{O}$ , but decomp. even in the cold. Sol. in  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$ . (Finci, Gazz. ch. it. 1911, 41. (2) 548.)

**Silver sulphate sulphide,  $\text{Ag}_2\text{SO}_4 \cdot \text{Ag}_2\text{S}$ .**

Decomp. by hot  $\text{H}_2\text{O}$  or cold  $\text{HCl} + \text{Aq}$ . Sol. in boiling  $\text{HNO}_3 + \text{Aq}$ . (Poleck and Thümmel, B. 16. 2435.)

**Sodium sulphate,  $\text{Na}_2\text{SO}_4$ .****Anhydrous.**

1 pt.  $\text{Na}_2\text{SO}_4$  is sol. in 7.367 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  (Gerlach); in 8.52 pts.  $\text{H}_2\text{O}$  at  $13.3^\circ$  (Poggendorf); in 10 pts.  $\text{H}_2\text{O}$  at  $13^\circ$ , and in 8.3 pts.  $\text{H}_2\text{O}$  at  $62.2^\circ$  (Wenzel).

100 pts.  $\text{H}_2\text{O}$  at  $0^\circ$  dissolve 5.165 pts.  $\text{Na}_2\text{SO}_4$  (Pfaff, A. 99. 226); at  $100.6^\circ$  dissolve 45.985 pts.  $\text{Na}_2\text{SO}_4$  (Griffiths).

See below for further data.

+  $7\text{H}_2\text{O}$ . Efflorescent. Insol. in alcohol.

See below for further data.

+  $10\text{H}_2\text{O}$ .

$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in  $\text{H}_2\text{O}$  with absorption of heat; 20 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  mixed with 100 pts.  $\text{H}_2\text{O}$  at  $12.5^\circ$  lower the temperature  $6.8^\circ$ . (Rüdorff, B. 2. 68.)

Sol. in 2.33 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ , or 100 pts.  $\text{H}_2\text{O}$  at  $19^\circ$  dissolve 42.8 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . (Schiff, A. 109. 326.)

100 pts.  $\text{H}_2\text{O}$  dissolve a pts.  $\text{Na}_2\text{SO}_4$  and b pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	a	b	$t^\circ$	a	b
0	5.02	12.17	33.88	50.04	312.11
11.67	10.12	26.38	40.15	48.78	291.44
13.30	11.74	31.33	45.04	47.81	276.91
17.91	16.73	48.28	50.40	46.82	262.35
25.05	28.11	99.48	59.79	45.42	..
28.76	37.35	161.53	70.61	44.35	..
30.75	43.05	215.77	84.42	42.98	..
31.84	47.37	270.22	103.17	42.65	..
32.73	50.65	322.12	..	..	..

(Gay-Lussac, A. ch. (2) 11. 312.)

Maximum solubility is at  $33^\circ$  from experiment and theoretical considerations. At this temp.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is converted into  $\text{Na}_2\text{SO}_4$ . (Kopp, A. 24. 271.)

100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$  dissolve pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .

$t^\circ$	Pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
2.5	11.39	37.50	294.04	75	241.68
7.5	16.88	43.75	261.04	81.25	217.20
12.5	29.03	50	285.06	87.50	220.65
18.75	70.78	56.25	248.11	93.75	225.46
25	143.38	62.5	222.22	100	241.69
31.25	479.97	68.75	242.88	..	..

(Brandes and Firnhaber, 1824.)

1 pt.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in 6.1 pts.  $\text{H}_2\text{O}$  at  $7.5^\circ$ ; 3.44 pts. at  $12.5^\circ$ ; 2.41 pts. at  $18.75^\circ$ ; and 1.724 pts. at  $20^\circ$ . (Karsten.)

1 pt.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in 2.86 pts. cold, and 0.8 pt. boiling  $\text{H}_2\text{O}$  (Bergmann); in 3 pts. cold, and 0.5 pt. boiling  $\text{H}_2\text{O}$  (Wittstein); in 4 pts. cold, and 1 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy); in 3 pts.  $\text{H}_2\text{O}$  at  $18.75^\circ$  (Abl.).

100 pts.  $\text{H}_2\text{O}$  dissolve 12.494 pts.  $\text{Na}_2\text{SO}_4$  or 35.492 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  at  $15^\circ$ , and sp. gr. of solution = 1.10847 (Miehel and Kraft, A. ch. (3) 41. 478.)

100 pts.  $\text{H}_2\text{O}$  dissolve 39.4 pts. cryst. salt at  $15.5^\circ$ ; 80 pts. cryst salt at  $100^\circ$ . (Ure's Dict.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Na}_2\text{SO}_4$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$
0	4.53	24.1	25.92
17.9	16.28	33	50.81

(Diacon, J. B. 1866. 61.)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at various pressures and temp. Pts.  $\text{Na}_2\text{SO}_4$  contained in 100 pts. sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at A pressure in atmos. and  $t^\circ$  are given.

A	$0^\circ$	$15^\circ$	$15.4^\circ$	A	$15^\circ$
1	4.40	11.32	11.4	30	10.05
20	4.53	10.78	10.74	40	10.33

(Möller, Pogg. 117. 386.)

The solubility of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  increases with the temperature from  $0$  to  $34^\circ$ . At  $34^\circ$  and above, it is converted into the anhydrous salt, the solubility of which is least at  $103.17^\circ$ , which is the boiling point of the saturated solution, and increases by cooling from that temp. down to  $18-17^\circ$ . Below the latter temperature the anhydrous salt cannot exist in the presence of  $\text{H}_2\text{O}$ , but is converted into  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$ , or  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . The solubility of  $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  increases with the temperature from  $0-26^\circ$ , and at  $27^\circ$  it is converted into the anhydrous salt.

Thus there are two different rates of solubility for  $\text{Na}_2\text{SO}_4$  for temperatures from  $0-18^\circ$ , three different rates from  $18-26^\circ$ , two from  $26-34^\circ$ , and only one above  $34^\circ$ .

1. By heating  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  to fusion and raising the heat until the liquid boils, placing in a closed vessel and cooling, the greater part of the anhydrous salt, which separates out on heating, redissolves on cooling, and the amount increases as the temp. falls until  $18^\circ$  is reached. Below  $18^\circ$   $\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$  is formed. Saturated  $\text{Na}_2\text{SO}_4 + \text{Aq}$  thus obtained contains for 100 pts. HO at:

18°	20°	25°	26°
53.25	52.76	51.53	51.31 pts. $\text{Na}_2\text{SO}_4$ .
30°	33°	34°	36°
50.37	49.71	49.53	49.27 pts. $\text{Na}_2\text{SO}_4$ .

2. By allowing the boiling saturated solution free from undissolved salt to cool to  $0^\circ$

with exclusion of air until crystals of  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$  are formed, then removing the greater part of the mother liquor with a warm pipette, and warming the rest of the mother liquor with the excess of crystals, the crystals dissolve in increasing quantity between  $0^\circ$  and  $26-27^\circ$ , so that at  $27^\circ$  the solution contains 56 pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . The remaining undissolved crystals of  $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$  begin to melt very slowly at  $27^\circ$ , more quickly at higher temperatures, and cause the separation of anhydrous crusts, and thus the strength of the solution is gradually lowered to the normal. Saturated solutions prepared in this way contain for 100 pts.  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$18^\circ$
19.62	30.49	34.27 pts. $\text{Na}_2\text{SO}_4$
or 44.89	78.9	92.9 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ .
$15^\circ$	$16^\circ$	$17^\circ$
37.43	38.73	39.99 pts. $\text{Na}_2\text{SO}_4$
or 105.8	117.4	111.0 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ .
$18^\circ$	$19^\circ$	$20^\circ$
41.63	43.35	44.73 pts. $\text{Na}_2\text{SO}_4$
or 124.6	133.0	140.0 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ .
$25^\circ$	$26^\circ$	
52.94	54.97 pts. $\text{Na}_2\text{SO}_4$	
or 188.5	202.6 pts. $\text{Na}_2\text{SO}_4 \cdot 7\text{H}_2\text{O}$ .	

3. Solutions obtained by shaking  $\text{H}_2\text{O}$  with  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  contain for 100 pts.  $\text{H}_2\text{O}$  at:

$0^\circ$	$10^\circ$	$15^\circ$
5.02	9.00	13.20 pts. $\text{Na}_2\text{SO}_4$
or 12.16	23.04	35.96 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .
$18^\circ$	$20^\circ$	$25^\circ$
16.80	19.40	23.00 pts. $\text{Na}_2\text{SO}_4$
or 48.41	58.85	98.48 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .
$26^\circ$	$30^\circ$	
30.00	40.00 pts. $\text{Na}_2\text{SO}_4$	
or 109.81	184.1 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .	
$33^\circ$	$34^\circ$	
50.76	55.0 pts. $\text{Na}_2\text{SO}_4$	
or 323.1	412.2 pts. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .	

At  $34^\circ$ ,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  begins to melt in its crystal  $\text{H}_2\text{O}$ . As long as there is a considerable quantity of unchanged crystals present, the solution contains 55 pts.  $\text{Na}_2\text{SO}_4$  for 100 pts.  $\text{H}_2\text{O}$ , but as the hydrous salt decreases in amount and becomes converted into the anhydrous salt, the solution becomes weaker and contains only 49.53 pts.  $\text{Na}_2\text{SO}_4$  for 100 pts.  $\text{H}_2\text{O}$  after warming for 6 or 8 hours at  $34^\circ$ . In the same way temporary solutions can be obtained at  $36-40^\circ$  with 55-56 pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ , but this amount sinks to the normal even more quickly than at  $34^\circ$ .

$\text{Na}_2\text{SO}_4$  dehydrated at  $100-150^\circ$ , after the addition of  $1\frac{1}{2}-1\frac{1}{2}$  pts.  $\text{H}_2\text{O}$ , gives a solution between  $0^\circ$  and  $32^\circ$  of the same strength as  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , but at  $34^\circ$  a solution with

55 pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$  cannot be obtained, but one with 49.53 pts. is formed. (Löwel, A. ch. (3) 49. 32.)

4. Solubility of anhydrous salt. Above  $34^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolve at:

$35^\circ$	$40^\circ$	$45^\circ$	$50^\circ$	$55^\circ$
50.2	48.8	47.7	46.7	45.9 pts. $\text{Na}_2\text{SO}_4$
$60^\circ$	$65^\circ$	$70^\circ$	$75^\circ$	$80^\circ$
45.3	44.8	44.4	44.0	43.7 pts. $\text{Na}_2\text{SO}_4$
$85^\circ$	$90^\circ$	$95^\circ$	$100^\circ$	$103.5^\circ$
43.3	43.1	42.8	42.5	42.2 pts. $\text{Na}_2\text{SO}_4$ .

(Mulder.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$	$t^\circ$	Pts. $\text{Na}_2\text{SO}_4$
0	4.8	35	50.2	70	44.4
1	5.1	36	49.9	71	44.3
2	5.4	37	49.6	72	44.2
3	5.7	38	49.3	73	44.2
4	6.0	39	49.1	74	44.1
5	6.4	40	48.8	75	44.0
6	6.8	41	48.5	76	44.0
7	7.3	42	48.3	77	43.9
8	7.8	43	48.1	78	43.8
9	8.4	44	47.9	79	43.7
10	9.0	45	47.7	80	43.7
11	9.7	46	47.5	81	43.6
12	10.5	47	47.3	82	43.5
13	11.4	48	47.1	83	43.5
14	12.4	49	46.9	84	43.4
15	13.4	50	46.7	85	43.3
16	14.5	51	46.6	86	43.3
17	15.7	52	46.4	87	43.2
18	16.9	53	46.2	88	43.2
19	18.2	54	46.1	89	43.1
20	19.5	55	45.9	90	43.1
21	20.9	56	45.8	91	43.0
22	22.5	57	45.7	92	43.0
23	24.1	58	45.6	93	42.9
24	25.9	59	45.4	94	42.9
25	27.9	60	45.3	95	42.8
26	30.1	61	45.2	96	42.7
27	32.4	62	45.1	97	42.6
28	35.0	63	45.0	98	42.6
29	37.8	64	44.9	99	42.5
30	40.9	65	44.8	100	42.5
31	44.2	66	44.7	101	42.4
32	47.8	67	44.6	102	42.3
32.75	50.65	68	44.5	103	42.2
33	50.6	69	44.5	103.5	42.2
34	50.4	..	...	...	...

(Mulder, Scheik. Verhandel. 1864. 123.)

100 pts. dissolve at:

$0^\circ$	$34^\circ$	$100^\circ$
5	78.8(?)	42.7
		41.95 pts. $\text{Na}_2\text{SO}_4$ .

$140^\circ$	$160^\circ$	$180^\circ$	$230^\circ$
42.0	42.9	44.25	46.4 pts. $\text{Na}_2\text{SO}_4$ .

(Tilden and Shenstone, Lond. R. Soc. Proc.



Solubility decreases above 230°. (Étard, C. R. 113. 854.)

Sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  contains at:

0° 7° 13° 24° 28° 30°  
4.1 6.2 9.9 19.3 25.2 29.5%  $\text{Na}_2\text{SO}_4$

49° 62° 83° 99° 134° 150°  
32.8 31.3 30.0 29.7 29.4 29.8%  $\text{Na}_2\text{SO}_4$

190° 240° 279° 320°  
29.9 30.0 24.5 17.8%  $\text{Na}_2\text{SO}_4$ .  
(Étard, A. ch. 1894, (7) 2. 548.)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{O}$  at t°.  
G. per 100 g.  $\text{H}_2\text{O}$ .

t°	$\text{Na}_2\text{SO}_4$	Sp. gr.	t°	$\text{Na}_2\text{SO}_4$	Sp. gr.
0.70	4.71	1.0432	33.5	49.39	1.3307
10.25	9.21	1.0802	38.15	48.47	1.3229
15.65	14.07	1.1150	44.85	47.49	1.3136
24.90	27.67	1.2067	60.10	45.22	1.2918
27.65	34.05	1.2459	75.05	43.59	1.2728
30.20	41.78	1.2894	89.85	42.67	1.2571
31.95	47.98	1.3230	101.9*	42.18	1.2450

\* B.-pt.

(Berkeley, Phil. Trans. Roy. Soc. 1904, 203. A, 189.)

Transition point from  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  to  $\text{Na}_2\text{SO}_4 = 32.5^\circ$  (Berkeley);  $32.383^\circ$ . (Richards and Churchill, Z. phys. Ch. 1899, 28. 314.)

100 g.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $15^\circ$  contain 11.5 g. anhydrous  $\text{Na}_2\text{SO}_4$ ; 21.9 g. at  $25^\circ$ . (Schreinemakers, Arch. Néer. Sc. 1910, (2) 15. 81.)

1 l.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $25^\circ$  contains 1.881 mols.  $\text{Na}_2\text{SO}_4$ . (Herz, Z. anorg. 1911, 70. 127.)

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	Mol. % $\text{Na}_2\text{SO}_4$
62	5.39
70	5.27
72	5.25
80	5.18
120	5.04
190	5.25
192	5.27
208	5.39
241	5.39
250	5.04
279	4.12
319	2.56
252	4.9
310	3.2
340	1.8
365	0.0

(Wuite, Z. phys. Ch. 1913, 86. 364.)

Supersaturated solutions of  $\text{Na}_2\text{SO}_4$  are easily formed; when  $\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at its b.-pt. is hermetically sealed, no crystals are deposited on cooling (Löwel). Supersat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  may also be obtained by cooling hot sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  in flasks loosely stoppered with cotton wool (Schroeder, A. 109. 45), or by covering the containing vessel with a glass plate, watch-glass, card, etc., or by covering the liquid itself with a layer of oil, and then allowing to cool.

Hot  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 1 pt.  $\text{H}_2\text{O}$  to 1 pt.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  does not crystallise on slowly cooling or on being quickly cooled by immersion in cold water, if it is contained in a barometer tube freed from air by boiling, or in an exhausted well-closed vessel, or in an open vessel with a layer of oil of turpentine on it (Gay-Lussac); or in a vessel containing air, either well stoppered or furnished with a loose cover (Schweigger); or in an open vessel under a bell jar full of air and closed at the bottom with a water joint; or in open bottles placed in a quiet situation; or in an open glass enclosed in a stoppered vessel, containing air and some KOH for drying; in this case  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  effloresces from the solution, and when washed down again does not cause instant crystallisation, but redissolves.

The crystallisation of a solution cooled in this way may often be brought about instantaneously, or often again after a short time; (1) by agitation, when the solution has been cooled in an open vessel; (2) by access of air caused by opening the vessel, the crystallisation taking place the more rapidly the larger the opening. In this case the crystallisation begins at the top, where the solution, the vessel, and the air come in contact; when a particle of dust falls in the liquid the crystallisation begins a little under the surface. When the solution has been cooled in vacuo, a bubble of air, hydrogen, carbonic acid, or nitrous oxide is sufficient to set up the crystallisation; (3) by contact with a solid body. The latter do not cause crystallisation when cooled in contact with the liquid, nor (excepting a crystal of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ) when they are moistened or warmed before contact with the solution.

Supersat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  is brought to crystallisation by addition of a crystal of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ , or an isomorphous substance as  $\text{Na}_2\text{SeO}_4 + 10\text{H}_2\text{O}$ , or  $\text{Na}_2\text{CrO}_4 + 10\text{H}_2\text{O}$ . Other crystals, as  $\text{MgSO}_4 + 7\text{H}_2\text{O}$ , etc., have no action. (Thomson, Chem. Soc. 35. 199.)

See also Hartley, Jones and Hutchinson, Chem. Soc. 1908, 93. 825, on "Spontaneous crystallisation of sodium sulphate solutions," and de Coppet (A. ch. 1907, (8) 10. 457) on same subject.

A more extended discussion of the phenomena and causes of supersaturation is not considered to the within the scope of this work.

$\text{Na}_2\text{SO}_4 + \text{Aq}$  sat. at  $16^\circ$  has sp. gr. 1.10847 (Michel and Kraft); at  $15^\circ$  has sp. gr. 1.119 (Stolba); at  $16^\circ$

has sp. gr. 1.1162 (Stolba); at 10° contains 29 pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$  (superaturated?), and has sp. gr. 1.1259 (Karsten).

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 19.5°.

% $\text{Na}_2\text{SO}_4$	Sp. gr.	% $\text{Na}_2\text{SO}_4$	Sp. gr.
2.894	1.0262	10.538	1.0977
5.589	1.0509	12.473	1.1162
7.995	1.0733	..	..

(Kremers, Pogg. 98. 120.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$ .

% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.
1.262	1.005	13.744	1.055
2.522	1.010	14.975	1.060
3.780	1.015	16.203	1.065
5.035	1.020	17.428	1.070
6.288	1.025	18.645	1.075
7.538	1.030	19.860	1.080
8.786	1.035	21.071	1.085
10.030	1.040	22.277	1.090
11.272	1.045	23.478	1.095
12.510	1.050	24.674	1.100

(Schmidt, Pogg. 123. 132.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 19°.

% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.	% $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	Sp. gr.
1	1.0040	16	1.0642
2	1.0079	17	1.0683
3	1.0118	18	1.0725
4	1.0158	19	1.0766
5	1.0198	20	1.0807
6	1.0232	21	1.0849
7	1.0278	22	1.0890
8	1.0318	23	1.0931
9	1.0358	24	1.0973
10	1.0398	25	1.1015
11	1.0439	26	1.1057
12	1.0479	27	1.1100
13	1.0520	28	1.1142
14	1.0560	29	1.1184
15	1.0601	30	1.1226

(Schiff, A. 110. 70.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 15°.

%	Sp. gr. if $\text{Na}_2\text{SO}_4$	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	%	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$	%	Sp. gr. if $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
1	1.0091	1.004	11	1.044	21	1.086
2	1.0182	1.008	12	1.047	22	1.090
3	1.0274	1.013	13	1.052	23	1.094
4	1.0365	1.016	14	1.056	24	1.098
5	1.0457	1.020	15	1.060	25	1.103
6	1.0550	1.024	16	1.064	26	1.107
7	1.0644	1.028	17	1.069	27	1.111
8	1.0737	1.032	18	1.073	28	1.116
9	1.0832	1.036	19	1.077	29	1.120
10	1.0927	1.040	20	1.082	30	1.125

(Gerlach, Z. anal. 8. 287.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 24.8°. a=no. of g., equivalent to  $\frac{1}{2}$  mol. wt., dissolved in 1000 g.  $\text{H}_2\text{O}$ ; b=sp. gr. if a is  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt.=161; c=sp. gr. if a is  $\text{Na}_2\text{SO}_4$ ,  $\frac{1}{2}$  mol. wt.=71.

a	b	c	a	b	c
1	1.054	1.059	4	1.163	1.213
2	1.098	1.114	5	1.188	...
3	1.134	1.165	6	1.209	...

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 18°.

% $\text{Na}_2\text{SO}_4$	Sp. gr.	% $\text{Na}_2\text{SO}_4$	Sp. gr.
5	1.0450	15	1.1426
10	1.0915	..	...

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 20° containing 0.5 mol.  $\text{Na}_2\text{SO}_4$  to 100 mols.  $\text{H}_2\text{O}$  = 1.03466; 1.0 mol.  $\text{Na}_2\text{SO}_4$  to 100 mols.  $\text{H}_2\text{O}$  = 1.06744. (Nicol, Phil. Mag. (5) 16. 122.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 25°.

Concentration of $\text{Na}_2\text{SO}_4 + \text{Aq}$	Sp. gr.
1-normal	1.0606
$\frac{1}{2}$ " "	1.0309
$\frac{1}{3}$ " "	1.0156
$\frac{1}{4}$ " "	1.0079

(Wagner, Z. phys. Ch. 1890. 5. 39.)

Sp. gr. at 16°/4° of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 9.4043%  $\text{Na}_2\text{SO}_4$  = 1.08655. (Schönrock, Z. phys. Ch. 1893. 11. 781.)

$\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 25.51%  $\text{Na}_2\text{SO}_4$  has sp. gr. 20°/20° = 1.2527.  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing 10.14%  $\text{Na}_2\text{SO}_4$  has sp. gr. 20°/20° = 1.0938. (Le Blanc and Rohland, Z. phys. Ch. 1896. 19. 278.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at 17.5°, when p = per cent strength of solution; d = observed density; and w = volume conc. in

p.	d.	w.
13.06	1.1226	0.14662
11.75	1.1094	0.13043
10.68	1.0990	0.11737
8.544	1.0784	0.09214
6.762	1.0615	0.07178
4.015	1.0358	0.04159
2.599	1.0225	0.02658
2.375	1.0204	0.02423
1.818	1.0154	0.01846
1.349	1.0109	0.01364
0.5204	1.0037	0.00522
0.2921	1.0014	0.00293

(Barnes, J. phys. Chem. 1898. 2. 543.)

Sp. gr. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  at  $20^\circ$ .

Normality of $\text{Na}_2\text{SO}_4 + \text{Aq}$	% $\text{Na}_2\text{SO}_4$	Sp. gr.
0.97	12.36	1.1138
0.48	6.41	1.0570

(Forchheimer, Z. phys. Ch. 1900, 24. 23.)

Sp. gr. of sat.  $\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	wt. of 1 ccm. of the solution	100 g. $\text{H}_2\text{O}$ dissolve g. $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
0	1.040	12.16
5	1.058	...
10	1.078	21.04
15	1.109	35.96
18	1.137	48.41
20	1.156	58.35
25	1.209	98.48
26	1.222	109.81
30	1.287	184.1
33	1.312	323.1
34	1.317	413.2
35	1.317	...

(Tschernaj, J. Russ. Phys. Chem. Soc. 1914, 46. 8.)

Sp. gr. and b-pt. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$ .  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing P pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  for every 100 pts.  $\text{H}_2\text{O}$  has given sp. gr. and b.pt.

P	Sp. gr.	B-pt.	P	Sp. gr.	B-pt.
1	1.005	100.5°	16	1.064	101.25°
2	1.008	100.62	17	1.067	101.25
3	1.014	100.62	18	1.070	101.37
4	1.020	100.75	19	1.072	101.37
5	1.021	100.75	20	1.074	101.37
6	1.028	100.87	21	1.076	101.37
7	1.030	100.87	22	1.078	101.5
8	1.032	101.0	23	1.080	101.5
9	1.036	101.0	24	1.082	101.5
10	1.040	101.0	25	1.084	101.5
11	1.043	101.12	26	1.090	101.5
12	1.050	101.12	27	1.092	101.63
13	1.055	101.25	28	1.095	101.63
14	1.060	101.25	29	1.098	101.63
15	1.062	101.25	30	1.100	101.75

(Brandes and Gruner, 1887.)

Saturated solution boils at  $103.17^\circ$  (Löwel),  $103.5^\circ$  (Mulder),  $105^\circ$  (Kremers),  $100.5^\circ$  (Griffiths),  $100.8^\circ$  (Gerlach).Crust forms at  $102.9^\circ$ ; highest temp.,  $103.2^\circ$ , and solution contains 43.9 pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . (Gerlach, Z. anal. 26. 426.)B-pt. of  $\text{Na}_2\text{SO}_4 + \text{Aq}$  containing pts.  $\text{Na}_2\text{SO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B-pt.	Pts. $\text{Na}_2\text{SO}_4$	B-pt.	Pts. $\text{Na}_2\text{SO}_4$
100.5°	9.5	102.5°	39.0
101.0	18.0	103.0	44.5
101.5	26.0	103.2	46.7
102.0	33.0	...	...

(Gerlach, Z. anal. 26. 430.)

M.-pt. of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O} = 34^\circ$ . (Tilden, Chem. Soc. 45. 409.)Sol. with decomp. in  $\text{HCl} + \text{Aq}$ .Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain		Solid phase
Mols $\text{H}_2\text{SO}_4$	Mols $\text{Na}_2\text{SO}_4$	
...	1.539	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
0.286	1.671	"
0.338	1.742	"
0.884	2.256	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
1.576	2.363	$\text{Na}_2\text{SO}_4 + \text{Na}_2\text{H}(\text{SO}_4)_2$
1.666	2.437	"
2.611	2.091	$\text{Na}_2\text{H}(\text{SO}_4)_2 + \text{Na}_2\text{H}(\text{SO}_4)_2, \text{H}_2\text{O}$

(D'Ans, Z. anorg. 1906, 49. 356.)

Solubility of  $\text{Na}_2\text{SO}_4$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain		Solid phase
Mol. $\text{Na}_2\text{SO}_4$	Mol. $\text{H}_2\text{SO}_4$	
1.55	0.08	$\text{Na}_2\text{SO}_4$
1.59	0.147	"
1.85	0.60	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
2.00	0.763	"
0.77	4.23	$\text{NaHSO}_4, \text{H}_2\text{O}$
0.47	4.96	"
0.32	6.61	$\text{Na}_2\text{HSO}_4$
0.305	6.87	"
0.07	7.18	$\text{Na}_2\text{H}(\text{SO}_4)_2$
0.79	8.78	"

(D'Ans, Z. anorg. 1909, 61. 92.)

10 ccm. of sat.  $\text{Na}_2\text{SO}_4 + \text{absolute } \text{H}_2\text{SO}_4$  contain approx. 2.999 g.  $\text{Na}_2\text{SO}_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .Solid Phase,  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ .

Millimole $\text{H}_2\text{SO}_4$ in 10 ccm.	Millimole $\text{Na}_2\text{SO}_4$ in 10 ccm.
...	18.81
5.10	22.38
7.79	24.65

(Hers, Z. anorg. 1912, 73. 276.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain		Solid phase
Mols $\text{SO}_3$	Mols $\text{Na}_2\text{SO}_4$	
5.91	0.409	$\text{NaHSO}_4$
6.30	0.332	"
6.64	0.297	$\text{NaHSO}_4 + \text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O}$
6.90	0.173	$\text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O}$
7.36	0.071	"
7.74	0.047	"
7.82	0.044	"
8.12	0.037	"
8.29	0.042	"
8.40	0.046	"
8.70	0.076	"
8.86	0.156	"
8.93	0.259	"
8.93	0.269	"
8.93	0.273	"
8.84	0.527	$\text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O}$ metastable solutions
8.73	0.681	
8.70	0.808	
8.62	0.834	
8.62	0.844	
8.61	0.899	$\text{NaH}_2(\text{SO}_4)_2, \text{H}_2\text{O} + \text{Na}_2\text{SO}_4, 4.5\text{H}_2\text{SO}_4$
8.87	0.445	
8.93	0.437	$\text{Na}_2\text{SO}_4, 4.5\text{H}_2\text{SO}_4$
9.06	0.394	"
9.36	0.425	$\text{Na}_2\text{SO}_4, 4.5\text{H}_2\text{SO}_4 + \text{NaHSO}_4$
9.18	0.567	$\text{NaHSO}_4$
9.42	0.728	"
9.48	0.760	"
9.55	0.775	"
9.48	0.953	$\text{NaHSO}_4 + ?$
9.85	0.787	?
9.98	0.908	?
(9.77)	(1.03)	Metastable
10.16	0.797	?
10.78	0.302	

(D'Ans, Z. anorg. 1913, 80. 236.)

Sl. sol. in conc.  $\text{HCl}$ . (Ure's Dict.)  
 Not pptd. by addition of glacial  $\text{HCl}$  to  
 $\text{Na}_2\text{SO}_4 + \text{Aq}$ . (Persoz.)

Solubility in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain		Solid phase
Mols ( $\text{NaOH}$ )	Mols $\text{Na}_2\text{SO}_4$	
0	1.54	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O}$
0.074	1.41	"
0.70	1.08	"
1.47	0.90	$\text{Na}_2\text{SO}_4, 10\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$
2.02	0.59	$\text{Na}_2\text{SO}_4$
2.82	0.24	"
3.52	0.126	"
5.83	0.013	"
6.62	...	$\text{NaOH}, \text{H}_2\text{O}$

(D'Ans and Schreiner, Z. anorg. 1910, 67. 437.)

Sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .Rapidly and abundantly sol. in sat.  $\text{KCl} + \text{Aq}$  with pptn. of  $\text{K}_2\text{SO}_4$ . $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  is sol. in sat.  $\text{NaCl} + \text{Aq}$  without pptn. If effloresced  $\text{Na}_2\text{SO}_4$  is used, a ppt. of  $\text{NaCl}$  is caused at first, and subsequently of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . (Karsten.)Sol. in boiling sat.  $\text{NaCl} + \text{Aq}$  with pptn. of  $\text{NaCl}$ , but from cold solutions the  $\text{Na}_2\text{SO}_4$  separates out first. (Vauquelin.)Less sol. in  $\text{NaCl} + \text{Aq}$  than in  $\text{H}_2\text{O}$ . (Hunt, Am. J. Sci. (2) 25. 368.)Solubility in  $\text{NaCl} + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	g. $\text{NaCl}$ per 100 g. $\text{H}_2\text{O}$	g. $\text{Na}_2\text{SO}_4$ per 100 g. $\text{H}_2\text{O}$
10	0.00	9.14
	4.28	6.42
	9.60	4.76
	15.65	3.99
	21.82	3.97
	28.13	4.15
	30.11	4.34
	32.27	4.59
	33.76	4.75
21.5	0.00	21.33
	9.05	15.48
	17.48	13.73
	20.41	13.62
	26.01	15.05
	26.53	14.44
	27.74	13.39
	31.25	10.64
	31.80	10.28
	32.10	8.43
	33.69	4.73
	34.08	2.77
	35.46	0.00
25	0.00	23.74
	2.74	26.57
	8.15	23.15
	19.86	20.52
	24.58	14.86
	31.21	9.95
	32.02	9.61

Solubility in NaCl+Aq at  $t^{\circ}$ —Continued.

$t^{\circ}$	g. NaCl per 100 g. H <sub>2</sub> O	g. Na <sub>2</sub> SO <sub>4</sub> per 100 g. H <sub>2</sub> O
27	0.00	31.10
	2.66	28.73
	5.29	27.17
	7.90	26.02
	16.13	24.83
	18.91	21.39
	19.64	20.11
	20.77	19.29
	32.33	9.53
30	0.00	39.70
	2.45	38.25
	5.61	36.50
	7.91	35.96
	10.61	31.64
	12.36	29.87
	15.65	25.02
	18.44	21.80
	20.66	19.06
	32.43	9.06
33	0.00	48.48
	1.22	46.49
	1.99	45.16
	2.64	44.09
	3.47	42.61
	12.14	29.32
	21.87	16.83
	32.84	8.76
	33.99	4.63
35	0.00	47.94
	2.14	43.75
	13.57	26.26
	18.78	19.74
	31.91	8.28
	35.63	0.00

At 33° and above the values represent the solubility of Na<sub>2</sub>SO<sub>4</sub> in NaCl+Aq. At 10° the solid phase in contact with the solution is probably Na<sub>2</sub>SO<sub>4</sub>·7H<sub>2</sub>O. Between 17° and 33° the solid phase is either Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O or Na<sub>2</sub>SO<sub>4</sub>. An inversion of Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O to Na<sub>2</sub>SO<sub>4</sub> takes place at various temp. below 33°, depending on the amount of NaCl contained in the solution in contact with the solid sodium sulphate.

(Seidell, Am. Ch. J. 1902, 27. 55.)

## Solubility in NaCl+Aq at 15°.

Composition of the sat. solution		Solid Phase
% by wt. Na <sub>2</sub> SO <sub>4</sub>	% by wt. NaCl	
11.5	0	Na <sub>2</sub> SO <sub>4</sub> +10H <sub>2</sub> O
7.86	5.42	"
5.87	11.51	"
5.23	15.97	"
5.26	21.03	"
5.64	23.39	Na <sub>2</sub> SO <sub>4</sub> ·10H <sub>2</sub> O+NaCl
2.26	25.21	NaCl
0	26.3	"

(Schreinemakers and de Baat, Z. phys. Ch. 1909, 67. 554.)

Sol. in sat. NH<sub>4</sub>NO<sub>3</sub>+Aq. (Margueritte, C. R. 33. 307.)

Sol. in sat. KNO<sub>3</sub>+Aq with pptn. after several hours. (Karsten.)

Na<sub>2</sub>SO<sub>4</sub>+10H<sub>2</sub>O is sol. in sat. NaNO<sub>3</sub>+Aq without pptn., but if effloresced Na<sub>2</sub>SO<sub>4</sub> is used, NaNO<sub>3</sub> is pptd. at first, and subsequently Na<sub>2</sub>SO<sub>4</sub>+7H<sub>2</sub>O.

The presence of CaSO<sub>4</sub> does not affect the solubility of Na<sub>2</sub>SO<sub>4</sub> in H<sub>2</sub>O to any great extent. (Barre, A. ch. 1911, (8) 24. 160.)

More sol. in K<sub>2</sub>SO<sub>4</sub>, CuSO<sub>4</sub>, MgSO<sub>4</sub>+Aq. than in H<sub>2</sub>O. (Pfaff, A. 99. 226.)

100 pts. H<sub>2</sub>O dissolve 20.7 pts. CuSO<sub>4</sub> and 15.9 pts. Na<sub>2</sub>SO<sub>4</sub>. (Rüdorff, B. 6. 484.)

Sol. in sat. MgSO<sub>4</sub>, K<sub>2</sub>SO<sub>4</sub>, CuSO<sub>4</sub>+Aq, but if more Na<sub>2</sub>SO<sub>4</sub> than can be dissolved is added to the CuSO<sub>4</sub>+Aq, a large quantity of a double sulphate separates out. (Karsten.)

The solubility of Na<sub>2</sub>SO<sub>4</sub> in K<sub>2</sub>SO<sub>4</sub>+Aq has been determined at 15°, 25°, 40°, 50°, 60°, 70° and 80°. From the results the conclusion is drawn that sodium and potassium sulphates form a double salt of the formula K<sub>2</sub>Na(SO<sub>4</sub>)<sub>2</sub>. (Okada, Chem. Soc. 1915, 108. (2) 344.)

See also under CuSO<sub>4</sub>, MgSO<sub>4</sub>, and K<sub>2</sub>SO<sub>4</sub>.

Slowly but abundantly sol. in sat. ZnSO<sub>4</sub>+Aq, with separation of a double salt after a few days.

Solubility of ZnSO<sub>4</sub>·7H<sub>2</sub>O+Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O in 100 g. H<sub>2</sub>O at  $t^{\circ}$ .

$t^{\circ}$	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
0	40.305	7.905
5	42.285	9.515

(Koppel, Z. phys. Ch. 1906, 32. 409.)

See also under Na<sub>2</sub>Zn(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O.

Solubility of  $\text{Na}_2\text{SO}_4 + \text{Th}(\text{SO}_4)_2$  at  $16^\circ$ .  
Solid phase  $\text{Th}(\text{SO}_4)_2$ .

Pts. per 100 pts. $\text{H}_2\text{O}$		Pts. per 100 pts. $\text{H}_2\text{O}$	
$\text{Na}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$	$\text{Na}_2\text{SO}_4$	$\text{Th}(\text{SO}_4)_2$
1.094	1.743	5.79	2.136
1.960	2.387	9.35	1.379
2.84	3.800	12.24	1.169
2.98	3.962	15.36	1.048
4.11	3.375	...	...

(Barre, C. R. 1911, 150. 155.)

Solubility in Na acetate + Aq at  $25^\circ$ .

Solid phase,  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .

Composition of the solutions

% Na acetate	% $\text{Na}_2\text{SO}_4$	% $\text{H}_2\text{O}$
0	21.9	78.10
4.10	17.72	78.18
7.71	16.48	75.81
12.58	13.50	73.92
16.26	11.50	72.24
20.63	8.10	71.27

(Fox, Chem. Soc. 1909, 95. 883.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Alcohol precipitates  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$  from the cold saturated aqueous solution. (Brandes and Firnhaber.)

Insol. in alcohol of from 0.817 to 0.90 sp. gr. (Kirwan.)

1000 pts. alcohol of 0.872 sp. gr. dissolve 0.7 pt.  $\text{Na}_2\text{SO}_4$  at  $12.5-15^\circ$ ; of 0.905 sp. gr. dissolve 3.8 pts.  $\text{Na}_2\text{SO}_4$  at  $12.5-15^\circ$ .

Insol. in alcohol of 0.83-0.85 sp. gr. (Anthon.)

From supersaturated solution in alcohol, crystals with  $7\text{H}_2\text{O}$  are formed. (Schiff, A. 106. 11.)

100 pts. 10% alcohol at  $15^\circ$  contain 14.35 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ; 20% alcohol at  $15^\circ$  contain 5.6 pts.  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ ; 40% alcohol at  $15^\circ$  contain 1.3%  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ . (Schiff, A. 118. 365.)

Very al. sol. in abs. alcohol at ord. temp.; somewhat more, though still exceedingly sparingly, sol. in abs. alcohol acidulated with  $\text{H}_2\text{SO}_4$ . (Fresenius.)

Alcohol does not affect crystal  $\text{H}_2\text{O}$  of  $\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$ .

Solubility of  $\text{Na}_2\text{SO}_4$  in alcohol + Aq at  $t^\circ$ .

$t^\circ$	% alcohol	g. per 100 g. solution			solid phase
		$\text{H}_2\text{O}$	alcohol	$\text{Na}_2\text{SO}_4$	
15	0.7	88.7	0.0	11.3	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
	9.2	85.1	8.6	6.3	"
	19.4	78.6	18.9	2.9	"
	39.7	60.0	39.5	0.5	"
	58.9	41.1	58.8	0.1	"
	72.0	28.0	72.0	0.0	"
	0.0	72.8	0.0	27.2	$\text{Na}_2\text{SO}_4 + 7\text{H}_2\text{O}$
	11.2	76.5	9.5	14.0	"
	20.6	74.3	19.2	6.5	"
	30.2	68.4	29.6	2.0	"
25	0.0	78.1	0.0	21.9	$\text{Na}_2\text{SO}_4 + 10\text{H}_2\text{O}$
	10.6	78.5	9.3	12.2	"
	24.0	72.8	22.9	4.3	"
	54.0	45.6	54.0	0.4	"
36	0.0	67.0	0.0	33.0	$\text{Na}_2\text{SO}_4$
	8.8	70.0	6.8	22.6	"
	12.8	71.2	10.5	18.3	"
	17.9	71.1	15.5	13.4	"
	18.1	71.0	15.7	13.3	"
	28.9	66.5	28.4	5.1	"
	48.7	50.9	48.3	0.8	"
45	0.0	67.6	0.0	32.4	"
	9.0	71.3	7.1	21.6	"
	14.5	71.8	12.1	16.1	"
	20.6	70.6	18.4	10.0	"
	31.0	65.6	29.5	4.9	"

Between certain concentrations of alcohol, the liquid separates into two layers at  $25^\circ$ ,  $36^\circ$  and  $45^\circ$ , of the following composition.

$t^\circ$	Upper Layer			Lower Layer		
	$\text{H}_2\text{O}$	alcohol	$\text{Na}_2\text{SO}_4$	$\text{H}_2\text{O}$	alcohol	$\text{Na}_2\text{SO}_4$
25	66.5	27.3	6.2	67.4	5.1	27.5
	68.1	23.9	8.0	68.5	6.0	25.5
	68.3	23.1	8.6	68.3	6.7	25.0
36	...	...	...	66.6	4.1	29.3
	57.7	38.4	3.9	...	...	...
	65.0	28.3	6.7	68.8	5.9	25.3
45	68.1	21.2	10.7	68.9	9.4	21.7
	61.8	32.9	5.3	...	...	...
	65.8	25.3	8.9	68.4	8.8	22.8
	66.0	24.0	10.0	68.6	10.1	21.3

(de Bruyn, Z. phys. Ch. 1900, 32. 101.)

## Solubility in alcohol + Aq at 25°.

Composition of the sat. solution			Solid phase
% by wt. H <sub>2</sub> O	% by wt. alcohol	% by wt. Na <sub>2</sub> SO <sub>4</sub>	
63.41	34.84	1.75	Na <sub>2</sub> SO <sub>4</sub> · 10H <sub>2</sub> O
49.0	50.5	0.5	"
46.6	53.0	0.4	Na <sub>2</sub> SO <sub>4</sub> · 10H <sub>2</sub> O + Na <sub>2</sub> SO <sub>4</sub>
34.9	64.95	0.15	Na <sub>2</sub> SO <sub>4</sub>

(Schreinemakers, Z. phys. Ch. 1909, **67**, 552.)

Solubility data for solution of NaCl in ethyl alcohol + Aq. at 15°, 25°, and 30° are given by Schreinemakers (Z. phys. Ch. 1909, **67**, 556).

## Solubility in propyl alcohol + Aq at 20°.

% propyl alcohol	g. Na <sub>2</sub> SO <sub>4</sub> per 100 g. solution	% propyl alcohol	g. Na <sub>2</sub> SO <sub>4</sub> per 100 g. solution
42.20	1.99	56.57	0.55
49.77	1.15	60.64	0.44
55.65	0.72	62.81	0.38

(Linebarger, Am. Ch. J. 1892, **14**, 380.)

Sol. in glycerine.

Insol. in acetone. (Naumann, B. 1904 **37**, 4329; Eidmann, C. C. 1899, II, 1014.)  
benzonitrile. (Naumann, B. 1914, **47**, 1370)  
methyl acetate. (Naumann, B. 1909, **42**, 7790); ethyl acetate. (Naumann, B. 1910, **43**, 314.)

100 g. H<sub>2</sub>O dissolve 183.7 g. sugar + 30.5 g. Na<sub>2</sub>SO<sub>4</sub> at 31.25°, or 100 g. sat. solution contain 52.2 g. sugar + 9.6 g. Na<sub>2</sub>SO<sub>4</sub>. (Köhler, Z. Ver. Zuckerind, 1897, **47**, 447.)

Min. Anhydrous, *Thenardite*. +10H<sub>2</sub>O, *Mirabilite*.

**Sodium hydrogen sulphate, NaHSO<sub>4</sub>.**

Not deliquescent. Very sol. in H<sub>2</sub>O with decomposition.

Sol. in 2 pts. H<sub>2</sub>O at 0° (Link); 1 pt. H<sub>2</sub>O at 100° (Schubarth). 100 pts. H<sub>2</sub>O at 15.5° dissolve 92.72 pts. Sol. in 2 pts. H<sub>2</sub>O at 18.75° (Abl); decomp. by alcohol.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, **20**, 829)

+H<sub>2</sub>O. Deliquescent, and decomp. by the H<sub>2</sub>O which it takes up.

NaH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>. Decomp. by H<sub>2</sub>O. (Schultz.)

**Trisodium hydrogen sulphate, Na<sub>3</sub>H(SO<sub>4</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O with decomp.

+H<sub>2</sub>O. (Rose.)

**Sodium pyrosulphate, Na<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.**

Sol. in fuming H<sub>2</sub>SO<sub>4</sub> without decomp.

**Sodium thallic sulphate, Na<sub>2</sub>SO<sub>4</sub> · Tl<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.**

Sol. in H<sub>2</sub>O. (Strecker, A. 185, 207.)

**Sodium thorium sulphate, Na<sub>2</sub>SO<sub>4</sub> · Th(SO<sub>4</sub>)<sub>2</sub> · 6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. 100 pts. cold sat. Na<sub>2</sub>SO<sub>4</sub> + Aq dissolve 4 pts. of this salt. (Cleve.)

See also under Na<sub>2</sub>SO<sub>4</sub> + ThSO<sub>4</sub>.

**Sodium titanium sesquisulphate, Na<sub>2</sub>Ti<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> · 5H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Spence, Chem. Soc. 1904, **86**, (2) 412.)

Insol. in alcohol. (Knecht, B. 1903, **36**, 169.)

**Sodium titanyl sulphate, Na<sub>2</sub>TiO<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub> · 10H<sub>2</sub>O.**

Hygroscopic. (Massuchelli and Pantanelli, C. C. 1909, II, 420.)

**Sodium uranyl sulphate, Na<sub>2</sub>(UO<sub>2</sub>)(SO<sub>4</sub>)<sub>2</sub> · 3H<sub>2</sub>O.**

(de Coninck, C. C. 1905, I, 919.)

**Sodium vanadium sulphate, Na<sub>2</sub>V<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub> · 24H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Piccini, Z. anorg. 1897, **13**, 444.)

**Sodium vanadyl sulphate, Na<sub>2</sub>SO<sub>4</sub> · VO(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O and alcohol + conc. H<sub>2</sub>SO<sub>4</sub>. (Koppel, Z. anorg. 1903, **35**, 177.)  
Na<sub>2</sub>SO<sub>4</sub> · 2VO(SO<sub>4</sub>)<sub>2</sub> · 2½H<sub>2</sub>O. Slowly sol. in H<sub>2</sub>O.

Can be cryst. from H<sub>2</sub>SO<sub>4</sub> at 100°. (Koppel.)

**Sodium yttrium sulphate, Na<sub>2</sub>SO<sub>4</sub> · Y<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> · 2H<sub>2</sub>O.**

Quite sol. in H<sub>2</sub>O. (Cleve.)

The only double salt capable of existing at 25°. (James and Holden, J. Am. Chem. Soc. 1913, **35**, 562.)

**Sodium zinc sulphate, Na<sub>2</sub>SO<sub>4</sub> · ZnSO<sub>4</sub> · 4H<sub>2</sub>O.**

Deliquescent in moist air.

Decomp. into constituents on dissolving in H<sub>2</sub>O. (Graham, Phil. Mag. 13, 417.)

Solubility of Na<sub>2</sub>Zn(SO<sub>4</sub>)<sub>2</sub> · 4H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
25	26.32	23.40
30	26.475	23.445
35	26.365	23.525
40	26.68	23.63

(Koppel, Z. phys. Ch. 1905, **52**, 409.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{ZnSO}_4$ .  
7H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>	t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
10	45.79	11.24	25	56.155	7.215
15	48.81	10.175	30	60.55	6.34
20	52.34	8.625	35	65.25	5.64

(Koppel.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{ZnSO}_4$ .  
6H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
38	66.64	4.98
40	64.89	4.71

(Koppel.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ .  
10H<sub>2</sub>O in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
10	43.495	12.35
15	36.925	16.71
20	28.77	21.98
25	19.935	29.875
30	10.67	42.515

(Koppel.)

Solubility of  $\text{Na}_2\text{Zn}(\text{SO}_4)_2 \cdot 4\text{H}_2\text{O} + \text{Na}_2\text{SO}_4$ .  
(anhydrous) in 100 g. H<sub>2</sub>O at t°.

t°	grams ZnSO <sub>4</sub>	grams Na <sub>2</sub> SO <sub>4</sub>
35	8.725	46.61
40	9.16	43.835

(Koppel.)

Sodium sulphate fluoride,  $\text{Na}_2\text{SO}_4 \cdot \text{NaF}$ .

Cryst. from H<sub>2</sub>O without decomp. (Marignac, Ann. Min. (5) 15. 236.)

Sodium sulphate antimony trifluoride.

See Antimony trifluoride sodium sulphate.

Strontium sulphate,  $\text{SrSO}_4$ .

Very al. sol. in cold, and still less in boiling H<sub>2</sub>O.

1 l. H<sub>2</sub>O at 11–15° dissolves 0.066 g.  $\text{SrSO}_4$  (Brandes and Silber); 0.145 g.  $\text{SrSO}_4$  (Fresenius); 0.154–0.167 g.  $\text{SrSO}_4$  (Marignac); 0.187 g.  $\text{SrSO}_4$  (Kremers); 0.278 g.  $\text{SrSO}_4$  (Andrews).

1 l. boiling H<sub>2</sub>O dissolves 0.104 g.  $\text{SrSO}_4$  (Fresenius); 0.282 g.  $\text{SrSO}_4$  (Brandes and Silber).

When a Sr salt is precipitated by H<sub>2</sub>SO<sub>4</sub>, 1 pt.  $\text{SrSO}_4$  remains dissolved in 700 pts. H<sub>2</sub>O. (Marignac.)

Sol. in about 8000 pts. H<sub>2</sub>O. (Schweitzer, J. B. 1877. 1054.)

Calculated from electrical conductivity of the solution,  $\text{SrSO}_4$  is sol. in 10,070 pts. H<sub>2</sub>O at 16.1° and 10,090 pts. at 20.1°. (Holleman, Z. phys. Ch. 12. 131.)

1 l. H<sub>2</sub>O dissolves 107 mg.  $\text{SrSO}_4$  at 18° and not much more at higher temp. (Kohlrausch and Rose, Z. phys. Ch. 12. 241.)

100 g. H<sub>2</sub>O dissolve

at t°	0°–5°	10°–12°	20°	30°
g. $\text{SrSO}_4$	0.0983	0.0994	0.1479	1.0600

at t°	50°	80°	90°	95–98°
g. $\text{SrSO}_4$	0.1629	0.1688	0.1727	0.1789

(Wolffmann, C. C. 1897, I. 632.)

1 l. H<sub>2</sub>O dissolves 114 mg.  $\text{SrSO}_4$  at 18°. (Kohlrausch, Z. phys. Ch. 1904, 50. 356.); 114.3 mg at 18°. (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Sol. in 6895 pts. cold, and 9638 pts. boiling H<sub>2</sub>O; in 11,000–12,000 pts. H<sub>2</sub>O containing H<sub>2</sub>SO<sub>4</sub>; in 474 HCl+Aq containing 8.5% HCl; in 432 pts. HNO<sub>3</sub>+Aq containing 4.8% N<sub>2</sub>O<sub>5</sub>; in 7843 pts. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq containing 15.6% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>. (Fresenius.)

Or, 1 l. cold HCl+Aq of 8.5% dissolves 2.11 g.  $\text{SrSO}_4$ ; 1 l. cold HNO<sub>3</sub>+Aq of 4.8% N<sub>2</sub>O<sub>5</sub> dissolves 2.31 g.  $\text{SrSO}_4$ ; 1 l. cold HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>+Aq of 15.6% HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> dissolves 0.1275 g.  $\text{SrSO}_4$ . (Fresenius.)

Solubility of  $\text{SrSO}_4$  in HCl+Aq.

No. cc. HCl + Aq containing 1 mg. equiv. HCl	g. per 100 cc. solution	
	HCl	$\text{SrSO}_4$
0.2	18.23	0.161
0.5	7.29	0.207
1.0	3.65	0.188
2.0	1.82	0.126
10.0	0.36	0.048

(Banthisch, J. pr. 1884, (2) 29. 54.)

Solubility of  $\text{SrSO}_4$  in HNO<sub>3</sub>+Aq.

No. cc. HNO <sub>3</sub> + Aq containing 1 mg. equiv. HNO <sub>3</sub>	g. per 100 cc. solution	
	HNO <sub>3</sub>	$\text{SrSO}_4$
0.2	31.52	0.381
0.5	12.61	0.307
1.0	6.30	0.217
2.0	3.15	0.138
10.0	0.63	0.049

(Banthisch, J. pr. 1884, (2) 29. 54.)

Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. See under  $\text{SrH}_2(\text{SO}_4)_2$ . Insol. in NH<sub>4</sub>Cl+Aq or conc. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>+Aq. (Rose.)

Slowly but completely sol. in NaCl+Aq. (Wackenroder.)

H<sub>2</sub>O containing Na<sub>2</sub>SO<sub>4</sub> dissolves less  $\text{SrSO}_4$ .



than pure  $H_2O$ ;  $H_2O$  containing  $H_2SO_4$  still less. (Andrews, Phil. Mag. Ann. 7. 406.)

Insol. in  $Na_2S_2O_3 + Aq$ .

Insol. in boiling conc.  $(NH_4)_2SO_4 + Aq$ . (Rose, Pogg. 110. 292.)

Sol. in 16.949 pts.  $(NH_4)_2SO_4 + Aq$  (1:4). (Fresenius, Z. anal. 33. 195.)

Pptn. is hindered by alkali metaphosphates and citrates, but not by citric acid.

Decomp. at ord. temp., and more rapidly on boiling by alkali carbonates +  $Aq$ .

Sol. in  $MgCl_2$  or  $KCl + Aq$ , solubility increasing with strength of solution; sol. in  $NaCl$  or  $CaCl_2 + Aq$ , maximum solubility occurring when the solutions are of a medium concentration. The numerical results are as follows:

100 pts. of the salt solutions containing given pts. salt dissolve pts.  $SrSO_4$ .

Salt	Pts. salt	Pts. $SrSO_4$
NaCl	22.17	0.1811
	15.54	0.2186
	8.44	0.1653
KCl	18.08	0.2513
	12.54	0.1933
	8.22	0.1925
$MgCl_2$	13.63	0.2419
	4.03	0.2057
	1.59	0.1986
$CaCl_2$	33.70	0.1706
	16.51	0.1853
	8.67	0.1756

(Virek, C. C. 1863. 402.)

Solubility in  $H_2O$ , and in solutions of the sulphates chlorides and nitrates of the alkalis and alkaline earths and in solutions of salts of the alkalis with strong organic acids has been determined. No data in abstract. (Wolfmann, Chem.\*Soc. 1898, (2) 74. 220.)

Solubility in  $H_2O$  is considerably decreased by the presence of  $K_2SO_4$ . (Barre, A. ch. 1911, (8) 24. 175.)

Solubility of  $SrSO_4$  in  $Ca(NO_3)_2 + Aq$  at ord. temp.

G. per 100 cc. sat. solution.

$Ca(NO_3)_2$	$SrSO_4$	$Ca(NO_3)_2$	$SrSO_4$
0.5	0.0483	4	0.1489
1	0.0619	5	0.1689
2	0.1081	6	0.1955
3	0.1275	....	....

(Raffo and Rossi, Gazz. ch. it. 1915, 45. (1) 45.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

100 g. 95% formic acid dissolve 0.02 g.  $SrSO_4$  at 18.5°. (Aschan, Chem. Ztg. 1913, 37. 1117.)

Insol. in absolute alcohol; scarcely sol. in dil. alcohol.

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790); acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1896, II. 1014.)

Min. Celestite.

### Strontium hydrogen sulphate, $SrH_2(SO_4)_2$ .

100 pts.  $H_2SO_4$  dissolve 2.2 pts.  $SrSO_4$  (Lies-Bodart and Jacquemin); 100 pts.  $H_2SO_4$  dissolve 5.68 pts. (Struve, Z. anal. 9. 34); 100 pts. fuming  $H_2SO_4$  dissolve 9.77 pts. (Struve).

1 g.  $SrSO_4$  dissolves in 1256 g. 91%  $H_2SO_4 + Aq$  (Varenne and Pauleau, C. R. 93. 1016); boiling  $H_2SO_4$  dissolves about 15%  $SrSO_4$ , and still more at 100°. (Schults, Pogg. 133. 147.)

Sol. in 1519 pts. 91%  $H_2SO_4$ . (Varenne and Pauleau, C. R. 93. 1016.)

100 pts.  $H_2SO_4$  (sp. gr. 1.843) dissolve 14 pts.  $SrSO_4$  at 70°. (Garside, C. N. 31. 245.)

Decomp. by  $H_2O$ .

100 pts. hot conc.  $H_2SO_4$  dissolve about 9.0 pts.  $SrSO_4$ . (Rohland, Z. anorg. 1910, 66. 206.)

10° ccm. of sat.  $SrSO_4 +$  absolute  $H_2SO_4$  contain approx. 2.17 g.  $SrSO_4$ . (Bergius, Z. phys. Ch. 1910, 72. 355.)

+  $H_2O$ . Decomp. by  $H_2O$ .

### Strontium tin (stannic) sulphate, $SrSO_4 \cdot Sn(SO_4)_2 \cdot 3H_2O$ .

Decomp. by  $H_2O$ . Sol. in  $HCl$ . (Weinland and Kühl, Z. anorg. 1907, 54. 249.)

### Strontium titanium sulphate, $SrSO_4 \cdot Ti(SO_4)_2$ .

Ppt; decomp. by  $H_2O$  giving titanous acid. (Weinland and Kühl, Z. anorg. 1907, 54. 254.)

### Tantalum sulphate, $3Ta_2O_5 \cdot SO_3 + 9H_2O$ .

(Hermann, J. pr. 70. 201.)

### Tellurium sulphate, basic, $TeO_2 \cdot SO_3$ .

Sol. in cold dil.  $H_2SO_4$ . Decomp. by hot  $H_2O$ . (Klein, C. R. 99. 326.)

### Terbium sulphate, $Tr_2(SO_4)_3 + 8H_2O$ .

Sol. in  $H_2O$ .

Sol. in  $H_2O$ ; pptd. by alcohol. (Urbain, C. R. 1908, 146. 127.)

### Thallous sulphate, $Tl_2SO_4$ .

1 pt. dissolves at t° in pts.  $H_2O$ , according to C = Crookes; L = Lamy:

15°	18°	62°	100°	101.2°
21.1	20.8	8.7	5.4	5.22 pts. $H_2O$ .
C	L	D	L	C

Solubility of  $\text{Th}_2\text{SO}_4$  in  $\text{H}_2\text{O}$ .

$t^\circ$	% $\text{Th}_2\text{SO}_4$	$t^\circ$	% $\text{Th}_2\text{SO}_4$
0	2.63	60	9.85
10	3.57	70	11.31
20	4.64	80	12.75
30	5.80	90	14.19
40	7.06	99.7*	15.57
50	8.44		

B.-pt. at 748 mm.

(Berkeley, Phil. Trans. Roy. Soc. 1904, 208. A, 189; calc. by Landolt-Börnstein.)

100 g.  $\text{H}_2\text{O}$  dissolve 3.36 g.  $\text{Th}_2\text{SO}_4$  at  $6.5^\circ$ ; 4.3 g. at  $12^\circ$ ; 19.14 g. at  $100^\circ$ . (Tutton, Proc. Roy. Soc. 1907, 79. A, 351.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.1928 equivalents  $\text{Th}_2\text{SO}_4$  at  $20^\circ$ , or 48.59 g. in 1 l. of solution. (Noyes, J. Am. Chem. Soc. 1911, 33. 1657.)

1 l.  $\text{H}_2\text{O}$  dissolves 0.1083 g. equiv.  $\text{Th}_2\text{SO}_4$  at  $25^\circ$ , or 27.28 g. in 1 l. of solution. (Noyes.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Strength of $\text{H}_2\text{SO}_4 + \text{Aq}$ g. mols. per l.	g. mols. $\text{Th}_2\text{SO}_4$ per l.
0.0494	0.1172
0.0987	0.1249

(Noyes, J. Am. Chem. Soc. 1911, 33. 1662.)

1 l.  $\text{TiClO}_3 + \text{Aq.}$  containing 0.1058 equivalents  $\text{TiClO}_3$ , dissolves 0.1366 equivalents  $\text{Th}_2\text{SO}_4$  at  $20^\circ$ . (Noyes.)

See also  $\text{TiClO}_3$ .Solubility in salts +  $\text{Aq}$  at  $25^\circ$ .

g. mols. per l.	g. mols. per l. $\text{Th}_2\text{SO}_4$ dissolved
0.0996 $\text{TiNO}_3$	0.08365
0.0497 $\text{Na}_2\text{SO}_4$	0.1080
0.1988 $\text{Na}_2\text{SO}_4$	0.1173
0.1010 $\text{NaHSO}_4$	0.1161

(Noyes.)

Thallous hydrogen sulphate,  $\text{ThHSO}_4$ .

Sl. hygroscopic.

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

1000 g. of the solution contain:

Mols. $\text{H}_2\text{SO}_4$	Mols. $\text{Th}_2\text{SO}_4$
4.55	0.56
4.79	0.55
4.89	0.59
4.92	0.66
4.78	0.75
4.26	1.01
4.03	1.08

(D'Ans, Z. anorg. 1910, 65. 232.)

$\text{Th}_2\text{SO}_4$ ,  $\text{ThHSO}_4$ . Sol. in  $\text{H}_2\text{O}$ . (Stortenbecker, R. t. c. 1902, 21. 90.)

Thallous pyrosulphate,  $\text{Th}_2\text{S}_2\text{O}_7$ .Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17. 2502.)Thallous octosulphate,  $\text{Th}_8\text{S}_8\text{O}_{32}$ .Decomp. by  $\text{H}_2\text{O}$ . (Weber, B. 17. 2502.)Thallic sulphate, basic,  $\text{Th}_2\text{O}_3 \cdot 2\text{SO}_3 + 3\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .+  $5\text{H}_2\text{O}$ . As above. (Willm, A. ch. (4) 5. 5.)Thallic sulphate,  $\text{Th}_2(\text{SO}_4)_3 \cdot 7\text{H}_2\text{O}$ .Decomp. by cold  $\text{H}_2\text{O}$  with separation of  $\text{TiO}(\text{OH})$ . (Crookes.)Thallothallic sulphate,  $2\text{Th}_2\text{O}_3 \cdot 3\text{Th}_2\text{O}_3 \cdot 12\text{SO}_3 + 25\text{H}_2\text{O}$ .

Gradually efflorescent. (Willm.)

 $\text{Th}_2(\text{SO}_4)_3$ . (Lepsius, Chem. Ztg. 1890. 1327.) $\text{ThHSO}_4$ . (Lepsius.)Thallous uranyl sulphate,  $\text{Th}_2(\text{UO}_2)(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .Sl. sol. in cold  $\text{H}_2\text{O}$ .

Easily forms supersat. solutions. (Kohn, Z. anorg. 1908, 59. 112.)

Thallium vanadium sulphate,  $\text{Th}_2\text{V}_2(\text{SO}_4)_4 + 24\text{H}_2\text{O}$ .100 pts.  $\text{H}_2\text{O}$  dissolve 11.06 pts. salt at  $10^\circ$ .Sp. gr. of solution at  $4^\circ/20^\circ = 2.342$ .Very sol. in hot  $\text{H}_2\text{O}$ . (Piccini, Z. anorg. 1897, 13. 446.)

256 g. anhydrous, or 433 g. hydrated salt, or 0.573 g. mols. of anhydrous salt are sol. in 1 l.  $\text{H}_2\text{O}$  at  $25^\circ$ .

Melts in crystal  $\text{H}_2\text{O}$  at  $48^\circ$ . (Locke, Am. Ch. J. 1901, 26. 175.)

Thallous zinc sulphate,  $\text{Th}_2\text{Zn}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ .

1 l.  $\text{H}_2\text{O}$  dissolves 86 g. anhydrous salt at  $25^\circ$ . (Locke, Am. Ch. J. 1902, 27. 459.)

Thallothallic sulphate bromide,  $\text{Th}_2\text{Br}_2\text{SO}_4$ .

Very sol. in cold  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$ . (Meyer and Goldschmidt, B. 1903, 36. 242.)

Thorium sulphate, basic,  $3[\text{Th}(\text{SO}_4)_2 + 2\text{H}_2\text{O}]$ ,  $\text{Th}(\text{SO}_4)_2\text{O} + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; very slowly attacked by dil. acids. (Demarcay.)

$\text{ThO}(\text{SO}_4) + 2\text{H}_2\text{O}$ . Stable in aq. solution at  $100^\circ$ . (Hauser, B. 1910, 43. 2776.)

+  $5\text{H}_2\text{O}$ . Somewhat sol. in hot conc.  $\text{MgSO}_4 + \text{Aq.}$  (Halla, Z. anorg. 1912, 79. 260.)

Thorium sulphate,  $\text{Th}(\text{SO}_4)_2$ .

Anhydrous. Easily sol. if brought into a large amount of  $\text{H}_2\text{O}$ , but very slowly sol. if only a little  $\text{H}_2\text{O}$  is added to the salt.

100 pts.  $\text{H}_2\text{O}$  dissolve about 4.86 pts.  $\text{Th}(\text{SO}_4)_2$  at  $0^\circ$ . (Cleve.)

When heated, a hydrous salt separates out, which redissolves on cooling. (Cleve.)

Solubility of anhydrous salt cannot be determined, as it begins to separate out  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  before a saturated solution is reached. At  $0^\circ$ , 100 pts.  $\text{H}_2\text{O}$  dissolved 22.97 pts.  $\text{Th}(\text{SO}_4)_2$  in 15 minutes; at  $25^\circ$ , 27.00 pts.  $\text{Th}(\text{SO}_4)_2$  were dissolved in 5 minutes. (Rooseboom, Z. phys. Ch. 5. 198.)

+  $2\text{H}_2\text{O}$ . Shows same behaviour as anhydrous salt. 100 pts.  $\text{H}_2\text{O}$  dissolved 35.50 pts.  $\text{Th}(\text{SO}_4)_2$  from this salt at  $1^\circ$ , but this is not the maximum solubility. (Rooseboom.)

+  $4\text{H}_2\text{O}$ . Pptd. by alcohol from hot aqueous solution; also formed by heating  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  in aqueous solution above  $60^\circ$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ . D = according to Demarcay (C. R. 96. 1860); R = according to Rooseboom (Z. phys. Ch. 5. 202).

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
17	9.41 D	50	2.54 R	70	1.09 R
35	4.50 D	55	1.94 D	75	1.32 D
40	4.04 R	60	1.634 R	95	0.71 D

+  $6\text{H}_2\text{O}$ . Behaves as the anhydrous salt, but action is much slower.

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 6\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ .

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	1.50	45	3.85
15	1.63	60	6.64
30	2.45	..	...

(Rooseboom.)

This determination gives too low figures, especially at the higher temperatures. (Rooseboom.)

+  $8\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ .

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	1.00	25	1.85
15	1.38	44	3.71

(Rooseboom.)

100 g.  $\text{Th}(\text{SO}_4)_2 + \text{Aq}$  sat. with  $\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$  at  $30^\circ$  contain 2.152 g. anhydrous  $\text{Th}(\text{SO}_4)_2$ . (Koppel and Holzkampf, Z. anorg. 1910, 67. 274.)

100 g.  $\text{H}_2\text{O}$  dissolve 1.722 g. at  $25^\circ$ . (Barre, Bull. Soc. 1912, (4). 11.)

+  $9\text{H}_2\text{O}$ . Pptd. by alcohol from cold

aqueous solution. Sol. in about 88 pts.  $\text{H}_2\text{O}$  at  $0^\circ$ . (Cleve.) Extremely slowly sol. in  $\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ .

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	0.88	30	1.85	50	4.86
10	1.02	40	2.83	55	6.5 ±
20	1.25	..	...	..	...

Above  $55^\circ$ ,  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  separates out.

(Demarcay C. R. 96. 1860, calculated by Rooseboom.)

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$ , calculated as  $\text{Th}(\text{SO}_4)_2$ , at  $t^\circ$ .

$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$	$t^\circ$	Pts. $\text{Th}(\text{SO}_4)_2$
0	0.74	30	1.995	51	5.22
10	0.98	40	2.998	55	6.76
20	1.38	..	...	..	...

Above  $60^\circ$ ,  $\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$  separates out.

(Rooseboom, Z. phys. Ch. 5. 201.)

For further data, see Rooseboom (Z. phys. Ch. 5. 198), where there is a full discussion of the subject.

100 g. sat. solution of  $\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $25^\circ$  contain 1.593 g. anhyd. salt. (Wirth, Z. anorg. 1912, 76. 174.)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{H}_2\text{SO}_4$	% $\text{ThSO}_4$	Solid phase
30	0.000	2.152	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
	0.466	2.055	"
	0.72	2.065	"
	1.468	2.267	"
	2.983	2.311	"
	4.38	2.367	"
	4.97	2.323	"
	9.95	1.961	"
	15.03	1.484	"
	18.95	1.078	"
	23.64	0.7196	"
	32.68	0.3364	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
	37.80	0.077	"
	43.28	0.0213	"
	45.69	0.0047	"
20	74.0	0.1208	"
	80.5	0.000	"
	5	1.722	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
	15	0.9752	"
Boiling temp.	25	0.3838	"
	40	0.0103	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
	5	0.7407	"
	10	0.4808	"
	15	0.3882	"

(Koppel and Holzkampf, Z. anorg. 1910, 67. 274.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Per 100 g. of solution

g. $\text{Th}(\text{SO}_4)_2$	g. $\text{H}_2\text{SO}_4$
1.722	0.000
1.919	1.072
2.017	1.941
2.060	2.821
2.061	3.843
2.035	5.212
1.863	8.055
1.702	10.105

(Barre, Bull. Soc. 1912, (4) 11. 647.)

Solubility in  $\text{H}_2\text{SO}_4 + \text{Aq}$  at  $25^\circ$ .

Normality $\text{H}_2\text{SO}_4$	In 100 g. of the liquid are dissolved		Solid phase
	g. oxide	g. anhydrous sulphate	
0	1.015	1.593	$\text{Th}(\text{SO}_4)_2 + 9\text{H}_2\text{O}$
1.1	1.14	1.831	"
2.16	0.9265	1.488	"
4.32	0.545	0.8751	"
6.68	0.2685	0.4312	"
9.68	0.0651	0.1045	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
10.89	0.0396	0.0636	"
15.15	0.0192	0.0308	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$

(Wirth, Z. anorg. 1912, 76. 186.)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{HCl} + \text{Aq}$  at  $30^\circ$ .

% $\text{HCl}$	% $\text{Th}(\text{SO}_4)_2$	Solid phase
0.0	2.15	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
4.55	3.541	"
6.95	3.431±	"
12.14	2.811	"
15.71	2.360	"
18.33	2.199	"
20	2.13	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
23.9	1.277	"

(Koppel and Holzkampf, Z. anorg. 1910, 67. 274.)

Solubility of  $\text{Th}(\text{SO}_4)_2$  in  $\text{HNO}_3 + \text{Aq}$  at  $30^\circ$ .

% $\text{HNO}_3$	% $\text{Th}(\text{SO}_4)_2$	Solid phase
0.0	2.15	$\text{Th}(\text{SO}_4)_2 + 8\text{H}_2\text{O}$
5.17	3.68	"
10.04	4.20	"
16.68	4.84	"
21.99	4.47	"
28.33	3.96	"
28.51	3.88	"
33.17	3.34	$\text{Th}(\text{SO}_4)_2 + 4\text{H}_2\text{O}$
38.82	2.51	"

(Koppel and Holzkampf, Z. anorg. 1910, 67. 274.)

The presence of phosphoric acid increases the solubility of thorium sulphate in  $\text{HCl}$  and  $\text{HNO}_3$ . (Koppel and Holzkampf, Z. anorg. 1910, 67. 280.)

For solubility of  $\text{Th}(\text{SO}_4)_2$  in  $(\text{NH}_4)_2\text{SO}_4$ ,  $\text{Li}_2\text{SO}_4$ , and  $\text{K}_2\text{SO}_4$ , see respective sulphates. Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Thorium hydrogen sulphate,  $\text{ThH}_2(\text{SO}_4)_2$ .

Hydroscopic.

Sol. in excess of hot  $\text{H}_2\text{SO}_4$ ; insol. in cold  $\text{H}_2\text{SO}_4$ . (Brauner, Z. anorg. 1904, 38. 333.)Thulium sulphate,  $\text{Tm}_2(\text{SO}_4)_3 + 8\text{H}_2\text{O}$ .

Insol. in alcohol. (James, J. Am. Chem. Soc. 1911, 33. 1343.)

Tin (stannic) sulphate, basic,  $(\text{SnO})\text{SO}_4 + \text{H}_2\text{O}$ .Easily sol. in cold  $\text{H}_2\text{O}$ , but quickly decomp. with separation of stannic hydroxide. (Ditte, C. R. 104. 178.)

$3\text{SnO}$ ,  $\text{SO}_3$ . Easily sol. in dil. acids. (Ditte, A. ch. 1882, (5) 27. 159.)  
 $+1\frac{1}{2}\text{H}_2\text{O}$ . Not decomp. by cold  $\text{H}_2\text{O}$ . (Ditte.)

Tin (stannous) sulphate,  $\text{SnSO}_4$ .Sol. in 5.3 pts.  $\text{H}_2\text{O}$  at  $19^\circ$ , and 5.5 pts. at  $100^\circ$ . (Marignac.) Solution soon decomposes with separation of a basic salt. Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Bouquet.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Tin (stannic) sulphate,  $\text{Sn}(\text{SO}_4)_2 + 2\text{H}_2\text{O}$ .Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ ; decomp. by much  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Slowly sol. in  $\text{HCl} + \text{Aq}$ . Decomp. by absolute alcohol. (Ditte, C. R. 104. 178.)Titanium sulphate,  $\text{Ti}(\text{SO}_4)_2 + 3\text{H}_2\text{O}$ .Deliquescent, and sol. in  $\text{H}_2\text{O}$ . The aqueous solution is decomp. on boiling. (Glatzel, B. 9. 1833.)Titanium sesquisulphate,  $\text{Ti}_2(\text{SO}_4)_3$ .Very deliquescent, and easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution is decomp. by boiling. (Ebelmen.)Insol. in  $\text{H}_2\text{O}$ , alcohol, ether and conc.  $\text{H}_2\text{SO}_4$ . Slowly sol. in dil.  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$ . (Stähler, B. 1905, 38. 2624.)

Not sol. in alcohol. (Knecht, B. 1903, 36. 169.)  
 $+8\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Glatzel, B. 9. 1833.)

Titanium hydrogen sesquisulphate,  $3\text{Ti}_2(\text{SO}_4)_3 + \text{H}_2\text{SO}_4 + 25\text{H}_2\text{O}$ .Gradually sol. in  $\text{H}_2\text{O}$ .Insol. in 60%  $\text{H}_2\text{SO}_4$ , alcohol, ether and glacial acetic acid. (Stähler, B. 1905, 38. 2621.)

**Titanyl sulphate, (TiO)<sub>2</sub>SO<sub>4</sub>.**

Decomp. by H<sub>2</sub>O. Slowly sol. in cold, rapidly in warm HCl + Aq. (Merz, J. pr. 99. 157.)

+2H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Blondel, Bull. Soc. 1899, (3) 21. 262.)

2TiO<sub>2</sub>, 3SO<sub>3</sub> + 3H<sub>2</sub>O. Sol. in H<sub>2</sub>O acidified with HCl. (Blondel, Bull. Soc. 1899, (3) 21. 262.)

5TiO<sub>2</sub>, SO<sub>3</sub> + 5H<sub>2</sub>O. (Blondel.)

7TiO<sub>2</sub>, 2SCl<sub>2</sub> + xH<sub>2</sub>O. (Blondel.)

2TiO<sub>2</sub>, SO<sub>3</sub> + xH<sub>2</sub>O. (Blondel.)

**Uranous sulphate, basic, U(OH)<sub>2</sub>SO<sub>4</sub> + H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O. H<sub>2</sub>O dissolves out H<sub>2</sub>SO<sub>4</sub>. (Ebelmen, A. ch. (3) 5. 217.)

+5H<sub>2</sub>O. Sol. in alcohol.

Pptd. by ether. (Rosenheim, Z. anorg. 1901, 26. 251.)

**Uranous sulphate, U(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O with immediate decomp. Easily sol. in dil. H<sub>2</sub>SO<sub>4</sub> + Aq. (Kohl-schütter, B. 1901, 34. 3629.)

Decomp. by H<sub>2</sub>O into insol. basic, and sol. acid salt. Sol. in dil. H<sub>2</sub>SO<sub>4</sub> or HCl + Aq. Difficultly sol. in conc. acids. (Ebelmen, A. ch. (3) 5. 215.)

**Solubility of U(SO<sub>4</sub>)<sub>2</sub> + 4H<sub>2</sub>O in H<sub>2</sub>O at t°.**

t°	% U(SO <sub>4</sub> ) <sub>2</sub>	t°	% U(SO <sub>4</sub> ) <sub>2</sub>
29	9.8	48.2	8.1
37	8.3	63	7.3

(Giolitti and Bucci, Gazz. ch. it. 1905, 35. (2) 162.)

1 pt. is sol. in 4.23 pts. H<sub>2</sub>O at 13°; 4.3 pts. at 11.3°; 4.4 pts. at 9.1°. (de Coninck, A. ch. 1903, (7) 23. 12.)

+8H<sub>2</sub>O.

**Solubility of U(SO<sub>4</sub>)<sub>2</sub> + 8H<sub>2</sub>O in H<sub>2</sub>O at t°.**

t°	% U(SO <sub>4</sub> ) <sub>2</sub>	t°	% U(SO <sub>4</sub> ) <sub>2</sub>
18	10.17	48.2	28.72
25.6	13.32	62	36.8
37	19.98	93	63.2

(Giolitti and Bucci, Gazz. ch. it. 1905, 35. (2) 162.)

**Sp. gr. of U(SO<sub>4</sub>)<sub>2</sub> + Aq at t°.**

t°	% salt	Sp. gr.
16	1	1.0058
16.8	2	1.0107
16	3	1.0165
17.8	4	1.0218
17.2	5	1.0272
18	6	1.0320
18.3	7	1.0379
17.4	8	1.0429
15.2	9	1.0485
15.6	10	1.0539

(de Coninck, A. ch. 1903, (7) 23. 11.)

**Solubility in acids + Aq.**

1 pt. U(SO<sub>4</sub>)<sub>2</sub> is sol. in pts. acid at t°.

t°	Acid	Concentration of acid	Pts. acid
9.7	HCl	1:4	5.74
9.2	"	"	5.8
11.2	HNO <sub>3</sub>	1:4	5.4
10.3	"	"	5.53
11.4	H <sub>2</sub> SeO <sub>4</sub> (sp. gr. 1.4)	1:4	4.57
10.7	"	"	4.66
15	HBr	1:4	4.
14.2	"	"	4.23
15.5	HC <sub>2</sub> H <sub>3</sub> O <sub>2</sub>	1:4.5	4.1
14.4	"	"	4.3
16.5	"	1:2	3.72
15.9	"	"	3.85
11.7	H <sub>2</sub> SO <sub>4</sub>	1:4	6.36
10.9	"	"	6.42
10.1	"	"	6.45
9	"	"	6.5

(de Coninck, Chem. Soc. 1902, 82. (2) 459.)

Sp. gr. of U(SO<sub>4</sub>)<sub>2</sub> + HCl (d = 1.046) at t°.

d<sub>1</sub> = Sp. gr. referred to H<sub>2</sub>O.

d<sub>2</sub> = Sp. gr. referred to HCl.

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
16	1	1.0525	1.0063
17	2	1.0572	1.0109
18	3	1.0619	1.0154
18.4	4	1.0667	1.0199
17.6	5	1.0714	1.0243

(de Coninck, A. ch. 1903, (7) 23. 11.)

Sp. gr. of U(SO<sub>4</sub>)<sub>2</sub> + H<sub>2</sub>SO<sub>4</sub> (d = 1.14) at t°.

d<sub>1</sub> = Sp. gr. referred to H<sub>2</sub>O.

d<sub>2</sub> = Sp. gr. referred to H<sub>2</sub>SO<sub>4</sub>.

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
18.7	1	1.1442	1.0038
18.3	2	1.1494	1.0083
17.4	3	1.1539	1.0123
17.6	4	1.1583	1.0162
18.1	5	1.1626	1.0204

(de Coninck, A. ch. 1903, (7) 23. 11.)

1 pt. is sol. in 8 pts. alcohol (94°) + Aq. (1:4) at 10.4°. (de Coninck.)

Solubility in glycol at 14.8° = 3.15%. (de Coninck, C. C. 1905, II. 883.)

Min. *Johannite*. Sl. sol. in H<sub>2</sub>O.

**Uranous hydrogen sulphate, U(SO<sub>4</sub>)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>, + 10H<sub>2</sub>O.**

(Giolitti, C. C. 1905, II. 1226.)

**Uranyl sulphate, basic,  $3\text{UO}_2 \cdot \text{SO}_3 + 2\text{H}_2\text{O}$ .**

(Athanasesco.)

+14H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Ordway, Sill. Am. J. (2) 26. 208.)4UO<sub>2</sub> · SO<sub>3</sub> + 7H<sub>2</sub>O. (Athanasesco, C. R. 103. 271.)UO<sub>2</sub>, 4UOSO<sub>4</sub> + 8H<sub>2</sub>O. Less sol. in min. acids, especially dil. H<sub>2</sub>SO<sub>4</sub> + Aq, than UOSO<sub>4</sub> + 2H<sub>2</sub>O. (de Coninck, C. C. 1901, II. 1038.)**Uranyl sulphate, (UO<sub>2</sub>)SO<sub>4</sub>.**+H<sub>2</sub>O. (de Coninck.)+3H<sub>2</sub>O. Efflorescent. Very sol. in H<sub>2</sub>O and alcohol.1 pt. is sol. in 0.6 pt. cold H<sub>2</sub>O; in 0.45 pt. boiling H<sub>2</sub>O; in 25 pts. cold absolute alcohol; in 20 pts. boiling absolute alcohol. (Bucholz.)Sol. in 0.47 pt. H<sub>2</sub>O at 21°, and 0.28 pt. boiling H<sub>2</sub>O. (Ebelmen.)100 pts. H<sub>2</sub>O at 15.5° dissolve 160 pts., and at 100°, 220 pts. (Ure's Dict.)1 pt. is sol. in 5.3 pts. H<sub>2</sub>O at 13.2°; 5.16 pts. at 14.1°; 4.96 pts. at 15.1°; 4.88 pts. at 15.5°. (de Coninck, A. ch. 1903, (7) 28. 8.)Sp. gr. of (UO<sub>2</sub>)SO<sub>4</sub> + Aq at t°.

t°	% (UO <sub>2</sub> )SO <sub>4</sub>	Sp. gr.
14	1	1.0062
15.5	2	1.0113
11.3	3	1.0172
10.2	4	1.0229
10.2	5	1.0280
10	6	1.0338
14	7	1.0389
15.6	8	1.0442
11	9	1.0503
10.3	10	1.0557
11.4	11	1.0612
11.6	12	1.0669

(de Coninck, A. ch. 1903, (7) 28. 7.)

**Solubility in acids + Aq.**1 pt. (UO<sub>2</sub>)SO<sub>4</sub> is sol. in:

3.4 pts. conc. HCl at 12.8°

3.25 " " " 13.6°

5.9 " HBr (d = 1.21) " 12.9°

6.1 " " " " 11.2°

10.8 " conc. HNO<sub>3</sub> " 12.3°

11.2 " " " " 10.8°

4.3 " H<sub>2</sub>SO<sub>4</sub> (d = 1.38) " 12.7°

4.1 " " " " 14.0°

5.6 " aqua regia (equal vol. HCl + HNO<sub>3</sub>) at 15.4°5.47 pts. aqua regia (equal vol. HCl + HNO<sub>3</sub>) at 16.4°

3.7 pts. selenic acid (d = 1.4) at 15.3°.

(de Coninck, A. ch. 1903, (7) 28. 8.)

Sp. gr. of (UO<sub>2</sub>)SO<sub>4</sub> + H<sub>2</sub>SO<sub>4</sub> (d = 1.168) at t°.d<sub>1</sub> = Sp. gr. referred to H<sub>2</sub>O.d<sub>2</sub> = Sp. gr. referred to H<sub>2</sub>SO<sub>4</sub>.

t°	% salt	d <sub>1</sub>	d <sub>2</sub>
20.6	1	1.1738	1.0050
22.2	2	1.1775	1.0062
21.1	3	1.1880	1.0129
22.7	4	1.1872	1.0165
22.3	5	1.1918	1.0204

(de Coninck, A. ch. 1903, (7) 28. 7.)

1 pt. is sol. in 37.9 pts. alcohol (85°) at 16.7°; 38.6 pts. at 15.8°. (de Coninck, A. ch. 1903, (7) 28. 8.)

Very sl. sol. in formic and glacial acetic acids. (de Coninck, A. ch. 1903, (7) 28. 9.)

Completely pptd. from (UO<sub>2</sub>)SO<sub>4</sub> + Aq by HCl, H<sub>2</sub>O<sub>2</sub>. (Persoz.)**Uranyl hydrogen sulphate, (UO<sub>2</sub>)SO<sub>4</sub> · H<sub>2</sub>SO<sub>4</sub>.**

Very deliquescent. (Schultz-Sellack.)

2(UO<sub>2</sub>)SO<sub>4</sub> · H<sub>2</sub>SO<sub>4</sub> + 5H<sub>2</sub>O. Very deliquescent. (Wyruboff, Bull. Soc. Min. 1909, 32. 351.)**Uranyl pyrosulphate, (UO<sub>2</sub>)S<sub>2</sub>O<sub>7</sub>.**Very deliquescent. Fizzes with H<sub>2</sub>O. (Schultz-Sellack.)**Uranouranyl sulphate, U<sub>2</sub>SO<sub>4</sub> · (UO<sub>2</sub>)SO<sub>4</sub>.**Sol. in H<sub>2</sub>O. (Ebelmen.) Decomp. by boiling. (Berzelius.)Min. *Voglianite*.**Uranyl sulphate ammonia, (UO<sub>2</sub>)SO<sub>4</sub> · 2NH<sub>3</sub>.**

(v. Unruh, Dissert. 1909.)

(UO<sub>2</sub>)SO<sub>4</sub> · 3NH<sub>3</sub>. (v. Unruh.)(UO<sub>2</sub>)SO<sub>4</sub> · 4NH<sub>3</sub>. (v. Unruh.)**Vanadous sulphate, V<sub>2</sub>O<sub>3</sub> · 4SO<sub>3</sub> + 9H<sub>2</sub>O.**Sol. in H<sub>2</sub>O. (Brierley, Chem. Soc. 49. 882.)**Vanadium sulphate, V<sub>2</sub>O<sub>5</sub> · 2SO<sub>3</sub> = (VO<sub>2</sub>)<sub>2</sub>S<sub>2</sub>O<sub>7</sub>.**Deliquescent. Easily sol. in H<sub>2</sub>O.V<sub>2</sub>O<sub>5</sub> · 3SO<sub>3</sub>. Deliquescent. Sol. in H<sub>2</sub>O and alcohol.+3H<sub>2</sub>O. Deliquescent. Very sol. in H<sub>2</sub>O, but decomp. by boiling. Sol. in alcohol. (Ditte, C. R. 102. 757.)VSO<sub>4</sub> + 7H<sub>2</sub>O. Decomp. by air; very unstable; sol. in H<sub>2</sub>O. (Piccini, Z. anorg. 1899, 19. 204.)**Vanadium sesquisulphate, V<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.***Anhydrous.*Insol. in H<sub>2</sub>O.Insol. in conc. H<sub>2</sub>SO<sub>4</sub>, but slowly sol. in boiling dil. H<sub>2</sub>SO<sub>4</sub>. Sol. in HCl.

Insol. in alcohol and ether. (Stähler, B. 1905, 38. 3979.)

**Vanadium hydrogen sulphate,**  
 $V_2(SO_4)_3, H_2SO_4 + 12H_2O.$ Sol. in  $H_2O$ .Sol. in  $HCl$ . Insol. in 60%  $H_2SO_4 + Aq$ , alcohol, ether and acetic acid. (Stähler, B. 1905, 38. 3978.)**Divanadyl sulphate,  $V_2O_5(SO_4)_2$ .**Insol. in  $H_2O$ ,  $HCl$ , or  $H_2SO_4 + Aq$ , but on heating to  $400^\circ$  becomes sol. in  $H_2O$  if heated to  $130^\circ$  therewith. (Gerland.)+  $4H_2O$ . Very slowly sol. in  $H_2O$  at  $10^\circ$ , quickly at  $60^\circ$ , and still more rapidly at  $100^\circ$ . Deliquesces in warm moist air more quickly than it dissolves in  $H_2O$  at  $10^\circ$ . Insol. in absolute alcohol. Very sol. in alcohol of 0.833 sp. gr. (Berzelius.)+  $5H_2O$ . (Koppel and Behrendt, Z. anorg. 1903, 35. 168.)+  $7H_2O$ , and  $10H_2O$ .+  $13H_2O$ . Efflorescent. (Gerland.) $2V_2O_5, 5SO_3 + 18H_2O$ . (Gain, C. R. 1906, 143. 1154.) $V_2O_5, 3SO_3 + 10H_2O$ . (G.) $2V_2O_5, 7SO_3 + 20H_2O$ . (G.) $2V_2O_5, 9SO_3 + 22H_2O$ . (G.) $V_2O_5, 5SO_3 + 12H_2O$ . (G.)**Divanadyl hydrogen sulphate,** $(V_2O_5)_2H_2(SO_4)_3 = V_2O_5, 3SO_3 + H_2O.$ +  $2H_2O$ .+  $3H_2O$ . Deliquescent. Very slowly sol. in cold  $H_2O$  or alcohol. Easily sol. in hot  $H_2O$ . (Gerland.)+  $5H_2O$ . Deliquescent. Insol. in ether. Scarcely sol. in alcohol. Slowly sol. in cold, easily in hot  $H_2O$ . (Crow.)+  $14H_2O$ . Easily sol. in cold  $H_2O$  or dil. alcohol. (Gerland.) $2VO_3, 3SO_3$ . Sl. sol. in  $H_2O$ . (Koppell and Behrendt, Z. anorg. 1903, 35. 163.) $2VOSO_4, H_2SO_4 + H_2O$ . Very slowly sol. in  $H_2O$ . (Koppell and Behrendt, Z. anorg. 1903, 35. 163.) $2VOSO_4, 3H_2SO_4 + 15H_2O$ . (Gain, C. R. 1906, 143. 1156.) $2VOSO_4, 4H_2SO_4 + 16H_2O$ . (G.) $2VOSO_4, 5H_2SO_4 + 15H_2O$ . (G.) $2VOSO_4, 7H_2SO_4 + 15H_2O$ . (G.) $2VOSO_4, 8H_2SO_4 + 16H_2O$ . (G.)**Ytterbium sulphate,  $Yb_2(SO_4)_3 + 8H_2O$ .**Quite slowly sol. in  $H_2O$  even at  $100^\circ$ . Anhydrous salt is easily sol. in much  $H_2O$ , but if little  $H_2O$  is used the hydrous salt is formed, which only slowly dissolves. Sol. in  $K_2SO_4 + Aq$ .100 pts.  $H_2O$  dissolve at: $0^\circ$  15.5° 35° 55° 60°44.2 34.6 19.1 11.5 10.4 pts.  $Yb_2(SO_4)_3$ ,

70° 80° 90° 100°

7.22 6.93 5.83 4.67 pts.  $Yb_2(SO_4)_3$ .

(Cleve, Z. anorg. 1902, 32. 143.)

**Yttrium sulphate, basic,  $Y_2O_3, SO_3 = (YO)_2SO_4$ .**Insol. in  $H_2O$ . (Berzelius.) $2Y_2O_3, SO_3 + 10H_2O$ . (Cleve.)**Yttrium sulphate,  $Y_2(SO_4)_3$ .***Anhydrous*. More sol. in  $H_2O$  than the hydrous salt, and more sol. in cold than hot  $H_2O$ . Solution sat. at  $0^\circ$  separates  $Y_2(SO_4)_3 + 8H_2O$  at  $50^\circ$ . 100 pts.  $H_2O$  dissolve 15.2 pts. anhydrous salt. at ord. temp.5.38 pts. are sol. in 100 pts.  $H_2O$  at  $25^\circ$ . (James and Holden, J. Am. Chem. Soc. 1913, 35. 561.)Easily sol. in large amount of sat.  $K_2SO_4 + Aq$ , from which  $3K_2SO_4, 2Y(SO_4)_3$  is pptd. on warming. (Cleve and Höglund, Sv. V. A. H. Bih. 1. No. 8.)Solubility of  $Y_2(SO_4)_3$  in  $Na_2SO_4 + Aq$  at  $25^\circ$ .

Pts. $Y_2(SO_4)_3$ per 100 pts. $H_2O$	Pts. $Na_2SO_4$ per 100 pts. $H_2O$	Solid phase
5.61	1.29	$Y_2(SO_4)_3$
6.38	3.85	
7.40	6.21	
8.43	8.53	
5.86	7.57	
4.75	7.72	
3.42	10.14	
2.36	11.36	
2.02	13.42	
1.90	14.89	
1.79	16.51	$Y_2(SO_4)_3, Na_2SO_4 + 2H_2O$
1.86	18.44	
2.99	19.96	
3.04	21.05	
2.27	27.14	$Na_2SO_4 + 10H_2O$
1.52	28.22	
1.61	28.13	
5.38	0.0	

(James and Holden, J. Am. Chem. Soc. 1913, 35. 560.)

+  $8H_2O$ . 100 pts.  $H_2O$  dissolve 9.3 pts. of cryst. salt at ord. temp., and 4.8 pts. at  $100^\circ$ . (Cleve, Bull. Soc. (2) 31. 344.)Less sol. in  $H_2O$  containing  $H_2SO_4$  than in pure  $H_2O$ . (Berzelius.)Completely pptd. by  $HC_2H_3O_2 + Aq$ . Insol. in alcohol.**Yttrium hydrogen sulphate,  $Y_2(SO_4)H_3$ .**

(Brauner, Z. anorg. 1904, 38. 332.)

**Zinc sulphate, basic,  $8ZnO, SO_3 + 2H_2O$ .**Insol. in  $H_2O$ . (Schindler, Mag. Pharm. 31. 181.) $8ZnO, SO_3 + 10H_2O$ . Insol. in  $H_2O$ . (Kane, A. ch. 72. 310.) $4ZnO, SO_3 + 2H_2O$ . Scarcely sol. in hot or cold  $H_2O$ . Sol. in  $ZnSO_4 + Aq$ . (Kühn, Schw. J. 60. 337.)

+3H<sub>2</sub>O. (Werner, B. 1907, 40. 4443.)  
 +5H<sub>2</sub>O. Nearly insol. in H<sub>2</sub>O. (Habermann, M. 5. 432.)  
 +6H<sub>2</sub>O. (Kraut, Z. anorg. 1897, 13. 5.)  
 +7H<sub>2</sub>O. (Athanasesco, C. R. 103. 271.)  
 +8H<sub>2</sub>O. Extremely slowly decomp. by H<sub>2</sub>O. (Reindel, J. pr. 1869, (1) 106. 373.)  
 +10H<sub>2</sub>O. (Schindler.)  
 3ZnO, SO<sub>3</sub>. Insol. in cold, sl. sol. in hot H<sub>2</sub>O. (Vogel.)  
 2ZnO, SO<sub>3</sub>. (Athanasesco.)  
 5ZnO, SO<sub>3</sub>. (Pickering, Chem. Soc. 1907, 91. 1986.)  
 +4H<sub>2</sub>O. (Moody, Am. J. Sci. 1906, [4] 22. 184.)  
 9ZnO, 2SO<sub>3</sub>+12H<sub>2</sub>O. (Reindel, J. pr. 1869, (1) 106. 374.)

#### Zinc sulphate, ZnSO<sub>4</sub>.

Sol. in H<sub>2</sub>O with evolution of heat.  
 Sol. in HCl+Aq.  
 +H<sub>2</sub>O. (Étard.)  
 +2H<sub>2</sub>O. Insol. in alcohol. (Kühn.)  
 +3½H<sub>2</sub>O. (Anthon.)  
 +5H<sub>2</sub>O. Insol. in boiling alcohol of 0.86 sp. gr. (Kühn.)  
 +6H<sub>2</sub>O. (Marignac.)  
 +7H<sub>2</sub>O. Slowly efflorescent.  
 M.-pt. of ZnSO<sub>4</sub>+7H<sub>2</sub>O=50°. (Tilden, Chem. Soc. 45. 409.)  
 For solubility data on hydrated salts, see below.

Sol. in 2+ pts. H<sub>2</sub>O at ord. temp., and in less at 100°. (Bergmann.)  
 100 pts. H<sub>2</sub>O at 104.4° dissolve 81.81 pts. ZnSO<sub>4</sub>. (Griffiths.)  
 100 pts. H<sub>2</sub>O at ord. temp. dissolve 140 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O. (Dumas.)  
 Sol. in 2.29 pts. H<sub>2</sub>O at 18.75°. (Abl.)  
 100 pts. H<sub>2</sub>O at 15.56° dissolve 140 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O. (Ure's Diet.)  
 100 pts. H<sub>2</sub>O at 15° dissolve 140.53 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O, and has sp. gr.=1.4442. (Michel and Kraft.)

1 pt. of the crystals dissolves in 0.923 pt. H<sub>2</sub>O at 17.5°, and forms a solution of 1.4353 sp. gr. (Karsten.)

100 pts. ZnSO<sub>4</sub>+Aq sat. at 18-20° contain 35.36 pts. ZnSO<sub>4</sub>. (v. Hauer, J. B. 1866. 59.)

100 pts. H<sub>2</sub>O dissolve at:  
 0° 20° 50° 75°  
 41.3 53.0 66.9 80.4 pts. ZnSO<sub>4</sub>. (Tobler, J. B. 1855. 309.)

100 pts. H<sub>2</sub>O at 20.5° dissolve 163.2 pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O. (Schiff, A. 109. 336.)

100 pts. H<sub>2</sub>O at t° dissolve pts. anhydrous ZnSO<sub>4</sub>, and pts. ZnSO<sub>4</sub>+7H<sub>2</sub>O.

t°	Pts. ZnSO <sub>4</sub>	Pts. ZnSO <sub>4</sub> +7H <sub>2</sub> O	t°	Pts. ZnSO <sub>4</sub>	Pts. ZnSO <sub>4</sub> +7H <sub>2</sub> O
0	43.02	115.22	60	74.20	313.48
10	48.36	138.21	70	79.25	369.36
20	53.13	161.49	80	84.60	442.62
30	58.40	190.90	90	89.78	533.02
40	63.52	224.05	100	95.03	653.59
50	68.75	263.84	...	...	...

(Poggiale, A. ch. (3) 8. 467.)

#### Solubility of ZnSO<sub>4</sub> in 100 pts. H<sub>2</sub>O at t°.

t°	Pts. ZnSO <sub>4</sub>	t°	Pts. ZnSO <sub>4</sub>	t°	Pts. ZnSO <sub>4</sub>
0	44.0	14	52.8	27	62.1
1	44.6	15	53.5	28	62.8
2	45.2	16	54.2	29	63.6
3	45.8	17	54.9	30	64.3
4	46.4	18	55.6	31	65.1
5	47.0	19	56.3	32	65.8
6	47.6	20	57.0	33	66.6
7	48.3	21	57.7	34	67.3
8	48.9	22	58.4	35	68.1
9	49.5	23	59.2	36	78.8
10	50.2	24	59.9	37	69.3
11	50.8	25	60.7	38	70.4
12	51.5	26	61.4	39	71.2
13	52.2	...	...	...	...

Decomp. into basic salt above 40°.

(Mulder, Scheik. Verhandel. 1864. 74.)

If solubility S represents number of pts. anhydrous salt in 100 pts. of solution, S=27.6+0.2604t from -5° to +81°; S=50.0-0.2244t from 81° to 175°. (Étard, C. R. 108. 207.)

Sat. ZnSO<sub>4</sub>+Aq contains at:

1°	13°	20°	41°	49°	
29.1	32.6	34.8	40.2	40.9%	ZnSO <sub>4</sub> ,
55°	62°	70°	77°	100°	
43.4	45.0	47.0	46.5	44.7%	ZnSO <sub>4</sub> ,
111°	12°	137°	144°	169°	171°
43.0	40.7	38.0	37.4	30.0	29.0% ZnSO <sub>4</sub> .

(Étard, A. ch. 1894, (7) 2. 551.)

Transition point from +6H<sub>2</sub>O to +1H<sub>2</sub>O is 70°. (Étard.)

#### Solubility of ZnSO<sub>4</sub>+6H<sub>2</sub>O in H<sub>2</sub>O at t°.

t°	g. ZnSO <sub>4</sub> in 100 g. H <sub>2</sub> O
-5.0	47.08
+0.1	49.48
9.1	54.20
15.0	57.15
25.0	63.74
30.0	65.82
35.0	67.99
39.0	70.08

(Cohen, Z. phys. Ch. 1900, 34. 182.)



Solubility of the hepta- and hexa-hydrates of  $\text{ZnSO}_4$  at  $t^\circ$ .

p = wt. of salt expressed in percent of solution.

$t^\circ$	p
0	29.43
0	29.53
0	29.49
15.00	33.66
15.88	33.85
30.70	38.46
39.92	41.36
39.95	41.37
40.73	41.43
41.49	41.70
46.40	42.68
49.97	43.51
49.99	43.41
50.00	43.50
50.02	43.51

Transition point from  $+7\text{H}_2\text{O}$  to  $+6\text{H}_2\text{O}$  is  $39^\circ$ .

The formula representing the change of solubility between  $0^\circ$  and  $39^\circ$  is

$$p = 29.5 + 0.270t + 0.00068t^2$$

while the expression for the hexahydrate above  $40^\circ$  is

$$p = 41.35 + 0.210t + 0.00070t^2$$

(Barnes, J. phys. Chem. 1900, 4, 19.)

Solubility of  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{ZnSO}_4$ in 100 g. $\text{H}_2\text{O}$
-5	39.30
+0.1	41.93
9.1	47.09
15.0	50.88
25.0	57.90
35.0	66.61
39.0	70.05

(Cohen, Z. phys. Ch. 1900, 34, 182.)

Solubility in  $\text{H}_2\text{O}$  at high pressures:

Pressure in atm.	$t^\circ$	g. $\text{ZnSO}_4$ in 100 g. $\text{H}_2\text{O}$	Solubility at $25^\circ$
1	26	57.95	57.95
500	26	58.43	57.92
500	25.8	58.32	57.91
1000	25.8	57.95	57.55
1000	25.8	57.95	57.55

(Cohen and Sinnige, Z. phys. Ch. 1909, 67, 444.)

Liable to form supersaturated solutions.

Sat.  $\text{ZnSO}_4 + \text{Aq}$  at  $8^\circ$  has sp. gr. = 1.421. (Anthon.)

Sp. gr. of  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $20.5^\circ$ .

% = %  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0057	21	1.1288	41	1.2754
2	1.0115	22	1.1355	42	1.2834
3	1.0173	23	1.1423	43	1.2917
4	1.0231	24	1.1491	44	1.3000
5	1.0289	25	1.1560	45	1.3083
6	1.0348	26	1.1629	46	1.3167
7	1.0407	27	1.1699	47	1.3252
8	1.0467	28	1.1770	48	1.3338
9	1.0527	29	1.1842	49	1.3424
10	1.0588	30	1.1914	50	1.3511
11	1.0649	31	1.1987	51	1.3599
12	1.0710	32	1.2060	52	1.3688
13	1.0772	33	1.2134	53	1.3779
14	1.0835	34	1.2209	54	1.3871
15	1.0899	35	1.2285	55	1.3964
16	1.0962	36	1.2362	56	1.4057
17	1.1026	37	1.2439	57	1.4151
18	1.1091	38	1.2517	58	1.4246
19	1.1156	39	1.2595	59	1.4342
20	1.1222	40	1.2674	60	1.4439

(Schiff, A. 110, 72.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $15^\circ$ .

% = %  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ .

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.006	21	1.130	41	1.280
2	1.013	22	1.137	42	1.288
3	1.019	23	1.143	43	1.295
4	1.024	24	1.150	44	1.304
5	1.0288	25	1.1574	45	1.3100
6	1.035	26	1.164	46	1.320
7	1.041	27	1.171	47	1.330
8	1.047	28	1.179	48	1.337
9	1.053	29	1.185	49	1.346
10	1.0593	30	1.1933	50	1.3532
11	1.066	31	1.200	51	1.362
12	1.073	32	1.209	52	1.380
13	1.079	33	1.216	53	1.370
14	1.085	34	1.224	54	1.390
15	1.0905	35	1.231	55	1.3966
16	1.097	36	1.240	56	1.408
17	1.103	37	1.246	57	1.416
18	1.110	38	1.255	58	1.425
19	1.116	39	1.263	59	1.435
20	1.1236	40	1.2709	60	1.4451

(Gerlach, Z. anal. & 288.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $23.5^\circ$ . a=no. of g., equivalent to  $\frac{1}{2}$  mol. wt., dissolved in 1000 g.  $\text{H}_2\text{O}$ ; b=sp. gr. if a is  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ ,  $\frac{1}{2}$  mol. wt.=143.5; c=sp. gr. if a is  $\text{ZnSO}_4$ ,  $\frac{1}{2}$  mol. wt.=80.5.

a	b	c	a	b
1	1.077	1.084	7	1.368
2	1.143	1.162	8	1.400
3	1.199	1.236	9	1.428
4	1.249	1.307	10	1.453
5	1.294	1.376	11	1.476
6	1.333	1.443	..	...

(Favre and Valson, C. R. 79. 968.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $18^\circ$ .

% $\text{ZnSO}_4$	Sp. gr.	% $\text{ZnSO}_4$	Sp. gr.	% $\text{ZnSO}_4$	Sp. gr.
5	1.0509	15	1.1675	32	1.3045
10	1.1369	20	1.2313	50	1.3788

(Kohlrausch, W. Ann. 1879. 1.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at room temp. containing:

7.12    16.64    23.09%  $\text{ZnSO}_4$ .  
1.1064    1.1953    1.2814

(Wagner, W. Ann. 1883, 18. 271.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $19.5^\circ$ .

Mass of salt per unit mass of solution	Density of solution. (g. per cc.)
0.00186	1.00179
0.00371	1.00356
0.00556	1.00530
0.00740	1.00711
0.01106	1.01066
0.01469	1.01410
0.01829	1.01753
0.02187	1.02112
0.02542	1.02446
0.02895	1.02798

(McGregor, C. N. 1887, 55. 4.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $25^\circ$ .

Concentration of $\text{ZnSO}_4 + \text{Aq}$	Sp. gr.
1—normal	1.0792
$\frac{1}{5}$ —"	1.0402
$\frac{1}{10}$ —"	1.0198
$\frac{1}{15}$ —"	1.0094
$\frac{1}{16}$ —"	1.0047

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$ .

g. salt in 100 g. solution	Sp. gr.
24.7170	1.3152
21.4444	1.2665
17.7573	1.2145
14.0307	1.1645
9.7428	1.1108
5.1110	1.0565

(Charpy, A. ch. 1893, (6) 29. 27.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$ .

g. equivalents $\text{ZnSO}_4$ per liter	$t^\circ$	Sp. gr. $t^\circ/t^\circ$
0.001309	13.59	1.0001126
0.002616	13.575	1.0002258
0.005212	13.573	1.0004451
0.01039	13.585	1.000886
0.09818	13.621	1.008189
0.18842	13.642	1.015587
0.1890	16.11	1.01550
2.493	15.88	1.19385

(Kohlrausch and Hallwachs, W. Ann. 1894, 53. 27.)

Sp. gr. of  $\text{ZnSO}_4 + \text{Aq}$  at  $18.5^\circ$ , when p = percent strength of solution; d = observed density; and w = volume conc.

in grams per cc.  $\left(\frac{pd}{100} = w\right)$

p	d	w
29.22	1.3718	0.40057
25.14	1.3091	0.32910
21.28	1.2528	0.26659
17.08	1.1957	0.20422
11.20	1.1220	0.12567
8.44	1.0894	0.09195
6.65	1.0696	0.07112
3.82	1.0387	0.03968
3.18	1.0318	0.03281
1.46	1.0138	0.01480
0.577	1.0045	0.00580

(Barnes, J. phys. Chem. 1898, 2. 542.)

Sp. gr. of dil.  $\text{ZnSO}_4 + \text{Aq}$  at  $20.004^\circ$ .

Conc. = g. equiv. per l. at  $20.004^\circ$ .

Sp. gr. compared with  $\text{H}_2\text{O}$  at  $20.004^\circ = 1$ .

Conc.	Sp. gr.
0.0000	1.000,000,0
0.0001	1.000,008,6
0.0002	1.000,017,2
0.0005	1.000,043,2
0.0010	1.000,086,3
0.0020	1.000,172,3
0.0050	1.000,429,1
0.0060	1.000,514,3
1.0100	1.000,853,9

(Lamb and Lee, J. Am. Chem. Soc. 1913, 35. 1690.)

Sat.  $\text{ZnSO}_4 + \text{Aq}$  boils at  $104.4^\circ$ , and solution contains 45 pts.  $\text{ZnSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . (Griffiths.)

Crust forms at  $103.5^\circ$ , the solution containing 68 pts.  $\text{ZnSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ . Highest temp. observed,  $105^\circ$ . (Gerlach, Z. anal. **26**, 426.)

B.-pt. of  $\text{ZnSO}_4 + \text{Aq}$  containing pts.  $\text{ZnSO}_4$  to 100 pts.  $\text{H}_2\text{O}$ .

B.-pt.	Pts. $\text{ZnSO}_4$	B.-pt.	Pts. $\text{ZnSO}_4$
100.5°	13.1	103.0°	61.0
101.0	25.0	103.5	68.0
101.5	37.7	104.0	74.9
102.0	45.4	104.5	80.7
102.5	53.9	105.0	85.7

(Gerlach, Z. anal. **26** 432.)

B.-pt. of  $\text{ZnSO}_4 + \text{Aq}$ .

g. $\text{ZnSO}_4$ in 100 g. $\text{H}_2\text{O}$	Rise of the b.-pt.	Barometric pressure mm.
2.886	0.080	743.0
6.647	0.169	"
10.139	0.266	"
13.389	0.372	"
17.713	0.461	"
22.202	0.591	"
25.199	0.690	"
28.249	0.811	"
30.470	0.899	742.0
32.89	0.995	"
35.18	1.122	"
37.36	1.240	"
39.83	1.381	"
41.30	1.459	"
44.56	1.671	"

(Kahlenberg, J. phys. Chem. 1901, **5**, 370.)

1 l. absolute  $\text{H}_2\text{SO}_4$  dissolves 0.0021 mols.  $\text{ZnSO}_4$  at  $25^\circ$ . (Bergius, Z. phys. Ch. 1912, **72**, 353.)

Completely pptd. from  $\text{ZnSO}_4 + \text{Aq}$  by  $\text{HCl} \cdot \text{H}_2\text{O}$ . (Persoz.)

Solubility of  $\text{ZnSO}_4$  in  $\text{KOH} + \text{Aq}$ .

Mols. $\text{KOH}$ to 1 mol. $\text{ZnSO}_4$	per cent $\text{ZnO}$ in ppt.
0.25	17.11
0.50	35.10
1.00	68.06
1.62	100.00
2.00	98.49
3.00	96.79
5.00	89.76
7.00	68.87
13.20	0.00

(Linebarger, J. Am. Chem. Soc. 1895, **17**, 390.)

Difficultly and slowly sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ , with separation of a double sulphate.

Sol. in considerable quantity in sat.  $\text{NaCl} + \text{Aq}$ , without pptn. at first, but finally  $\text{Na}_2\text{SO}_4$  separates out. See under  $\text{NaCl}$ .

Sol. in sat.  $\text{NaNO}_3 + \text{Aq}$  as in  $\text{NaCl} + \text{Aq}$ . See under  $\text{NaNO}_3$ .

Sol. in sat.  $\text{KNO}_3 + \text{Aq}$  with immediate pptn. of double sulphate. (Karsten.) See under  $\text{KNO}_3$ .

Very rapidly sol. in sat.  $\text{K}_2\text{SO}_4 + \text{Aq}$ , with separation of a double salt. (Karsten.) See under  $\text{K}_2\text{SO}_4$ .

Abundantly. in sat.  $\text{CuSO}_4 + \text{Aq}$ .

Slowly sol. in sat.  $\text{MgSO}_4 + \text{Aq}$ .

Very rapidly and abundantly sol. in sat.  $\text{Na}_2\text{SO}_4 + \text{Aq}$ .

For solubility of  $\text{ZnSO}_4 + \text{Na}_2\text{SO}_4$ , see under  $\text{Na}_2\text{SO}_4$  and  $\text{Na}_2\text{Zn(SO}_4)_2 + 4\text{H}_2\text{O}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 830.)

Insol. in alcohol of 0.88 sp. gr.; 1000 pts. alcohol of 0.905 sp. gr. dissolve 2 pts. (Anthon.)

100 pts. of a saturated solution in  $40^\circ\text{C}$  alcohol contain 3.48 pts.  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$ ;  $20^\circ$ , 39 pts.;  $10^\circ$ , 51.1 pts. (Schiff, J. B. 1861, 87.)

100 pts. absolute methyl alcohol dissolve 0.65 pt.  $\text{ZnSO}_4$  at  $18^\circ$ . (de Bruyn, Z. phys. Ch. 10, 783.)

100 pts. absolute methyl alcohol dissolve 59 pts.  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $17^\circ$ .

100 pts. 50% methyl alcohol dissolve 15.7 pts.  $\text{ZnSO}_4 + 7\text{H}_2\text{O}$  at  $17^\circ$ . (de Bruyn.)

Insol. in acetone. (Eidmann, C. C. 1899, II, 1014; Naumann, B. 1904, **37**, 4329.)

100 pts. glycerine dissolve 35 pts.  $\text{ZnSO}_4$  at ord. temp. (Klever, Bull. Soc. 1872, (2) 18, 372.)

Insol. in methyl acetate. (Naumann, B. 1909, **42**, 3790); ethyl acetate. (Naumann, B. 1904, **37**, 3601.)

Min. *Gossalarite*.

Zinc hydrogen sulphate,  $\text{ZnH}_2(\text{SO}_4)_2 + 8\text{H}_2\text{O}$ .

Somewhat difficultly sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (v. Kobell, J. pr. **23**, 492.)

Zinc sulphate ammonia, basic,  $4\text{NH}_3$ ,  $4\text{ZnO}$ ,  $\text{SO}_3 + 4\text{H}_2\text{O}$ .

Ppt. (Schindler.)

Zinc sulphate ammonia,  $\text{ZnSO}_4 \cdot 2\text{NH}_3$ .

+  $\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into basic zinc sulphate.

$\text{ZnSO}_4 \cdot 4\text{NH}_3 + 4\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Kane, A. ch. **72**, 304.)

+  $3\text{H}_2\text{O}$ . (André, C. R. 100, 241.)

$\text{ZnSO}_4 \cdot 5\text{NH}_3$ . Sol. in  $\text{H}_2\text{O}$  with partial decomp. (Rose, Pogg. **20**, 149.)

Zinc sulphate cupric oxide,  $\text{ZnSO}_4 \cdot 2\text{CuO} + 5\text{H}_2\text{O}$ .

(Mailhe, A. ch. 1902, (7) **27**, 169.)

$\text{ZnSO}_4 \cdot 3\text{CuO} + x\text{H}_2\text{O}$ . (Recours, C. R. 1901, **132**, 1415.)

+5H<sub>2</sub>O.  
 2ZnSO<sub>4</sub>, 3CuO+12H<sub>2</sub>O. (Mailhe, A. ch. 1902, (7) 37. 189.)  
 7ZnSO<sub>4</sub>, 24CuO+xH<sub>2</sub>O. (Recoura, C. R. 1901, 132. 1415.)

**Zinc sulphate hydrazine, ZnSO<sub>4</sub>, 2N<sub>2</sub>H<sub>4</sub>.**

Sol. in NH<sub>4</sub>OH+Aq. (Fransen, Z. anorg. 1908, 60. 278.)

Sol. in NH<sub>4</sub>OH+Aq without decomp. (Curtius, J. pr. 1894, (2) 50. 345.)

ZnH<sub>2</sub>(SO<sub>4</sub>)<sub>2</sub>, N<sub>2</sub>H<sub>4</sub>. 1 pt. is sol. in 185 pts. H<sub>2</sub>O at 12°. SL sol. in dil. acids. Decomp. by conc. HNO<sub>3</sub> and by hot conc. H<sub>2</sub>SO<sub>4</sub>.

Very sol. in NH<sub>4</sub>OH+Aq. (Curtius, J. pr. 1894, (2) 50. 331.)

**Zirconium sulphate, basic, 3ZrO<sub>2</sub>, 2SO<sub>3</sub>.**

Insol. in H<sub>2</sub>O. Sol. in HCl+Aq. (Paykull, B. 12. 1719.)

4ZrO<sub>2</sub>, 3SO<sub>3</sub>+14H<sub>2</sub>O. Ppt. Difficulty sol. in H<sub>2</sub>O. (Hauser, B. 1904, 37. 2024.)

3ZrO<sub>2</sub>, SO<sub>3</sub>. Insol. in boiling H<sub>2</sub>O. (Frans, B. 3. 58.)

7ZrO<sub>2</sub>, 6SO<sub>3</sub>. Insol. in H<sub>2</sub>O. (Endemann, J. pr. (2) 11. 219.)

ZrO<sub>2</sub>, SO<sub>3</sub>. Sol. in very little H<sub>2</sub>O. More H<sub>2</sub>O decomp. into 3ZrO<sub>2</sub>, 2SO<sub>3</sub> and Zr(SO<sub>4</sub>)<sub>2</sub>. (Berselius.)

3ZrO<sub>2</sub>, 4SO<sub>3</sub>+15H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Paykull.)

6ZrO<sub>2</sub>, 7SO<sub>3</sub>+19H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Paykull.)

**Zirconium sulphate, Zr(SO<sub>4</sub>)<sub>2</sub>.**

*Anhydrous.* Slowly but completely sol. in cold, quickly in hot H<sub>2</sub>O.

Sol. in warm H<sub>2</sub>SO<sub>4</sub>, but separates on cooling. Precipitated from aqueous solution by alcohol.

+4H<sub>2</sub>O. Easily sol. in H<sub>2</sub>O.

100 pts. of the solution contain 59.3 pts. of the hydrated salt at 39.5°. (Hauser, B. 1904, 37. 2025.)

Solubility of Zr(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>SO<sub>4</sub>+Aq at t°.

100 g. of the solution contain:

t°	g. ZrO <sub>2</sub>	g. SO <sub>3</sub>
39.5	19.5	25.40
	19.3	25.6
	19.6	25.99
	19.3	26.5
	18.8	27.0
	18.15	27.6
	17.3	25.3
	16.2	29.1
	9.6	32.3
	5.3	34.7
	3.51	36.01
	1.03	38.2
	0.46	39.8
	0.31	42.0

Solubility of Zr(SO<sub>4</sub>)<sub>2</sub>+4H<sub>2</sub>O in H<sub>2</sub>SO<sub>4</sub>+Aq at t°.—*Continued.*

t°	g. ZrO <sub>2</sub>	g. SO <sub>3</sub>
	0.33	42.1
	0.14	46.8
	0.13	47.1
	0.15	56.7
	0.20	56.8
	0.27	57.1
	0.50	57.5
	0.60	57.8
	2.00	59.5
	3.25	60.4
	4.40	61.4
22.	0.10	56.1
	0.13	46.5
	0.21	57.2

(Hauser, Z. anorg. 1907, 54. 197.)

**Zirconium hydrogen sulphate, Zr(SO<sub>4</sub>)<sub>2</sub>, H<sub>2</sub>SO<sub>4</sub>+H<sub>2</sub>O.**

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq. at 39.5°.

100 g. of the solution contain:

0.11	0.10	0.10	g. ZrO <sub>2</sub>
81.4	81.6	81.5	g. SO <sub>3</sub>

(Hauser, Z. anorg. 1907, 54. 200.)

+3H<sub>2</sub>O.

Solubility in H<sub>2</sub>SO<sub>4</sub>+Aq at t°.

100 g. of the solution contain:

t°	g. ZrO <sub>2</sub>	g. SO <sub>3</sub>
39.5	4.55	61.5
	3.25	62.5
	3.33	63.8
	3.35	63.8
	1.80	64.2
	1.60	64.6
	1.55	65.0
	1.12	66.8
	0.96	68.4
22	0.80	66.4
	0.65	67.5
	0.60	68.1

(Hauser, Z. anorg. 1907, 54. 200.)

**Persulphuric acid, HSO<sub>5</sub>.**

*See Persulphuric acid.*

**Pyrosulphuric acid and pyrosulphates.**

*See under Sulphuric acid and sulphates.*

**Sulphuric boric acid.**

*See Borosulphuric acid.*

**Sulphuric vanadic acid, V<sub>2</sub>O<sub>5</sub>, 3SO<sub>3</sub>+3H<sub>2</sub>O.**

*See Sulphate, vanadium.*

**Sulphurous acid, anhydrous, SO<sub>2</sub>.***See Sulphur dioxide.***Sulphurous acid, H<sub>2</sub>SO<sub>3</sub>.**

Known only in aqueous solution, from which SO<sub>2</sub> is given off upon heating. Crystallizes in cold, with various amounts of water, forming compounds which approximate H<sub>2</sub>SO<sub>3</sub>+8H<sub>2</sub>O (Pierre, A. 68. 228); H<sub>2</sub>SO<sub>3</sub>+10H<sub>2</sub>O (Döpping, Bull. Ac. St. Pétersb. 7. 100); H<sub>2</sub>SO<sub>3</sub>+14H<sub>2</sub>O (Schönfeld, A. 95. 22); H<sub>2</sub>SO<sub>3</sub>+6H<sub>2</sub>O (Rooseboom, R. t. c. 3. 29, 59, 75, 84; Geuther, A. 224. 218). Crystals are sol. in 2 pts. H<sub>2</sub>O at 10° (Pierre.)

For sp. gr. of solutions, etc., see sulphur dioxide.

**Sulphites.**

*Normal.* Only the alkali sulphites are sol. in H<sub>2</sub>O, and they are insol. or only sl. sol. in alcohol.

Insol. in liquid NH<sub>3</sub>. (Franklin, Am. ch. J. 1893, 30. 824.)

*Acid.* All the acid sulphites are sol. in H<sub>2</sub>O.

In general it is rarely possible to determine whether the compd. described is a pure chemical compound or not. It is probable that many substances described by Svenassen and others are isomorphous mixtures whose composition depends upon the temp. and conc. of the solution in which it was pptd. (Rosenheim, Z. anorg. 1900, 25. 72.)

**Aluminum sulphite, basic, Al<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub>+4H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O; sol. in H<sub>2</sub>SO<sub>3</sub>+Aq. (Fourcroy and Vauquelin.)

6Al(OH)<sub>3</sub>, Al<sub>2</sub>(SO<sub>3</sub>)<sub>3</sub>+9H<sub>2</sub>O. Ppt. (Seubert, Z. anorg. 1893, 4. 66.)

**Ammonium sulphite, basic, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, NH<sub>3</sub>+ $\frac{1}{2}$ H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. Pptd. from aqueous solution by alcohol. (Muspratt.)

Does not exist. (Marignac.)

**Ammonium sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>.**

Very hygroscopic. (Divers, Chem. Soc. 1900, 77. 336.)

Insol. in acetone. (Eidmann, C.C. 1899, II. 1014.)

+H<sub>2</sub>O. Slowly sol. in H<sub>2</sub>O. (Muspratt, A. 60. 268.)

Sol. in 1 pt. H<sub>2</sub>O at 12°. (Fourcroy and Vauquelin, Crell. Ann. 1800. 2. 415.)

More sol. in hot H<sub>2</sub>O with evolution of NH<sub>3</sub>. Sl. sol. in absolute alcohol. (Muspratt.)

Much more sol. in alcohol than K<sub>2</sub>SO<sub>3</sub>. (Pierre.)

Loses NH<sub>3</sub> in the air.

Sol. in H<sub>2</sub>O. Conc. solution charged with NH<sub>3</sub> will deposit salt on evaporation over KOH. Dil. solution decomp. on evaporation. (Divers, Chem. Soc. 1900, 77. 335.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Ammonium hydrogen sulphite, NH<sub>4</sub>HSO<sub>3</sub>.**

Insol. in acetone. (Eidmann, C.C. 1899, II. 1014; Naumann, B. 1904, 37. 4329.)

**Ammonium pyrosulphite, (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.**

Deliquescent. Very sol. in H<sub>2</sub>O and alcohol. Insol. in ether. (Fock and Klüss, B. 23. 3149.)

Very sol. in H<sub>2</sub>O; very hygroscopic. Aq. solution is sl. decomp. on evaporation. (Divers, Chem. Soc. 1900, 77. 336.)

**Ammonium cadmium sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, CdSO<sub>3</sub>.**

Nearly insol. in H<sub>2</sub>C. Partly sol. in excess of H<sub>2</sub>SO<sub>3</sub>+Aq, but separates out on boiling. (Schuler, A. 87. 34.)

**Ammonium cobaltous sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, CoSO<sub>3</sub>+xH<sub>2</sub>O.**

Decomp. on air. (Berglund, B. 7. 469.)

**Ammonium cobaltocobaltic sulphite.**

*See* Cobaltisulphite, ammonium cobalt.

**Ammonium cuprous sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, 2Cu<sub>2</sub>SO<sub>3</sub>+2H<sub>2</sub>O.**

(Böttger, A. 51. 411.)

(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>. Insol. in cold, decomp. by boiling H<sub>2</sub>O. (Rogojski, J. B. 1851. 366.)

Decomp. by warming with H<sub>2</sub>O, in which it is insol. Sol. in acids with evolution of SO<sub>2</sub>. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 99.)

+2H<sub>2</sub>O. (Commaille, J. B. 1867. 300.)

2(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+3H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. Solution decomp. on standing. Decomp. by acids. (Rosenheim and Steinhäuser.)

5(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+2H<sub>2</sub>O. Decomp. on air. Sol. in H<sub>2</sub>O with decomp. (Svensson.)

6(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+4H<sub>2</sub>O. Easily decomp. (Rosenheim and Steinhäuser.)

7(NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, Cu<sub>2</sub>SO<sub>3</sub>+4H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. Solution soon decomp. (Rosenheim and Steinhäuser.)

+10H<sub>2</sub>O. Decomp. on air. Sl. sol. in warm, less sol. in cold H<sub>2</sub>O. (de Saint-Gilles.)

+14H<sub>2</sub>O. Decomp. on air. Sol. in H<sub>2</sub>O, but solution decomp.

Very easily sol. in mother liquor. (Svensson, Acta Lund. 1899. 13.)

**Ammonium cuprocupric sulphite, (NH<sub>4</sub>)<sub>2</sub>SO<sub>3</sub>, 2Cu<sub>2</sub>SO<sub>3</sub>, CuSC<sub>2</sub>+5H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O and weak acids. Sol. in NH<sub>4</sub>OH+Aq. (de Saint-Gilles, A. ch. (3) 42. 31.)

+6 $\frac{1}{2}$ H<sub>2</sub>O. Ppt. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 98.)

**Ammonium glucinum sulphite,**  
 $(\text{NH}_4)_2\text{O}, 2\text{GIO}, 3\text{SO}_2 + 4\text{H}_2\text{O}.$

Ppt. Very unstable in the air. (Rosenheim, Z. anorg. 1897, 15. 310.)

**Ammonium gold (aurous) sulphite,**  
 $3(\text{NH}_4)_2\text{SO}_3, \text{Au}_2\text{SO}_3.$

Very easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Haase, Z. Ch. 1869. 535.)

**Ammonium gold (aurous) sulphite ammonia,**  
 $(\text{NH}_4)_2\text{SO}_3, 3\text{Au}_2\text{SO}_3, 6\text{NH}_3 + \text{H}_2\text{O}.$

Decomp. by  $\text{H}_2\text{O}$ . Sol. in warm  $\text{NH}_4\text{OH} + \text{Aq}$ , but decomp. by boiling.

$(\text{NH}_4)_2\text{Au}_2(\text{SO}_3)_3, 3\text{NH}_3 + 4\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1908, 59. 201.)

**Ammonium iridium sulphite.**

See Iridosulphite, ammonium.

**Ammonium iron (ferrous) sulphite,**  
 $(\text{NH}_4)_2\text{SO}_3, \text{FeSO}_3 + x\text{H}_2\text{O}.$

(Berglund.)

**Ammonium iron (ferric) sulphite sulphate,**  
 $\text{FeSO}_3\text{SO}_4\text{NH}_4 + \text{H}_2\text{O}.$

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. by cold dil.  $\text{HCl}$ . (Hofmann, Z. anorg. 1897, 14. 287.)

**Ammonium magnesium sulphite,**  
 $(\text{NH}_4)_2\text{Mg}_2(\text{SO}_3)_4 + 18\text{H}_2\text{O}.$

Very sl. sol. in  $\text{H}_2\text{O}$ . (Fourcroy and Vauquelin.)

Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .  
 $+ 5\text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$  than  $\text{MgSO}_3$ . (Rammelsberg.)

**Ammonium manganous sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{MnSO}_3.$

Relatively easily decomp. by  $\text{H}_2\text{O}$ . (Berglund, Bull. Soc. (2) 21. 213.)

Not easily decomp. (Gorgeu, C. R. 96. 376.)

**Ammonium mercuric sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{HgSO}_3.$

Very easily sol. in  $\text{H}_2\text{O}$ , but  $\text{H}_2\text{O}$  solution gradually decomp., even in the cold.

**Ammonium nickel sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $3\text{NiSO}_3 + 18\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 7. 469.)

**Ammonium platinous sulphite.**

See Platosulphite, ammonium.

**Ammonium potassium sulphite,  $10(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{K}_2\text{SO}_3 + 11\text{H}_2\text{O}.$

Decomp. by  $\text{H}_2\text{O}$ , etc. (Härtog, C. R. 109. 221.)

**Ammonium scandium sulphate,**  
 $(\text{NH}_4)_2\text{SO}_3, \text{Sc}_2(\text{SO}_4)_3 + 7\text{H}_2\text{O}.$

Insol. in  $\text{H}_2\text{O}$ . Difficulty sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Meyer, Z. anorg. 1914, 86. 281.)

**Ammonium silver sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{Ag}_2\text{SO}_3.$

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. (Svensson, B. 4. 714.)

$6(\text{NH}_4)_2\text{SO}_3, \text{Ag}_2\text{SO}_3 + 19\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Svensson.)

$3(\text{NH}_4)_2\text{SO}_3, 4\text{NH}_4\text{HSO}_3, \text{Ag}_2\text{SO}_3 + 18\text{H}_2\text{O}.$   
 Easily sol. in  $\text{H}_2\text{O}$ , but decomp. by warming.

**Ammonium sodium hydrogen sulphite,**  
 $\text{NH}_4\text{Na}_2\text{H}(\text{SO}_3)_2 + 4\text{H}_2\text{O}.$

Not deliquescent. (Marignac, Ann. Min. (5) 12. 29.)

100 pts.  $\text{H}_2\text{O}$  dissolve 42.3 pts. salt at  $12.4^\circ$ , and 48.5 pts. at  $15^\circ$ . (Schwicker, B. 22. 1732.)  
 $+ 5\text{H}_2\text{O} = 2\text{Na}_2\text{SO}_3, (\text{NH}_4)_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}.$   
 (Tauber, Techn. J. B. 1888. 444.)

**Ammonium tellurium sulphite,  $(\text{NH}_4)_2\text{SO}_3,$**   
 $\text{TeSO}_3 + x\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 7. 469.)

**Ammonium uranyl sulphite,**  
 $\text{NH}_4(\text{UO}_2)(\text{OH})\text{SO}_3.$

Insol. in pure  $\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  than the K salt, and less than the Na salt. (Scheller, A. 144. 240.)

$(\text{NH}_4)_2\text{O}, 2\text{UO}_3, 3\text{SO}_3.$

$(\text{NH}_4)_2\text{O}, 4\text{UO}_3, 5\text{SO}_3.$

$(\text{NH}_4)_2\text{O}, 3\text{UO}_3, 2\text{SO}_3.$

$(\text{NH}_4)_2\text{O}, \text{UO}_3, 2\text{SO}_3.$  (Kohlechütter, A. 1900, 311. 10.)

**Ammonium vanadium sulphite.**

See Vanadiousulphite, ammonium.

**Ammonium vanadyl sulphite,**  
 $(\text{NH}_4)_2\text{SO}_3, \text{VO}_2\text{SO}_3 + 2\text{H}_2\text{O}.$

Sol. in  $\text{H}_2\text{O}$  with decomp. (Koppel, Z. anorg. 1903, 35. 184.)

$(\text{NH}_4)_2\text{O}, 3\text{VO}_3, 2\text{SO}_3 + \text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$  without decomp.

Easily sol. in mineral acids and alkalis.

Sl. sol. in alcohol and ether. (Koppel Z. anorg. 1903, 35. 182.)

**Ammonium zinc sulphite,  $(\text{NH}_4)_2\text{SO}_3, \text{ZnSO}_3.$**

Sol. in  $\text{H}_2\text{O}$ . (Berglund, B. 7. 469.)

**Ammonium sulphite mercuric chloride,**  
 $2(\text{NH}_4)_2\text{SO}_3, \text{HgCl}_2.$

Sl. sol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ . (de St-Giles, A. ch. (3) 36. 95.)

**Antimony sulphite,  $\text{Sb}_2\text{O}_3, 3\text{SO}_3(?)$ .**

Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

Could not be obtained. (Röhrig, J. pr. (2) 37. 241.)

**Barium sulphite, BaSO<sub>3</sub>.**

Very sl. sol. in H<sub>2</sub>O. (Fourcroy and Vauquelin, A. ch. 24. 301.)

Sol. in about 46,000 pts. H<sub>2</sub>O at 16°. (Autenrieth, Z. anal. 1898, 37. 294.)

Sol. in H<sub>2</sub>SO<sub>3</sub>+Aq.

Insol. in acetone. (Naumann, B. 1904, 37. 4329); methyl acetate. (Naumann, B. 1909, 42. 3790.)

Solubility in sugar+Aq at t°.

Solvent	t°	100 ccm. of solution contain g. BaSO <sub>3</sub>
water	20	0.01974
sucrose+Aq 10° Brix		0.01040
" " 20° "		0.00968
" " 30° "		0.00782
" " 40° "		0.00484
" " 50° "		0.00298
(sat.) " 60° "		0.00223
water	80	0.00177
sucrose+Aq 10° Brix		0.00335
" " 20° "		0.00289
" " 30° "		0.00223
" " 40° "		0.00158
" " 50° "		0.00149
(sat.) " 60° "		0.00112

(Rogowicz, C. C. 1905, II. 1223.)

**Barium cobaltic sulphite.**

See Cobaltisulphate, barium.

**Barium gold (aurous) sulphite, 3BaSO<sub>3</sub>, Au<sub>2</sub>SO<sub>3</sub>+xH<sub>2</sub>O.**

Ppt. (Haase.)

**Barium mercuric sulphite, BaSO<sub>3</sub>, HgSO<sub>3</sub>+H<sub>2</sub>O.**

Ppt. (Barth, Z. phys. Ch. 9. 196.)

**Barium mercuric sulphite chloride, BaSO<sub>3</sub>, BaCl<sub>2</sub>, 2HgSO<sub>3</sub>+3½H<sub>2</sub>O.**

(Barth, Z. phys. Ch. 1892, 9. 208.)

**Bismuth sulphite, basic, Bi<sub>2</sub>O<sub>3</sub>, 3SO<sub>3</sub>+5H<sub>2</sub>O.**

Insol. in H<sub>2</sub>O, alcohol, or ether. Sl. sol. in H<sub>2</sub>SO<sub>3</sub>+Aq. (Röhrig, J. pr. (2) 37. 241.)

(BiO)<sub>2</sub>SO<sub>3</sub>, 3(BiOH)SO<sub>3</sub>+H<sub>2</sub>O. (Seubert and Elten, Z. anorg. 1893, 4. 72-5.)

2(BiO)<sub>2</sub>SO<sub>3</sub>, 3(BiOH)SO<sub>3</sub>+2H<sub>2</sub>O. (S. and E.)

3(BiO)<sub>2</sub>SO<sub>3</sub>, 7(BiOH)SO<sub>3</sub>+10H<sub>2</sub>O. (S. and E.)

4(BiO)<sub>2</sub>SO<sub>3</sub>, (BiOH)SO<sub>3</sub>+5H<sub>2</sub>O. (S. and E.)

9(BiO)<sub>2</sub>SO<sub>3</sub>, (BiOH)SO<sub>3</sub>+2H<sub>2</sub>O. (S. and E.)

**Bismuth cobaltic sulphite.**

See Cobaltisulphite, bismuth.

**Cadmium sulphite, CdSO<sub>3</sub>.**

Difficultly sol. in H<sub>2</sub>O. Easily sol. in dil. acids. (Rammelsberg, Pogg. 67. 256.)

+2H<sub>2</sub>O. Difficultly sol. in H<sub>2</sub>O. Sol. in H<sub>2</sub>SO<sub>3</sub>+Aq. Sol. in NH<sub>4</sub>OH+Aq. Insol. in alcohol. (Muspratt, Phil. Mag. (3) 30. 414.) Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

Contains 2½H<sub>2</sub>O. (Deniges, Bull. Soc. (3) 7. 569.)

**Cadmium sodium sulphite, 3CdSO<sub>3</sub>, Na<sub>2</sub>SO<sub>3</sub>.**

Sol. in H<sub>2</sub>O. (Berghund, B. 7. 469.)

**Cadmium sulphite, ammonia, CdSO<sub>3</sub>, NH<sub>3</sub>.**

Decomp. by H<sub>2</sub>O. Sol. without decomp. in hot NH<sub>4</sub>OH+Aq. (Rammelsberg, Pogg. 67. 256.)

**Cæsium sulphite, Cs<sub>2</sub>SO<sub>3</sub>.**

Easily sol. in H<sub>2</sub>O. Sl. sol. in alcohol. (Chabrie, C. R. 1901, 123. 297.)

**Cæsium hydrogen sulphite, CaHSO<sub>3</sub>.**

Easily sol. in H<sub>2</sub>O. Sl. sol. in alcohol. (Chabrie, C. R. 1901, 123. 297.)

**Calcium sulphite, basic, Ca<sub>2</sub>S<sub>2</sub>O<sub>7</sub>=6CaO, 5SO<sub>3</sub>.**

(Schott, Dingl. 202. 52.)

**Calcium sulphite, CaSO<sub>3</sub>+2H<sub>2</sub>O.**

Slowly effloresces. Sol. in 800 pts. cold H<sub>2</sub>O. (Berzelius.)

Insol. in H<sub>2</sub>O. (Röhrig, J. pr. (2) 37. 230.) 0.043 g. is sol. in 1 l. H<sub>2</sub>O at 18°. (Weisberg, Bull. Soc. 1896, (3) 15. 1249.)

CaSO<sub>3</sub> equiv. to 78 mg. CaO is sol. in 1 l. H<sub>2</sub>O at 100°. (Robart, C. A. 1913. 2500.)

Very sol. in H<sub>2</sub>SO<sub>3</sub>+Aq. See CaH<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>. Insol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 827.)

CaSO<sub>3</sub> equiv. to 37 mg. CaO is sol. in 1 l. 12% cane sugar+Aq at 100°. (Robart, C. A. 1913. 2500.)

0.0825 g. is sol. in 1 l. 10% sugar+Aq. at 18°; 0.0800 g. is sol. in 1 l. 30% sugar+Aq. at 18°. (Weisberg, Bull. Soc. 1896, (3) 15. 1249.)

Insol. in acetone. (Krug and M'Elroy.) Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790; ethyl acetate. (Naumann, B. 1904, 37. 3601.)

+½H<sub>2</sub>O. (Rammelsberg.)

**Calcium hydrogen sulphite, CaH<sub>2</sub>(SO<sub>3</sub>)<sub>2</sub>.**

Know only in solution.

100 ccm. H<sub>2</sub>O containing 9 g. SO<sub>3</sub> dissolve 0.553 g. CaSO<sub>3</sub> to form a solution of 1.06 sp. gr. (Gerland, J. pr. (2) 4. 119.)

**Calcium cobaltic sulphite.**

See Cobaltisulphite, calcium.

**Cerous sulphite,  $\text{Ce}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ .**

More sol. in cold than hot  $\text{H}_2\text{O}$ .  
Solution gradually decomposes. (Berthier, A. ch. (3) 7. 77.)

**Chromous sulphite,  $\text{CrSO}_3$ .**

Precipitate. Insol. in  $\text{H}_2\text{O}$ . (Moberg.)

**Chromium sulphite, basic,  $\text{Cr}_2\text{O}_3, \text{SO}_3$ .**

*Colloidal modification.* Sol. in  $\text{H}_2\text{O}$ .  
 $2\text{Cr}_2\text{O}_3, \text{SO}_3$ . Ppt. (Recoura, Bull. Soc. 1898, (3) 19. 169.)

**Chromic sulphite.**

Known only in aqueous solution, which precipitates a basic salt on boiling.

$2\text{Cr}_2\text{O}_3, 3\text{SO}_3 + 16\text{H}_2\text{O}$ . Precipitate. (Dan-son, Chem. Soc. 2. 205.)

**Chromic potassium sulphite,  $\text{K}_2\text{O}, \text{Cr}_2\text{O}_3, 2\text{SO}_3 + z\text{H}_2\text{O}$ .**

Precipitate. (Berglund, B. 7. 470.)

**Cobaltous sulphite, basic.**

Ppt. Decomp. by  $\text{H}_2\text{O}$ . (Berthier.)  
 $\text{Co}(\text{OH})_2, 5\text{CoSO}_3 + 10\text{H}_2\text{O}$ . Ppt. (Seu-  
bert and Elten, Z. anorg. 1893, 4. 89.)  
 $\text{Co}(\text{OH})_2, 10\text{CoSO}_3 + 15\text{H}_2\text{O}$ . (Seubert and  
Elten.)

**Cobaltous sulphite,  $\text{CoSO}_3$ .**

$+ 3\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Sol. in  
 $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Rammelsberg.)  
Partly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  
 $+ 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4 +$   
 $\text{Aq}$ . (Muspratt, A. 30. 282.)

**Cobaltocobaltic sulphite.**

See Cobaltisulphite, cobaltous.

**Cobaltic sulphite with  $3\text{M}_2\text{SO}_3$ .**

See Cobaltisulphite, M.

**Cobaltous potassium sulphite,  $\text{CoSO}_3, \text{K}_2\text{SO}_3, + z\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{HCl} + \text{Aq}$ .  
(Schultze, J. B. 1864. 270.)

**Cobaltic potassium sulphite,  $\text{Co}_2(\text{SO}_3)_3, \text{K}_2\text{SO}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$  or  
 $\text{HCl} + \text{Aq}$ . (Schultze.)

**Cobaltous sodium sulphite,  $3\text{CoO}, \text{Na}_2\text{O}, 3\text{SO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ .  
(Schultze.)

**Cobaltic sodium sulphite,  $\text{Co}_2\text{O}_3, \text{Na}_2\text{O}, 3\text{SO}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Schultze.)

**Cuprous sulphite,  $\text{Cu}_2\text{SO}_3 + \text{H}_2\text{O}$ .**

(a) *Red*. Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$   
or  $\text{HCl} + \text{Aq}$ . (Rogojski, J. B. 1851. 366.)  
Could not be obtained by St. Gilles or  
Svensson (B. 4. 713).

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. (Étard, C.  
R. 95. 38.)

Composition is  $(\text{Cu}_2)_2\text{H}_{18}(\text{SO}_3)_3$ , "Cuprous  
isosulphite," according to Étard.

$+ \frac{1}{2}\text{H}_2\text{O}$ . Étard's formula,  $\text{Cu}_2\text{SO}_3 + \text{H}_2\text{O}$   
is incorrect.

The salt is almost colorless. (Ramberg  
Z. phys. Ch. 1909, 69. 512.)

(β) *White*. Normal salt. Insol. in  $\text{H}_2\text{O}$ ,  
alcohol, or ether. (Étard.)

**Cupric sulphite, basic,  $4\text{CuO}, \text{SO}_3 + 7\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ , and decomp. by washing  
therewith. (Millon and Commaille.)

$7\text{CuO}, 4\text{SO}_3 + 8\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4$ .  
(Seubert and Elten, Z. anorg. 1893, 4. 48.)

$3\text{CuO}, 2\text{SO}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .  
(Newbury, Am. Ch. J. 14. 232.)

$7\text{CuO}, 4\text{SO}_3 + 8\text{H}_2\text{O}$ , or  $4\text{CuSO}_4, 3\text{Cu}(\text{OH})_2$   
 $+ 5\text{H}_2\text{O}$ . Sol. in dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Seubert  
and Elten, Z. anorg. 1893, 4. 50.)

**Cuprocupric sulphite,  $\text{CuSO}_3, \text{Cu}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .**

Nearly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by  
boiling.

Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ .  
(Berthier.)

Sol. in very dil.  $\text{HNO}_3 + \text{Aq}$ . (Döpping,  
J. B. 1851. 365.)

Insol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{Cu}$  salts  $+ \text{Aq}$ .  
(de St. Gilles.)

$+ 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  
 $\text{H}_2\text{SO}_4 + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , in cupric salts  
 $+ \text{Aq}$ ,  $\text{NH}_4\text{OH} + \text{Aq}$ , or  $\text{HCl} + \text{Aq}$ . (de St.  
Gilles, A. ch. (3) 42. 34.)

Composition is  $(\text{Cu})_2\text{Cu}_2\text{H}_{18}(\text{SO}_3)_3 + 21\text{H}_2\text{O}$ ,  
"acid cuprocupric octosulphite." (Étard,  
C. R. 95. 1475.)

**Cuprous ferroferric sodium sulphite,  $\text{Cu}_2\text{O}, 2\text{FeO}, \text{Fe}_2\text{O}_3, \text{Na}_2\text{O}, 6\text{SO}_3 + 16\text{H}_2\text{O}$ .**

Sol. in about 1000 pts.  $\text{H}_2\text{O}$ .

Sol. in cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ ; sol. in cold  
dil.  $\text{HCl} + \text{Aq}$  with a residue of  $\text{Cu}_2\text{Cl}_2$ .  
(Stromeyer, A. 109. 237.)

**Cuprous lithium sulphite,  $\text{Cu}_2\text{SO}_3, \text{Li}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp.  
thereby. (Étard, C. R. 95. 138.)

**Cupric mercuric sulphite,  $\text{CuSO}_3, \text{HgSO}_3$ .**

Sol. in  $\text{H}_2\text{O}$  in all proportions, but decomp.  
on boiling.

**Cuprous potassium sulphite,  $\text{Cu}_2\text{SO}_3, \text{K}_2\text{SO}_3$  (?)**

(Vohl, J. pr. 95. 219.)  
 $+ 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp.



(Rosenheim and Steinhäuser, Z. anorg. 1890, 25. 96.)

$\text{Cu}_2\text{SO}_3$ ,  $2\text{K}_2\text{SO}_3$ . (Chevreul, Graham, etc.)

Does not exist. (Svensson.)

$\text{Cu}_2\text{O}$ ,  $3\text{K}_2\text{O}$ ,  $6\text{SO}_2 + 7\text{H}_2\text{O} = 4\text{KHSO}_3$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Cu}_2\text{SO}_3 + 5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Svensson, B. 4. 713.)

Could not be obtained. (Rosenheim and Steinhäuser.)

$\text{Cu}_2\text{O}$ ,  $4\text{K}_2\text{O}$ ,  $8\text{SO}_2 + 3\text{H}_2\text{O} = 6\text{KHSO}_3$ ,  $\text{K}_2\text{SO}_3$ ,  $\text{Cu}_2\text{SO}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Svensson.)

Could not be obtained. (Rosenheim and Steinhäuser.)

$\text{Cu}_2\text{SO}_3$ ,  $8\text{K}_2\text{SO}_3 + 16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  with decomp. (Rammelsberg, Pogg. 57. 391.)

Does not exist, according to Svensson.

**Cuprocupric potassium sulphite**,  $3\text{Cu}_2\text{SO}_3$ ,  $3\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3$ .

Properties as cuprous potassium sulphite. (Rogojski, J. B. 1851. 367.)

$2\text{Cu}_2\text{SO}_3$ ,  $\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and weak acids. (de St-Gilles.)

$\text{Cu}_2\text{SO}_3$ ,  $4\text{CuSO}_3$ ,  $\text{K}_2\text{SO}_3 + 16\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser.)

**Cuprous sodium sulphite**,  $\text{Cu}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3$ .  $+2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Svensson, 1870.)

$+11\text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ , but decomp. by excess. (Étard, C. R. 95. 138.)

$2\text{Cu}_2\text{SO}_3$ ,  $3\text{Na}_2\text{SO}_3 + 29\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 94.)

$\text{Cu}_2\text{SO}_3$ ,  $5\text{Na}_2\text{SO}_3 + 38\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Svensson.)

$\text{Cu}_2\text{SO}_3$ ,  $7\text{Na}_2\text{SO}_3 + 19\text{H}_2\text{O}$ . Completely sol. in  $\text{H}_2\text{O}$ , but solutions decomp. on standing. (Svensson.)

"Cuprous sodium octosulphite,"

$(\text{Cu}_2)_3\text{H}_{10}\text{Na}_{16}\text{S}_8\text{O}_{31} + 43\text{H}_2\text{O}$ . (Étard.)

$5\text{Cu}_2\text{SO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 30\text{H}_2\text{O}$ . Easily decomp. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 94.)

**Cuprocupric sodium sulphite**,

$\text{Cu}_2\text{SO}_3$ ,  $2\text{CuSO}_3$ ,  $2\text{Na}_2\text{SO}_3 + 6\text{H}_2\text{O}$ .

Nearly insol. in cold, decomp. by hot  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 95.)

$+8\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser.)

**Cuprocupric sodium hydrogen sulphite**,

$\text{Na}_2\text{Cu}_2^{\text{H}}(\text{Cu})\text{H}_3(\text{SO}_3)_6, 6\text{H}_2(\text{SO}_4) + 5\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Étard, C. R. 94. 1422.)

$(\text{Cu})\text{Cu}_2^{\text{H}}\text{Na}_2\text{H}_3(\text{SO}_3)_6$ . (Étard.)

**Copper sodium sulphites.**

Doubtless many of the compds. described in this class are in reality isomorphic mixtures whose composition depends upon the temp. and conc. of the solution in which pptd.

(Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 92-95.)

**Didymium sulphite**,  $\text{Di}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ , or  $6\text{H}_2\text{O}$ .

Precipitate. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$  + Aq, from which it is reprecipitated by heating, redissolving on cooling. (Marignac, A. ch. (3) 38. 167.)

**Erbium sulphite**,  $\text{Er}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ .

Precipitate.

**Glucinum sulphite, basic**,  $2\text{GISO}_3$ ,  $9\text{Gl}(\text{OH})_3 + 6\text{H}_2\text{O}$ .

Ppt. (Seubert, Z. anorg. 1893, 4. 52.)

$\text{GISO}_3$ ,  $\text{GIO}$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. (K. and M.)

$3\text{GISO}_3$ ,  $\text{GIC}$ . Sol. in alcohol. (K. and M.)

**Glucinum sulphite**,  $\text{GISO}_3$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Krüss and Moraht, B. 23. 734.)

**Glucinum potassium sulphite**,

$2\text{GISO}_3$ ,  $\text{K}_2\text{SO}_3 + 9\text{H}_2\text{O}$ .

Unstable in the air. (Rosenheim, Z. anorg. 1897, 15. 310.)

**Gold (aurous) potassium sulphite**,  $\text{Au}_2\text{SO}_3$ ,  $3\text{K}_2\text{SO}_3$ .

Very sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Haase.)

**Gold (auric) potassium sulphite**,  $\text{Au}_2\text{O}_3$ ,  $5\text{K}_2\text{O}$ ,  $8\text{SO}_2 + 5\text{H}_2\text{O} = 5\text{K}_2\text{SO}_3$ ,  $\text{Au}_2(\text{SO}_3)_3 + 5\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Decomp. by acids; insol. in alkalis. (Fremy, A. 79. 46.)

**Gold (auric) potassium sulphite**,

$\text{Au}_2(\text{SO}_3)_3$ ,  $5\text{K}_2\text{SO}_3 + 10\text{H}_2\text{O}$ .

(Rosenheim and Hertmann, Z. anorg. 1908, 59. 199.)

**Gold (auric) potassium sulphite ammonia**,

$\text{Au}_2(\text{SO}_3)_3$ ,  $3\text{K}_2\text{SO}_3$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ .

As the corresponding  $\text{NH}_4$  salt. (Rosenheim and Hertmann, Z. anorg. 1908, 59. 202.)

**Gold (aurous) sodium sulphite**,  $\text{Au}_2\text{SO}_3$ ,  $3\text{Na}_2\text{SO}_3 + 3\text{H}_2\text{O}$ .

Sol. in less than 1 pt.  $\text{H}_2\text{O}$ . Insol. in alcohol (Hasse.)

$+5\text{H}_2\text{O}$ . (Himly.)

**Gold (auric) sodium sulphite**,

$\text{Au}_2(\text{SO}_3)_3$ ,  $5\text{Na}_2\text{SO}_3 + 28\text{H}_2\text{O}$ .

As K salt. (Rosenheim and Hertmann, anorg. 1908, 59. 199.)

**Gold (aurous) sulphite ammonia**,  $3\text{Au}_2\text{O}$ ,  $4\text{SO}_2$ ,  $8\text{NH}_3 + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$  with decomp. Decomp. by acids.

Sl. sol. in cold, more easily in hot  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by boiling. (Hasse, Zeit. Ch. 1889, 535.)

**Gold (auric) sulphite ammonia**,  $\text{Au}_3(\text{SO}_3)_3$ ,  $4\text{NH}_3 + 4\text{H}_2\text{O}$ .

Ppt. Decomp. in moist air and in neutral solution (Hersmann, Z. anorg. 1908, 59, 198.)

**Indium sulphite**,  $2\text{In}_2\text{O}_3$ ,  $3\text{SO}_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Bayer, A. 158, 372.)

**Iridium sulphite**,  $\text{Ir}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$ .

Scarcely sol. in  $\text{H}_2\text{O}$ ; easily sol.  $\text{HCl} + \text{Aq}$ . (Birnbbaum, A. 136, 179.)

**Iridyl sulphite**,  $(\text{IrO})\text{SO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Birnbbaum.)

**Iridous potassium sulphite**,  $\text{IrO}$ ,  $3\text{K}_2\text{O}$ ,  $5\text{SO}_2(?)$ .

Sl. sol. in  $\text{H}_2\text{O}$ , more sol. in  $\text{KOH} + \text{Aq}$ . Easily sol. in  $\text{HCl} + \text{Aq}$ . (Claus, J. pr. 42, 359.)

**Iridous sulphite potassium chloride**.

See Iridosulphite, potassium.

**Iridium sulphite with  $\text{M}_2\text{SO}_3$** .

See Iridosulphite, M.

**Iron (ferrous) sulphite**,  $\text{FeSO}_3 + 2\frac{1}{2}\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in alcohol, but sol. therein in presence of  $\text{SO}_2$ . (Muspratt.)

**Iron (ferric) sulphite**,  $\text{Fe}_2\text{O}_3$ ,  $\text{SO}_2 + 6\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in acids. (Koene.)  $2\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_2$ . Deliquescent; decomp. by  $\text{H}_2\text{O}$  into  $\text{SO}_2$  and above comp.  $3\text{Fe}_2\text{O}_3$ ,  $\text{SO}_2 + 7\text{H}_2\text{O}$ . Ppt.

**Iron (ferroferric) potassium sulphite**,  $\text{FeSO}_3$ ,  $(\text{FeO})\text{SO}_3$ ,  $2\text{K}_2\text{SO}_3$ .

Ppt. (Berglund.)

**Iron (ferric) potassium sulphite**,  $\text{K}_2\text{O}$ ,  $\text{Fe}_2\text{O}_3$ ,  $3\text{SO}_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Koene, Pogg. 63, 453.)

$\text{Fe}_2\text{O}_3$ ,  $2\text{K}_2\text{O}$ ,  $3\text{SO}_2 + 5\text{H}_2\text{O}$ . Ppt. (Muspratt, Phil. Mag. (3) 30, 414.)

**Iron (ferric) potassium sulphite sulphate**,  $\text{FeSO}_4\text{SO}_3\text{K}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ .

Sol. in 20%  $\text{HCl}$ ; decomp. on boiling. (Hofmann, Z. anorg. 1897, 14, 286.)

$\text{Fe}(\text{SO}_3)_2\text{SO}_4\text{K}_2$ . Almost insol. in cold  $\text{H}_2\text{O}$ . Decomp. by boiling with dil. acids. (Hofmann.)

$\text{Fe}_2(\text{SO}_3)_2\text{SO}_4\text{K}_4 + 5\text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ ; sol. in cold 20%  $\text{HCl} + \text{Aq}$ ; decomp. on boiling with  $\text{H}_2\text{O}$ . (Hofmann.)

**Iron (ferric) sodium sulphite sulphate**,  $\text{Fe}(\text{SO}_3)_2\text{SO}_4\text{Na}_2 + 6\text{H}_2\text{O}$ .

Almost insol. in  $\text{H}_2\text{O}$ .

Decomp. by boiling with dil. acids. (Hofmann, Z. anorg. 1897, 14, 289.)

**Iron (ferric) sodium hydrogen sulphite sulphate**,  $\text{FeSO}_4(\text{SO}_3)_2\text{H}_2\text{Na}_2 + 2\text{H}_2\text{O}$ .

Only very sl. sol. in  $\text{H}_2\text{O}$ . (Hofmann.)

**Lanthanum sulphite**,  $\text{La}_2(\text{SO}_3)_3 + 4\text{H}_2\text{O}$ .

Precipitate. (Cleve.)

**Lead sulphite**,  $\text{PbSO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. Sl. sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Röhrig, J. pr. (2) 37, 233.)

**Lithium sulphite**,  $\text{Li}_2\text{SO}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; precipitated from aqueous solution by abs. alcohol. (Danson, Chem. Soc. 2, 205.) Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$+ \text{H}_2\text{O}$ . Sl. sol. in alcohol, and still less sol. in ether. (Röhrig, J. pr. (2) 37, 225.)  $+ 2\text{H}_2\text{O}$ . (Röhrig.)

**Lithium potassium sulphite**,  $\text{LiKSO}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Röhrig, J. pr. (2) 37, 251.)

**Lithium sodium sulphite**,  $6\text{Li}_2\text{SO}_3$ ,  $\text{Na}_2\text{SO}_3 + 8\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Röhrig.)

**Magnesium sulphite**,  $\text{MgSO}_3 + 6\text{H}_2\text{O}$ .

Sol. in 20 pts. cold, and in less hot  $\text{H}_2\text{O}$ . (Fourcroy and Vauquelin.)

Sol. in 80 pts. cold, and in 120 pts. boiling  $\text{H}_2\text{O}$ . (Hager, C. C. 1875, 135.)

More easily sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20, 828.)

Precipitated from aqueous solution by alcohol.

$+ 3\text{H}_2\text{O}$ . (Röhrig, J. pr. (2) 37, 234.)

**Manganous sulphite**,  $\text{MnSO}_3 + 2\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , alcohol, or ether. Easily sol. in acids, also in  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

Insol. in acetone. (Naumann, B. 1904, 37, 4329.)

$+ 2\frac{1}{2}\text{H}_2\text{O}$ . (Rammelsberg.)

$+ 3\text{H}_2\text{O}$ . Sol. in 10,000 pts. cold, and 5000 pts. hot  $\text{H}_2\text{O}$ ; more sol. in conc.  $\text{Mn}$  salts  $+ \text{Aq}$ ; sol. in 1000 pts.  $\text{H}_2\text{CO}_3 + \text{Aq}$ . 100 pts.  $\text{H}_2\text{SO}_4 + \text{Aq}$  dissolve 15-17 pts. (Gorgeu, C. R. 96, 341.)

Salt with  $2\frac{1}{2}\text{H}_2\text{O}$  is the only one which exists. (Röhrig, J. pr. (2) 37. 2.)

**Manganous potassium sulphite**,  $2\text{MnSO}_3, \text{K}_2\text{SO}_3$ .

Insol. in  $\text{H}_2\text{O}$ , even when boiling. (Gorgeu, C. R. 96. 376.)

$\text{MnSO}_3, \text{K}_2\text{SO}_3$ . Sol. in  $\text{H}_2\text{O}$ . (Gorgeu.)

**Manganous sodium sulphite**,  $\text{MnSO}_3, \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ .

Insol. in hot  $\text{H}_2\text{O}$ , but decomp. by cold  $\text{H}_2\text{O}$ . (Gorgeu.)

$4\text{MnSO}_3, \text{Na}_2\text{SO}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Gorgeu.)

**Mercuric sulphite**,  $2\text{HgO}, \text{SO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ , alkali sulphites with subsequent decomp., and in  $\text{KCN} + \text{Aq}$ . (de St-Gilles, A. ch. (3) 36. 80.)

$\text{HgSO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$ . (de St-Gilles.)

Does not exist. (Divers and Shimidzu, Chem. Soc. 49. 553.)

$\text{HgO}, 2\text{SO}_3 + \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (de St-Gilles.) Exists only in aqueous solution. (Divers and Shimidzu.)

**Mercuriomercuric sulphite**,  $\text{Hg}_2(\text{SO}_3)_2 + 2\text{H}_2\text{O} = \text{Hg}_2\text{SO}_3, \text{HgSO}_3$ .

Very efflorescent. Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

$+4\text{H}_2\text{O}$ . Very efflorescent.

**Hypomercurosis sulphite**,  $\text{Hg}_2(\text{SO}_3)_2 + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ , but easily decomp. on standing therewith. Almost absolutely insol. in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Divers and Shimidzu.)

**Mercuric oxysulphite**,  $\text{Hg}(\text{SO}_3\text{OH})_2, \text{Hg} + \text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . Insol. in dil.  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Divers and Shimidzu.)

**Mercuric potassium sulphite, basic**,  $\text{K}_2\text{O}, 2\text{HgO}, 2\text{SO}_3$ .

(Barth, Z. phys. Ch. 1892, 9. 210.)

$\text{K}_2\text{O}, 3\text{HgO}, 3\text{SO}_3$ . Insol. in  $\text{H}_2\text{O}$ . Partly sol. in  $\text{KOH} + \text{Aq}$ . (Barth.)

**Mercuric potassium sulphite**,  $\text{HgSO}_3, \text{K}_2\text{SO}_3 + \text{H}_2\text{O}$ .

Sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. on boiling. (de St-Gilles, A. ch. (3) 36. 90.)

**Mercuric potassium sulphite mercuric chloride**,  $\text{K}_2\text{Hg}(\text{SO}_3)_2, \text{HgCl}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 1892, 9. 206.)

**Mercuric silver sulphite**,  $\text{HgSO}_3, \text{Ag}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Decomp. rapidly; insol. in  $\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 9. 195.)

**Mercuric sodium sulphite**,  $\text{HgSO}_3, \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (de St-Gilles.)

Sol. in 25 pts. cold  $\text{H}_2\text{O}$ , and decomp. on heating. (Divers and Shimidzu.)

$+2\text{H}_2\text{O} = \text{Na}_2(\text{SO}_3), \text{Hg} + 2\text{H}_2\text{O}$ . (Barth, Z. phys. Ch. 9. 193.)

$2\text{HgSO}_3, \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ . Much more sol. in  $\text{H}_2\text{O}$  than the above comp. especially on heating. (de St-Gilles.)

Does not exist. (Divers and Shimidzu.)

**Mercuric strontium sulphite**,  $\text{HgSO}_3, \text{SrSO}_3 + 2\text{H}_2\text{O}$ .

Ppt. (Barth.)

**Mercuric sulphite ammonium bromide**,  $\text{HgSO}_3, \text{NH}_4\text{Br}$ .

As  $\text{NH}_4\text{Cl}$  comp. (Barth, Z. phys. Ch. 1892, 9. 215.)

**Mercuric sulphite ammonium chloride**,  $\text{HgSO}_3, \text{NH}_4\text{Cl}$ .

As K salt. (Barth.)

**Mercuric sulphite potassium chloride**,  $\text{HgSO}_3, \text{KCl}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Mercuric sulphite sodium chloride**,  $\text{HgSO}_3, \text{NaCl} + \text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Barth.)

**Nickel sulphite, basic**,  $2\text{NiSO}_3, \text{Ni}(\text{OH})_2 + 6\text{H}_2\text{O}$ .

Ppt. (Seubert and Elten, Z. anorg. 1893, 4. 91.)

**Nickel sulphite**,  $\text{NiSO}_3 + 4\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$ . with evolution of  $\text{SO}_3$ . (Musprratt, A. 80. 259.)

$+6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Rammelsberg, Pogg. 67. 391.)

**Nickel sulphite ammonia**,  $\text{NiSO}_3, 3\text{NH}_3 + 3\text{H}_2\text{O}$ .

Sol. in little  $\text{H}_2\text{O}$ . Decomp. by much  $\text{H}_2\text{O}$  or heat. (Rammelsberg, Pogg. 67. 245.)

**Osmious sulphite**,  $\text{OsSO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HCl} + \text{Aq}$  without evolution of  $\text{SO}_3$ . Very slowly decomp. by  $\text{KOH} + \text{Aq}$ . (Claus.)

**Osmious potassium sulphite**,  $\text{OsSO}_3, 2\text{K}_2\text{SO}_3, 2\text{KHSO}_3 + 4\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

**Osmious potassium sulphite chloride**,  $\text{OsO}_2 \cdot 2\text{SO}_3 \cdot 6\text{KCl}$ .

Easily sol. in  $\text{H}_2\text{O}$ .

**Palladous sodium sulphite**,  $\text{PdSO}_3 \cdot 3\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O} = \text{Na}_2\text{Pd}(\text{SO}_3)_2 + 2\text{H}_2\text{O}$ .

Sol. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{NaOH} + \text{Aq}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Wöhler and Frerichs, A. 174. 199.)

**Platinous sulphite**,  $\text{PtO}_2 \cdot 2\text{SO}_3$ .

Easily sol. in  $\text{H}_2\text{O}$  or alcohol. (Döbereiner, J. pr. 15. 315.)

Formula is  $\text{PtSO}_3$ . (Gmelin.)

$\text{PtSO}_3$ ,  $\text{H}_2\text{SO}_3$ . (Birnbäum, A. 139. 172.)

**Platinic potassium sulphite**,  $\text{PtO}_2 \cdot \text{SO}_3 \cdot \text{K}_2\text{SO}_3 + \text{H}_2\text{O}$ .

Sol. in  $\text{KOH} + \text{Aq}$ . (Birnbäum, A. 139. 173.)

**Platinic sodium sulphite**,  $\text{PtO}_2 \cdot \text{SO}_3 \cdot 2\text{Na}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Birnbäum.)

**Platinous sulphite with  $\text{M}_2\text{SO}_3$** .

See **Platosulphite**, M.

**Platinum sulphite ammonium chloride**.

See **Chloroplatosulphite**, ammonium.

**Potassium sulphite**,  $\text{K}_2\text{SO}_3 + 2\text{H}_2\text{O}$ .

Somewhat deliquescent. Sol. in 1 pt. cold, and still less hot  $\text{H}_2\text{O}$ . (Fourcroy and Vauquelin, A. ch. 24. 254.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Very slightly soluble in alcohol. Insol. in ethyl acetate. (Casaseca, C. R. 30. 821.)

**Potassium hydrogen sulphite**,  $\text{KHSO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in absolute alcohol.

**Potassium pyrosulphite**,  $\text{K}_2\text{S}_2\text{O}_5$ .

Slowly sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in alcohol; insol. in ether. (Muspratt, A. 50. 259.)

**Potassium rhodium sulphite**,  $3\text{K}_2\text{SO}_3 \cdot \text{Rh}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$ .

See **Rhodosulphite**, potassium.

**Potassium ruthenium sulphite**,  $\text{O}[\text{Ru}(\text{SO}_3)_2\text{K}_2]_2 + 2\text{H}_2\text{O}$ .

Ppt. (Miolati, C. C. 1901, I. 501.)

**Potassium sodium sulphite**,  $\text{KNaSO}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Spring, B. 7. 1161.)

+1, and  $2\text{H}_2\text{O}$ . (Schwicker, B. 22. 1731.)

Isomeric salts,  $\text{KSO}_3\text{Na}$  and  $\text{NaSO}_3\text{K}$ . (Barth, Z. phys. Ch. 9. 176.)

**Potassium sodium hydrogen sulphite**,  $\text{KNa}_2\text{H}(\text{SO}_3)_2 + 4\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ ; 100 pts.  $\text{H}_2\text{O}$  dissolve 69 pts. salt at  $15^\circ$ . (Schwicker, B. 22. 1731.)

$\text{K}_2\text{NaH}(\text{SO}_3)_2 + 3\text{H}_2\text{O}$ . (Schwicker.)

**Potassium uranyl sulphite**,  $\text{K}(\text{UO}_2)(\text{OH})\text{SO}_3$ .

Insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Scheller.)

$\text{K}_2\text{O}$ ,  $2\text{UO}_3$ ,  $3\text{SO}_3$ . (Kohlschütter, A. 1900, 311. 10 *et seq.*)

$\text{K}_2\text{O}$ ,  $4\text{UO}_3$ ,  $5\text{SO}_3$ . (K.)

$\text{K}_2\text{O}$ ,  $3\text{UO}_3$ ,  $2\text{SO}_3$ . (K.)

$\text{K}_2\text{O}$ ,  $\text{UO}_3$ ,  $2\text{SO}_3$ . (K.)

**Potassium vanadium sulphite**.

See **Vanadidosulphite**, potassium.

**Potassium vanadyl sulphite**,  $\text{K}_2\text{SO}_3 \cdot \text{VOSO}_3 + 5\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. and can be recryst. therefrom. (Koppel and Behrendt, B. 1901, 34. 3932.)

$\text{K}_2\text{O}$ ,  $3\text{VO}_3$ ,  $2\text{SO}_3$ . Sol. without decomp. in cold and hot  $\text{H}_2\text{O}$ .

Insol. in alcohol and ether. (Koppel, Z. anorg. 1903, 35. 182.)

**Potassium zinc sulphite**,  $\text{K}_2\text{SO}_3 \cdot 3\text{ZnSO}_3 + 7\frac{1}{2}\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with decomp. (Berglund, Acta Lund. 1872.)

**Rhodium sulphite**,  $\text{Rh}_2(\text{SO}_3)_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Claus.)

**Rhodium sodium sulphite**.

See **Rhodosulphite**, sodium.

**Ruthenium sulphite**,  $\text{Ru}_2(\text{SO}_3)_3$ .

Colloidal substance, sol. in a large quantity of  $\text{H}_2\text{O}$ . (Lucchesi, Gazz. ch. it. 1900, 30. (2) 71.)

**Ruthenium sodium sulphite**,  $\text{Na}_2\text{Ru}(\text{SO}_3)_3 + 2\text{H}_2\text{O}$ .

Ppt. (Miolati, C. C. 1901, I. 501.)

**Samarium sulphite**,  $\text{Sm}_2(\text{SO}_3)_3$ .

Amorphous precipitate. (Cleve.)

**Scandium sulphite**,  $\text{Sc}_2(\text{SO}_3)_3$ .

Insol. in cold  $\text{H}_2\text{O}$ . Sl. sol. in hot  $\text{H}_2\text{O}$ .

Sol. in excess of sodium sulphite when heated. (Crookes, Phil. Trans. 1910, 210. A. 383.)

+  $6\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ .

Decomp. by boiling with  $\text{H}_2\text{O}$  with separation of  $\text{H}_2\text{SO}_3$ . (R. J. Meyer, Z. anorg. 1914, 36. 281.)

**Selenium sulphite,  $\text{SeSO}_3$ .**

Correct composition for "selenium sulphoxide." (Divers, Chem. Soc. 49. 583.)

**Silver sulphite,  $\text{Ag}_2\text{SO}_3$ .**

Very sl. sol. in cold  $\text{H}_2\text{O}$ . Decomp. on heating.

Solubility in  $\text{H}_2\text{O}$  is <1:20,000. (Bauhigny, C. R. 1909, 149. 858.)

Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  and alkali sulphites +  $\text{Aq.}$  Insol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  Decomp. by strong acids, but not by acetic acid. (Berthier, A. ch. (3) 7. 82.)

Easily sol. in alkali thiosulphates +  $\text{Aq.}$  (Herschel.)

Cold  $\text{NaHSO}_3 + \text{Aq}$  dissolves a considerable amount of  $\text{Ag}_2\text{SO}_3$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 78.)

Practically insol. in  $\text{HNO}_3 + \text{Aq}$  or dil.  $\text{AgNO}_3 + \text{Aq.}$  also in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Divers, Chem. Soc. 49. 579.)

**Silver sodium sulphite,  $\text{Ag}_2\text{SO}_3, \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Svensson, B. 4. 714.)

**Sodium sulphite,  $\text{Na}_2\text{SO}_3$ .**

100 pts. dissolve at  $0^\circ$ , 14.1 pts.; at  $20^\circ$ , 25.8 pts.; at  $40^\circ$ , 49.5° pts.  $\text{Na}_2\text{SO}_3$ . (Kremers, Pogg. 99. 50.) Maximum solubility is at  $33.5^\circ$  (Mitscherlich.)

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Na}_2\text{SO}_3$
60.4	28.29
59.8	28.29
59.8	28.65
59.8	28.75
37.0	28.01
37.0	28.07
47.0	28.19
47.0	28.07
55.6	28.21
84.0	28.26

The temp. at which  $\text{Na}_2\text{SO}_3 + 7\text{H}_2\text{O}$  changes into  $\text{Na}_2\text{SO}_3$  is about  $21.6^\circ$ .

(Hartley and Barrett, Chem. Soc. 1909, 95. 1183.)

See also  $+7\text{H}_2\text{O}$ .

Sp. gr. of sat. solution at  $15^\circ = 1.21$ . (Greenish and Smith, Pharm. J. 1901, 66. 774.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol.

Insol. in ethyl acetate. (Casaseca, C. R. 30. 821.); methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in benzonitrile. (Naumann, B. 1914, 47. 1370.)

$+7\text{H}_2\text{O}$ . Decomp. slowly on air.

Sol. in 4 pts.  $\text{H}_2\text{O}$  at  $15^\circ$  with absorption of heat (Dumas), and in 1 pt. boiling  $\text{H}_2\text{O}$  (Fourcroy).

Solubility in 100 pts.  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{Na}_2\text{SO}_3$
37.2	44.08
33.5	39.64
29.0	34.99
23.5	29.92
18.2	25.31
10.6	20.01
5.9	17.61
2.0	14.82
-1.9	13.09

Supersolubility curves have also been plotted for ice and  $\text{Na}_2\text{SO}_3 + 7\text{H}_2\text{O}$ .

(Hartley and Barrett, Chem. Soc. 1909, 95. 1181.)

$+10\text{H}_2\text{O}$ . Efflorescent. Somewhat less sol. than above salt. (Muspratt.)

**Sodium hydrogen sulphite,  $\text{NaHSO}_3$ .**

More difficultly sol. in  $\text{H}_2\text{O}$  than  $\text{NaHCO}_3$ , and is precipitated by alcohol from aqueous solution. (Muspratt.)

Insol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4329) methyl acetate. (Naumann, B. 1909, 42. 3790.)

$+4\text{H}_2\text{O}$ . (Clark.)

**Sodium pyrosulphite,  $\text{Na}_2\text{S}_2\text{O}_3$ .**

Decomp. gradually on the air.

**Sodium uranyl sulphite,  $\text{Na}(\text{UO}_2)(\text{OH})\text{SO}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{SCl}_3 + \text{Aq}$  than the K salt. (Scheller.)

$\text{Na}_2\text{O}$ ,  $2\text{UO}_3$ ,  $3\text{SO}_2$ .  
 $\text{Na}_2\text{O}$ ,  $3\text{UO}_3$ ,  $2\text{SO}_2$ . (Kohlschütter, A. 1900, 311. 10 et seq.)

**Sodium vanadyl sulphite,  $\text{Na}_2\text{O}$ ,  $2\text{SO}_3$ ,  $\text{VO}_2 + 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp.

$\text{Na}_2\text{O}$ ,  $2\text{SO}_3$ ,  $3\text{VO}_2 + 4\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{O}$ ; decomp. on heating. (Koppel, B. 1901, 34. 3933.)

**Sodium zinc sulphite,  $\text{Na}_2\text{SO}_3$ ,  $3\text{ZnSO}_3 + 7\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  with decomp. (Berglund, Acta Lund, 1872.)

**Sodium sulphite silver chloride,  $3\text{Na}_2\text{SO}_3$ ,  $\text{AgCl} + 21\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Svensson.)

**Strontium sulphite,  $\text{SrSO}_3$ .**

Precipitate. Almost insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Muspratt.)

Sol. in about 30,000 pts.  $\text{H}_2\text{O}$  at  $16-18^\circ$ . (Autenrieth, Z. anal. 1898, **37**, 293.)

Abundantly sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Röhrig.)

**Tellurium sulphite,  $\text{TeSO}_3$ .**

Correct composition of "tellurium sulphoxide." (Divers, Chem. Soc. **49**, 583.)

**Thallous sulphite,  $\text{Tl}_2\text{SO}_3$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Röhrig, J. pr. (2) **37**, 229.)

100 pts.  $\text{H}_2\text{O}$  dissolve 3.34 pts. at  $15.5^\circ$ . Easily sol. in hot  $\text{H}_2\text{O}$ ; insol. in alcohol. (Seubert and Elten, Z. anorg. **2**, 434.)

**Thallous vanadyl sulphite,  $2\text{Tl}_2\text{SO}_3$ ,**

(Gain, A. ch. 1908, (8) **14**, 278.)

$\text{Tl}_2\text{SO}_3, 3\text{V}_2\text{O}_5 \cdot \text{SO}_3 + 8\text{H}_2\text{O}$ . (Gain.)

**Thorium sulphite,  $\text{Th}(\text{SO}_3)_2 + \text{H}_2\text{O}$ .**

Precipitate. (Cleve.)

**Tin (stannous) sulphite,  $5\text{SnO}, 2\text{SO}_2 + x\text{H}_2\text{O}$ .**

Ppt. Partly sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Röhrig, J. pr. (2) **37**, 249.)

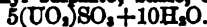
$+ 20\text{H}_2\text{O}$ . (Röhrig.)

$8\text{SnO}, 2\text{SO}_2 + 20\text{H}_2\text{O}$ .

$11\text{SnO}, 2\text{SO}_2 + 20\text{H}_2\text{O}$ . (Röhrig.)

**Uranous sulphite, basic,  $\text{U}(\text{OH})_2\text{SO}_3 + \text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  but is soon decomp. (Rammelsberg.)

**Uranyl sulphite, basic,  $3\text{UO}_2(\text{OH})_2$ ,**

(Seubert and Elten, Z. anorg. 1893, **4**, 80.)

**Uranyl sulphite,  $(\text{UO}_2)_2\text{SO}_3 + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_3 + \text{Aq}$  or alcoholic solution of  $\text{SO}_2$ . (Röhrig, J. pr. (2) **37**, 240.)

**Vanadyl sulphite,  $3\text{VO}_2, 2\text{SO}_2 + 4\frac{1}{2}\text{H}_2\text{O}$ .**

Decomp. slowly on standing.

Sol. in  $\text{H}_2\text{O}$  without apparent decomp. (Koppel, Z. anorg. 1903, **35**, 186.)

$2\text{V}_2\text{O}_5, 3\text{SO}_2 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; aq. sol. decomp. on boiling giving off  $\text{SO}_2$  and forming  $\text{V}_2\text{O}_5, 2\text{H}_2\text{O}$ . (Gain, C. R. 1906, **143**, 824.)

**Vanadyl zinc sulphite,  $\text{ZnO}, 3\text{VO}_2, 2\text{SO}_2$ .**

Decomp. slowly in the air.

Sol. in  $\text{H}_2\text{O}$  without decomp. (Koppel, Z. anorg. 1903, **35**, 183.)

**Ytterbium sulphite,  $\text{Yb}_2(\text{SO}_3)_3 + 9\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Clève, Z. anorg. 1902, **32**, 143.)

**Yttrium sulphite,  $\text{Y}_2(\text{SO}_3)_3 + 3\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Zinc sulphite, basic,  $2\text{ZnSO}_3, 3\text{Zn}(\text{OH})_2$ .**

(Seubert, Arch. Pharm. **229**, 321.)

$\text{ZnSO}_3, \text{Zn}(\text{OH})_2 + \text{H}_2\text{O}$ . (Seubert.)

**Zinc sulphite,  $\text{ZnSO}_3 + 2$ , and  $2\frac{1}{2}\text{H}_2\text{O}$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 0.16 pt.  $\text{ZnSO}_3 + 2\text{H}_2\text{O}$ . (Hanston and Tichborne, Brit. Med. J. **1890**, 1063.)

Easily sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  (Koene.)

Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$

Insol. in alcohol.

Decomp. into basic salt by boiling  $\text{H}_2\text{O}$ . (Seubert, Arch. Pharm. **229**, 1.)

**Zinc sulphite ammonia,  $\text{ZnSO}_3, \text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Rammelsberg, Pogg. **67**, 255.)

**Zirconium sulphite.**

Insol. in  $\text{H}_2\text{O}$ . Somewhat sol. in  $\text{H}_2\text{SO}_3 + \text{Aq.}$  from which it is reprecipitated on boiling. Sol. in  $(\text{NH}_4)_2\text{SO}_3 + \text{Aq.}$  from which Zr hydroxide is precipitated on boiling. (Berzelius.)

$\text{Zr}(\text{SO}_3)_2 + 7\text{H}_2\text{O}$ . Ppt. (Venable, J. Am. Chem. Soc. 1895, **17**, 449.)

**Sulphuryl bromide,  $\text{SO}_2\text{Br}_2$ .**

(Ödling, Chem. Soc. **7**, 2.)

Does not exist. (Sestini, Bull. Soc. **10**, 226; Melsens, C. R. **76**, 92; Michaelis.)

**Sulphuryl chloride,  $\text{SO}_2\text{Cl}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  and alcohol.

Decomp. by moist air, water, or abs. alcohol; more rapidly by alkalis,  $\text{HCl}$ ,  $\text{SO}_2$ , etc. (Schiff, A. **102**, 111.)

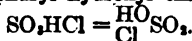
$+ \text{H}_2\text{O}$ . Only sl. sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  with slow decomp. (Baeyer, B. 1901, **34**, 737.)

$+ 15\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$  at  $0^\circ$  and stable therein for several hours. (Baeyer.)

**Disulphuryl chloride (Pyrosulphuryl chloride),  $\text{S}_2\text{O}_4\text{Cl}_2$ .**

Decomp. slowly with  $\text{H}_2\text{O}$ . (Rose, Pogg. **44**, 291.)

Sol. in  $\text{CCl}_4$  and  $\text{CHCl}_3$ ; miscible with liquid  $\text{SO}_2$ .

**Sulphuryl hydroxyl chloride,**

Decomp. on moist air, and violently with  $\text{H}_2\text{O}$ . Not miscible with  $\text{CS}_2$ . Decomp. with alcohol.

**Sulphuryl titanium chloride,  $\text{SO}_2, \text{TiCl}_4 = \text{TiCl}_4\text{OSO}_2\text{Cl}$ .**

Slowly deliquescent. (Clausnitzer, B. **11**, 2011.)

**Disulphuryl chloride stannic oxychloride,**  
 $5\text{Sn}_2\text{O}_3\text{Cl}_2, 4\text{SnOCl}_2.$ 

Sol. in a little  $\text{H}_2\text{O}$ , but decomp. by more  $\text{H}_2\text{O}$ . (Rose, Pogg. 44. 320.)

**Sulphuryl fluoride,  $\text{SO}_2\text{F}_2$ .**

1 pt. is sol. in 10 pts.  $\text{H}_2\text{O}$  at  $9^\circ$ . 3 vol. are sol. in 1 vol. alcohol at  $9^\circ$ ; insol. in conc.  $\text{H}_2\text{SO}_4$  at  $66^\circ$ ; sol. in aq. solution of  $\text{KOH}$ ,  $\text{Ca}(\text{OH})_2$ ,  $\text{Ba}(\text{OH})_2$  and in alcoholic solution of alkalis. (Moissan, C. R. 1901, 123. 377.)

**Sulphuryl hydroxyl fluoride,  $\text{HSO}_2\text{F}$ .**

Violently decomp. by  $\text{H}_2\text{O}$ . (Thorpe and Kirwan, Z. anorg. 3. 63.)

**Sulphuryl peroxide,  $\text{SO}_4$ .**

See Sulphur heptoxide.

**Sulphydric acid.**

See Hydrogen Sulphide.

**Sulphhydroxyl.**

See Sulphhydroxyl.

**Tantallic acid,  $\text{H}_2\text{Ta}_2\text{O}_7$  (?).**

Sol. in  $\text{HF}$  (Rose), and  $\text{KH}_2(\text{C}_2\text{O}_4)_2 + \text{Aq}$  (Gahn, Schw. J. 16. 437). At the instant of precipitation is sol. in various acids. (Rose.)

**Aluminum tantalate.**

Insol. in  $\text{H}_2\text{O}$ . (Berselius.)

**Ammonium hexatantalate,  $(\text{NH}_4)_2\text{H}_2\text{Ta}_2\text{O}_{11} + \text{H}_2\text{O}$ .**

Somewhat sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. 102. 57.)

**Barium hexatantalate,  $\text{Ba}_2\text{Ta}_2\text{O}_{11} + 6\text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . (Rose.)

**Cesium tantalate,  $4\text{Cs}_2\text{O}, 3\text{Ta}_2\text{O}_5 + 14\text{H}_2\text{O}$ .**

Completely sol. in a small amount of hot  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1666.)

$7\text{Cs}_2\text{O}, 6\text{Ta}_2\text{O}_5 + 38\text{H}_2\text{O}$ . Pptd. from its aqueous solution by alcohol. (Smith.)

**Ferrous tantalate,  $\text{Fe}(\text{TaO}_2)_2$ .**

Min. *Tantalite*.

$5\text{FeO}, 4\text{Ta}_2\text{O}_5$ . Min. *Tapiolite*.

**Magnesium hexatantalate,  $\text{Mg}_2\text{Ta}_2\text{O}_{11} + 9\text{H}_2\text{O}$ .**

Ppt. (Rose, Pogg. 102. 61.)

$4\text{MgO}, \text{Ta}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . (Joly, C. R. 31. 266.)

**Mercurous tantalate,  $5\text{Hg}_2\text{O}, 4\text{Ta}_2\text{O}_5 + 5\text{H}_2\text{O}$ .**

Decomp. by warm  $\text{HNO}_3 + \text{Aq}$  (1.21 sp. gr.) with separation of  $\text{Ta}_2\text{O}_5$ . (Rose, Pogg. 102. 64.)

**Potassium tantalate,  $\text{KTaO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{KOH} + \text{Aq}$ . (Marignac, A. ch. (4) 9. 249.)

**Potassium hexatantalate,  $\text{K}_2\text{Ta}_2\text{O}_{11} + 16\text{H}_2\text{O}$ .**

Sol. without decomp. in moderately warm  $\text{H}_2\text{O}$ . Decomp. by boiling. (Marignac, A. ch. (4) 9. 259.)

**Rubidium tantalate,  $4\text{Rb}_2\text{O}, 3\text{Ta}_2\text{O}_5 + 14\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1908, 30. 1666.)

**Silver tantalate,  $4\text{Ag}_2\text{O}, 3\text{Ta}_2\text{O}_5$ .**

Completely sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .  $\text{HNO}_3 + \text{Aq}$  dissolves  $\text{Ag}_2\text{O}$ , and  $\text{Ta}_2\text{O}_5$  separates out. (Rose, Pogg. 102. 64.)

**Sodium tantalate,  $\text{NaTaO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rose.)

**Sodium hexatantalate,  $\text{Na}_2\text{Ta}_2\text{O}_{11} + 25\text{H}_2\text{O}$ .**

1 pt. salt. dissolves in 493 pts.  $\text{H}_2\text{O}$  at  $13.5^\circ$ , and in 162 pts. at  $100^\circ$ . Very slightly sol. in alcohol. Insol. in alkaline solutions. (Rose.)

**Pertantallic acid.**

See Pertantallic acid.

**Tantalum, Ta.**

Not attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , aqua regia, or hot conc.  $\text{H}_2\text{SO}_4$ . Easily sol. in a mixture of  $\text{HNO}_3$  and  $\text{HF}$  (Berselius, Pogg. 4. 6; Rose). Also sol. in  $\text{HF}$  alone (Berselius.)

Not attacked by alkali hydrates +  $\text{Aq}$ .

Insol. in single acids and in aqua regia. Oxidized by a mixture of  $\text{HF}$  and aqua regia. (Moissan, C. R. 1902, 124. 211.)

Pure Ta is insol. in boiling  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ , aqua regia or mixtures of these acids; slowly sol. in  $\text{HF} + \text{Aq}$ . (v. Bolton, Zeit. Elektrochem. 1905, 11. 45.)

**Tantalum bromide,  $\text{TaBr}_5$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Rose.)

**Tantalum dichloride,  $\text{TaCl}_5 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  when freshly prepared. (Chabrie, C. R. 1907, 144. 805.)

**Tantalum pentachloride,  $\text{TaCl}_5$ .**

Takes up  $\text{H}_2\text{O}$  from the air without deliquescing. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$ . Sol. in cold  $\text{HCl} + \text{Aq}$  to a cloudy liquid, which gelatinises after a time. Not completely sol. in boiling  $\text{HCl} + \text{Aq}$ , and the solution does not gelatinise by the subsequent addition of water, but all goes into solution. Partly sol. in  $\text{KOH} + \text{Aq}$ . Insol. in  $\text{K}_2\text{SO}_4 + \text{Aq}$ . Sol. in absolute alcohol.

**Tantalum pentafluoride, TaF<sub>5</sub>.**

Very hygroscopic; sol. in H<sub>2</sub>O. (Ruff, B. 1909, 42. 494.)

**Tantalum fluoride with MF.**

*See Fluotantalate, M.*

**Tantalum hydroxide, Ta<sub>2</sub>O<sub>5</sub>, xH<sub>2</sub>O.**

*See Tantallic acid.*

**Tantalum nitride, TaN.**

Not sol. in any acids, except a mixture of HF and HNO<sub>3</sub>. (Rose, Pogg. 100. 146.)  
Ta<sub>2</sub>N<sub>5</sub>. (Joly, Bull. Soc. (2) 25. 506.)

**Tantalum dioxide, Ta<sub>2</sub>O<sub>5</sub>(?).**

Sol. in HF with evolution of hydrogen. (Hermann, J. pr. (2) 5. 69.)

**Tantalum tetroxide, Ta<sub>2</sub>O<sub>4</sub>.**

Not attacked by any acid, not even a mixture of HNO<sub>3</sub> and HF. (Berzelius, Pogg. 4. 20.)

Decomp. by HCl. (Smith, Z. anorg. 1894, 7. 98.)

**Tantalum pentoxide, Ta<sub>2</sub>O<sub>5</sub>.**

Insol. in any acid, even boiling H<sub>2</sub>SO<sub>4</sub> or in HF. (Berzelius.)

Sol. in fused KHSO<sub>4</sub>, 10 pts. being necessary to dissolve 1 pt. Ta<sub>2</sub>O<sub>5</sub>.

**Tantalum silicide, TaSi<sub>2</sub>.**

Insol. in most inorganic acids. Sol. in HF and in HF+HNO<sub>3</sub>.

Decomp. by fused alkali hydroxides. (Hönigschmid, M. 1907, 23. 1027.)

**Tantalum sulphide, Ta<sub>2</sub>S<sub>4</sub>.**

Not attacked by HCl+Aq. Oxidised by boiling with HNO<sub>3</sub>+Aq, more rapidly with aqua regia. Attacked by H<sub>2</sub>SO<sub>4</sub> on heating. Not completely sol. in HF or a mixture of HF and HNO<sub>3</sub>.

**Telluretted hydrogen, TeH<sub>2</sub>.**

*See Hydrogen telluride.*

**Telluric acid, H<sub>2</sub>TeO<sub>4</sub>.**

Insol. in H<sub>2</sub>O, cold conc. HCl, hot HNO<sub>3</sub>, or boiling KOH+Aq, but when heated with H<sub>2</sub>O is gradually converted into H<sub>2</sub>TeO<sub>4</sub>+2H<sub>2</sub>O and dissolved.

+2H<sub>2</sub>O. Very slowly sol. in cold H<sub>2</sub>O, but sol. in hot H<sub>2</sub>O in every proportion. Insol. in absolute alcohol; sol. in dil. alcohol according to the amount of H<sub>2</sub>O present. Sol. in acids and alkalies. Insol. in alcohol or ether.

Insol. in alcohol; sol. in NaOH+Aq. (Mylius, B. 1901, 34. 2216.)

Stable in the air.

Sol. in H<sub>2</sub>O; pptd. by HNO<sub>3</sub>. (Staudenmaier, Z. anorg. 1895, 10. 191.)

**Solubility in H<sub>2</sub>O.**

Solid phase	Temp.	% H <sub>2</sub> TeO <sub>4</sub>	Mols H <sub>2</sub> O to 1 mol H <sub>2</sub> TeO <sub>4</sub>	Mols H <sub>2</sub> TeO <sub>4</sub> to 100 mols H <sub>2</sub> O
H <sub>2</sub> TeO <sub>4</sub> +6H <sub>2</sub> O	0°	13.92	66.2	1.51
"	5°	17.84	49.2	2.03
"	10°	26.21	30.2	3.31
"	15°	32.79	21.9	4.55
H <sub>2</sub> TeO <sub>4</sub> .2H <sub>2</sub> O	10°	25.29	31.7	3.15
"	18°	28.90	26.2	3.82
"	30°	33.36	21.4	4.67
"	40°	36.38	18.8	5.33
"	60°	43.67	14.2	7.04
"	80°	51.55	10.07	9.93
"	100°	60.84	6.89	14.52

(Mylius, B. 1901, 34. 2211.)

+6H<sub>2</sub>O. Obtained from solutions at 0°. (Staudenmaier, Z. anorg. 1895, 10. 191.)

**Allotelluric acid, H<sub>2</sub>TeO<sub>4</sub>.**

Miscible with H<sub>2</sub>O.

Sol. in alcohol; pptd. by NaOH+Aq but sol. in excess. (Mylius, B. 1901, 34. 2216.)

**Tellurates.**

Neutral alkali salts are sol. in H<sub>2</sub>O; the acid salts are only sl. sol. therein, but dissolve in HCl+Aq.

**Aluminum tellurate.**

Ppt. Sol. in excess of aluminum salts+Aq. (Berzelius.)

**Ammonium tellurate, (NH<sub>4</sub>)<sub>2</sub>TeO<sub>4</sub>.**

Slowly but completely sol. in H<sub>2</sub>O. Sl. sol. in NH<sub>4</sub>OH+Aq or NH<sub>4</sub>Cl+Aq. Sl. sol. in alcohol. (Berzelius.)

(NH<sub>4</sub>)<sub>2</sub>O, 2TeO<sub>3</sub>. Sl. sol. in H<sub>2</sub>O, but more sol. than the corresponding K salt.

(NH<sub>4</sub>)<sub>2</sub>O, 4TeO<sub>3</sub>. Very sl. sol. in H<sub>2</sub>O. Insol. in alcohol. (Berzelius.)

**Barium tellurate, BaTeO<sub>4</sub>+3H<sub>2</sub>O.**

Sl. sol. in cold, more in boiling H<sub>2</sub>O. Easily sol. in HNO<sub>3</sub>+Aq. (Berzelius.)

BaH<sub>2</sub>(TeO<sub>4</sub>)<sub>2</sub>+2H<sub>2</sub>O. More sol. in H<sub>2</sub>O than BaTeO<sub>4</sub>. Decomp. by H<sub>2</sub>O. (Berzelius.)

BaO, 4TeO<sub>3</sub>. More sol. in H<sub>2</sub>O than either BaTeO<sub>4</sub> or BaH<sub>2</sub>(TeO<sub>4</sub>)<sub>2</sub>. (Berzelius.)

**Bismuth tellurate, Bi<sub>2</sub>TeO<sub>4</sub>+2H<sub>2</sub>O.**

Min. *Montanite*. Sol. in HCl+Aq with evolution of Cl.

**Cadmium tellurate, CdTeO<sub>4</sub>.**

Ppt. Sol. in HCl+Aq. (Oppenheim.)

**Cæsium hydrogen tellurate, CsHTeO<sub>4</sub>+½H<sub>2</sub>O.**

1 pt. is sol. in 30 pts. H<sub>2</sub>O. (Norris, Am. Ch. J. 1901, 23. 321.)



**Calcium tellurate,  $\text{CaTeO}_4$ .**Ppt. Sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.)**Chromic tellurate,  $\text{Cr}_2(\text{TeO}_4)_3$ .**

Ppt. Sol. in excess of Cr salts + Aq.

**Cobaltous tellurate.**

Ppt. (Berzelius.)

**Cupric tellurate,  $\text{CuTeO}_4$ .**

Ppt. (Berzelius.)

 $\text{CuO}$ ,  $2\text{TeO}_3$ . Ppt. (B.) $\text{Cu}_2\text{TeO}_6$ . Insol. in  $\text{H}_2\text{O}$ .Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{NH}_4\text{OH}$ ,  $\text{KCN}$  and acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, 27. 1181.)**Glucinum tellurate,  $\text{GtTeO}_4$ .**Insol. in  $\text{H}_2\text{O}$ .**Iron (ferrous) tellurate,  $\text{FeTeO}_4$ .**Ppt. Min. *Ferrotellurate*.**Iron (ferric) tellurate,  $\text{Fe}_2(\text{TeO}_4)_3$ .**

Ppt. Sol. in ferric salts + Aq. (Berzelius.)

**Lead tellurate, basic.**Not completely insol. in  $\text{H}_2\text{O}$ .**Lead tellurate,  $\text{PbTeO}_4$ .**Somewhat sol. in  $\text{H}_2\text{O}$ . $\text{PbO}$ ,  $2\text{TeO}_3$ . More sol. than  $\text{PbTeO}_4$ . $\text{PbO}$ ,  $4\text{TeO}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  + Aq, less sol. in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. (Berzelius.)**Lithium tellurate,  $\text{Li}_4\text{TeO}_6 + x\text{H}_2\text{O}$ .**Sl. sol. in  $\text{H}_2\text{O}$  with decomp. (Mylius, B. 1901, 34. 2209.)**Magnesium tellurate,  $\text{MgTeO}_4$ .**Ppt. More sol. in  $\text{H}_2\text{O}$  than the Ba, Sr. or Ca salts. $\text{MgTe}_2\text{O}_7$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{MgTeO}_4$ .**Manganous tellurate.**

Ppt.

**Mercurous tellurate, basic,  $3\text{Hg}_2\text{O}$ ,  $2\text{TeO}_3$ .**

Ppt. (Hutchins, J. Am. Chem. Soc. 1905, 27. 1178.)

**Mercurous tellurate,  $\text{Hg}_2\text{TeO}_4$ .**Ppt. Min. *Magnotile*.**Mercuric tellurate,  $\text{HgTeO}_4$ .**Ppt. Very easily decomp. by  $\text{H}_2\text{O}$ . (Hutchins, J. Am. Chem. Soc. 1905, 27. 1179.) $+2\text{H}_2\text{O}$ . Slowly decomp. by cold  $\text{H}_2\text{O}$ .Rapidly decomp. by boiling  $\text{H}_2\text{O}$ . (Hutchins.) $\text{Hg}_2\text{TeO}_6$ . Insol. in  $\text{H}_2\text{O}$ . Unchanged by boiling with  $\text{H}_2\text{O}$ .Sol. in  $\text{HNO}_3$ , but more readily sol. in  $\text{HCl}$ . (Hutchins.)**Mercuric tellurate.**

Ppt. (Berzelius.)

**Mercurous hydrogen tellurate,  $\text{HgHTeO}_4 + 3\text{H}_2\text{O}$ .**Stable in the air if protected from the light. Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$  or by an excess of cold conc.  $\text{HgNO}_3$  + Aq.Sol. in dil.  $\text{HNO}_3$  or dil. acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, 27. 1177.)**Nickel tellurate.**

Ppt.

**Potassium tellurate,  $\text{K}_2\text{TeO}_4 + 5\text{H}_2\text{O}$ .**Deliquesces. Sol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$  containing  $\text{KOH}$ .100 g.  $\text{H}_2\text{O}$  dissolve at:

0°	20°	30°
8.82	27.53	50.42 g. $\text{K}_2\text{TeO}_4$ .

(Rosenheim and Weinheber, Z. anorg. 1911, 69. 264.)

Insol. in alcohol. (Berzelius.)

 $\text{K}_2\text{O}$ ,  $2\text{TeO}_3$ . Insol. in  $\text{H}_2\text{O}$ , acids, or alkalies. (B.) $\text{KHTEO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.) $\text{K}_2\text{O}$ ,  $3\text{TeO}_3 + 5\text{H}_2\text{O}$ . Much more sol. in hot than in cold  $\text{H}_2\text{O}$ . (Hutchins, J. Am. Chem. Soc. 1905, 27. 1174.) $\text{K}_2\text{O}$ ,  $4\text{TeO}_3$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{HNO}_3$  + Aq. Sol. by long heating with conc.  $\text{HNO}_3$  + Aq. $\text{KHTEO}_4$ ,  $\text{H}_2\text{TeO}_4 + \frac{1}{2}\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .**Rubidium tellurate,  $\text{Rb}_2\text{TeO}_4 + 3\text{H}_2\text{O}$ .**Sol. in about 10 pts.  $\text{H}_2\text{O}$ . (Norris, Am. Ch. J. 1901, 26. 322.)**Rubidium hydrogen tellurate,  $\text{RbHTEO}_4 + \frac{1}{2}\text{H}_2\text{O}$ .**Sol. in about 20 pts. cold  $\text{H}_2\text{O}$ . Sl. more sol. in hot  $\text{H}_2\text{O}$ . (Norris, Am. Ch. J. 1901, 26. 320.)**Silver tellurate,  $3\text{Ag}_2\text{O}$ ,  $\text{TeO}_3$ .**Sol. in  $\text{NH}_4\text{OH}$  + Aq. $3\text{Ag}_2\text{O}$ ,  $2\text{TeO}_3$ . Insol. in boiling  $\text{H}_2\text{O}$  +  $3\text{H}_2\text{O}$ . Ppt. Unchanged by cold  $\text{H}_2\text{O}$ .Gradually decomp. by boiling  $\text{H}_2\text{O}$ . (Hutchins, J. Am. Chem. Soc. 1905, 27. 1169.) $\text{Ag}_2\text{TeO}_4$ . Decomp. by  $\text{H}_2\text{O}$  into  $3\text{Ag}_2\text{O}$ ,  $\text{TeO}_3$ . Sol. in  $\text{NH}_4\text{OH}$  + Aq. $+2\text{H}_2\text{O}$ . Insol. in hot and cold  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ ,  $\text{KCN}$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. Decomp. by conc.  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$  or acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, 27. 1165.)

$\text{Ag}_2\text{TeO}_3$ . Ppt.  
 $\text{Ag}_2\text{O}$ ,  $4\text{TeO}_2$ . Ppt.  
 Could not be obtained. (Hutchins, J. Am. Chem. Soc. 1905, 27. 1168.)

### Sodium tellurate, $\text{Na}_2\text{TeO}_4 + 2\text{H}_2\text{O}$ .

Very sl. sol. in hot or cold  $\text{H}_2\text{O}$ . When heated to drive off  $2\text{H}_2\text{O}$  becomes insol. in  $\text{H}_2\text{O}$ , but sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Berzelius.)  
 1 pt. is sol. in about 130 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ ; 50 pts.  $\text{H}_2\text{O}$  at  $100^\circ$ .  
 $+4\text{H}_2\text{O}$ . 1 pt. is sol. in about 70 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ ; 40 pts.  $\text{H}_2\text{O}$  at  $50^\circ$ . (Mylius, B. 1901, 34. 2209.)

$\text{Na}_2\text{TeO}_4 + 4\text{H}_2\text{O} = \text{NaHTeO}_4 + 1\frac{1}{2}\text{H}_2\text{O}$ .  
 Slowly but completely sol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 + \text{Aq}$ . Insol. in alcohol. (Berzelius.)

$\text{Na}_2\text{O}$ ,  $4\text{TeO}_2$ . Insol. in  $\text{H}_2\text{O}$ , acids, or alkalis, except by long boiling with  $\text{HNO}_3 + \text{Aq}$ .

$+x\text{H}_2\text{O}$ . (a) Slowly sol. in  $\text{H}_2\text{O}$ . (b) Insol. even in boiling  $\text{H}_2\text{O}$ .

$\text{Na}_4\text{TeO}_6 + 8\text{H}_2\text{O}$ : Very sol. in  $\text{H}_2\text{O}$  but with decomp. (Mylius.)

### Strontium tellurates.

Resemble Ca salts.

### Thallous tellurate, $\text{Tl}_2\text{TeO}_4$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Dennis, J. Am. Chem. Soc. 1898, 18. 975.)

### Thorium tellurate.

Ppt. Insol. in excess of thorium salts +  $\text{Aq}$ .

### Uranium tellurate, $\text{U}_2(\text{TeO}_4)_3(?)$ .

Ppt. Insol. in  $\text{H}_2\text{O}$  or  $\text{UO}_2(\text{NO}_3)_2 + \text{Aq}$ .

### Yttrium tellurate.

Ppt. Insol. in  $\text{H}_2\text{O}$  or Yt salts +  $\text{Aq}$ .

### Zinc tellurate, $\text{Zn}_3\text{TeO}_8$ .

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , and acetic acid. (Hutchins, J. Am. Chem. Soc. 1905, 27. 1181.)

### Zirconium tellurate.

Ppt. (Berzelius.)

### Tellurium, Te.

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . Sl. sol. in hot conc.  $\text{H}_2\text{SO}_4$ , but separates out on cooling. Sol. in boiling conc.  $\text{H}_2\text{SO}_4$ . Easily oxidised by  $\text{HNO}_3$  or aqua regia. Sol. in boiling very conc.  $\text{KOH} + \text{Aq}$ , separating out again on cooling.

Not attacked by boiling conc.  $\text{HNO}_3 + \text{Aq}$ , according to Hartung-Schwartzkoff (Ann. Min. (4) 19. 345).

Sol. in warm conc.  $\text{KCN} + \text{Aq}$ .

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

100 pts. methylene iodide dissolve 0.1 pt. Te at  $12^\circ$ . (Retgers, Z. anorg. 3. 343.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0014 g. Te in 6 days. (Gates, J. phys. Ch. 1911, 15. 143.)

A colloidal solution of Te in  $\text{H}_2\text{O}$  can be obtained. It exists in two modifications, a brown and a blue-gray. Both can be diluted with  $\text{H}_2\text{O}$  or concentrated by boiling without decomp. They are, however, decomp. by electrolytes, especially  $\text{NH}_4\text{Cl}$ . (Gutbier, Z. anorg. 1902, 32. 53.)

### Tellurium dibromide, $\text{TeBr}_2$ .

Decomp. on air or by  $\text{H}_2\text{O}$ . (Rose, Pogg. 21. 443.)

Conc. tartaric acid dissolves partly without decomp. (Brauner, M. 1891, 12. 34.)

### Tellurium tetrabromide, $\text{TeBr}_4$ .

Sol. in a little, but decomp. by much  $\text{H}_2\text{O}$ . Completely sol. in tartaric acid +  $\text{Aq}$  (1:1). (Brauner, M. 1891, 12. 34.)

### Tellurium hydrogen bromide, $\text{TeBr}_4$ , $\text{HBr} + 5\text{H}_2\text{O}$ .

Fumes in the air. Deliquescent. Stable in an atmos. of  $\text{HBr}$ . (Metaner, C. R. 1897, 124. 1951.)

### Tellurium dichloride, $\text{TeCl}_2$ .

Decomp. on air, or by  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . (Rose, Pogg. 21. 443.)

### Tellurium tetrachloride, $\text{TeCl}_4$ .

Extremely deliquescent. Decomp. by cold  $\text{H}_2\text{O}$ , with separation of oxychloride and tellurous acid. Sol. in hot  $\text{H}_2\text{O}$  with decomp. Sol. in dil.  $\text{HCl} + \text{Aq}$  without decomp. (Rose, Pogg. 21. 443.)

Insol. in sulphur chloride and in  $\text{CS}_2$ . (Lenher, J. Am. Chem. Soc. 1902, 24. 188.)

### Tellurium hydrogen chloride, $\text{TeCl}_4$ , $\text{HCl} + 5\text{H}_2\text{O}$ .

Easily decomp. (Metzner, C. R. 1897, 125. 24.)

### Tellurium chloride with $\text{MCl}$ .

See Chlorotellurate, M.

### Tellurium tetrachloride ammonia,

$\text{TeCl}_4 \cdot 3\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Metzner, C. R. 1897, 124. 33.)

$\text{TeCl}_4 \cdot 4\text{NH}_3$ . Not deliquescent. Decomp. by  $\text{H}_2\text{O}$ . (Espenschied, J. pr. 80. 480.)

### Tellurium tetrachloride sulphur trioxide,

$\text{TeCl}_4 \cdot \text{SO}_3$ .

Ppt. ((Prandtl, Z. anorg. 1909, 62. 247.)  
 $\text{TeCl}_4 \cdot 2\text{SO}_3$ . Decomp. by moisture. On heating at  $120^\circ$ , it gives  $\text{TeCl}_4 \cdot \text{SO}_3$ . (Prandtl.)

**Tellurium tetrafluoride,  $\text{TeF}_4$ .**

(Metsner, C. R. 1897, **125**. 25.)  
 $+\text{H}_2\text{O}$ . (Högbom, Bull. Soc. (2) **35**. 60.)

**Tellurium hexafluoride,  $\text{TeF}_6$ .**

Decomp. by  $\text{H}_2\text{O}$  slowly but completely.  
 (Prideaux, Chem. Soc. 1906, **39**. 322.)

**Tellurium zirconium fluoride,**  
*See Fluozirconate, tellurium.*

**Tellurium diiodide,  $\text{TeI}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. **21**. 448.)

**Tellurium tetraiodide,  $\text{TeI}_4$ .**

Insol. in cold, decomp. by hot  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HI}$ , but only sol. in  $\text{MI} + \text{Aq}$ . (Berzelius.)

Data on solubility of  $\text{TeI}_4$  in  $\text{HI} + \text{I} + \text{Aq}$  are given by Menke (Z. anorg. 1912, **77**. 283.)

**Tellurium hydrogen iodide,  $\text{TeI}_2$ ,  $\text{HI} + 8\text{H}_2\text{O}$ , and  $+9\text{H}_2\text{O}$ .**

Deliquescent. (Metsner, A. ch. 1898, (7) **15**. 203.)

**Tellurium nitride,**

Two forms.

a. Stable at ord. temp.

b. Unstable at ord. temp.

(Frans Fischer, B. 1910, **43**. 1472.)

$\text{TeN}$ . Not attacked by  $\text{H}_2\text{O}$  or dil. acetic acid.

Insol. in liquid  $\text{NH}_3$ . Decomp. by  $\text{KOH} + \text{Aq}$ . (Metsner, A. ch. 1898, (7) **15**. 203.)

**Tellurium monoxide,  $\text{TeO}$ .**

Sl. sol. in cold dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ . Easily oxidised by  $\text{HNO}_3 + \text{Aq}$  or aqua regia. Decomp. immediately by boiling conc.  $\text{HCl} + \text{Aq}$ . Slowly decomp. by  $\text{KOH} + \text{Aq}$ . (Divers and Shimose, Chem. Soc. **35**. 563.)

**Tellurium dioxide,  $\text{TeO}_2$ .**

Very al. sol. in  $\text{H}_2\text{O}$ . Sl. attacked by acids. Sl. sol. in  $\text{NH}_4\text{OH}$  or alkali carbonates  $+ \text{Aq}$ . Easily sol. in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq}$ . Not sol. in less than 150,000 pts.  $\text{H}_2\text{O}$ . Easily sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in warm  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Klein and Morel, Bull. Soc. (2) **43**. 203.)

20%  $\text{H}_2\text{SO}_4 + \text{Aq}$ . dissolves on warming about 0.7%; 30%  $\text{H}_2\text{SO}_4 + \text{Aq}$ , about 0.85%; 50%  $\text{H}_2\text{SO}_4 + \text{Aq}$ , about 4.4%.

These solutions are supersat. and  $\text{TeO}_2$  separates from the more dil. acids on standing. (Brauner, M. 1891, **12**. 34.)

Min. *Tellurite*.

**Tellurium dioxide hydrobromic acid,  $\text{TeO}_2$ ,  $3\text{HBr}$ .**

(Ditte, C. R. **83**. 336.)

**Tellurium dioxide hydrochloric acid,  $\text{TeO}_2$ ,  $2\text{HCl}$ .**

(Ditte, C. R. **83**. 336.)  
 $\text{TeO}_2$ ,  $3\text{HCl}$ . (Ditte.)

**Tellurium trioxide,  $\text{TeO}_3$ .**

Insol. in cold or hot  $\text{H}_2\text{O}$ , cold  $\text{HCl} + \text{Aq}$ , or cold or hot  $\text{HNO}_3 + \text{Aq}$ . Insol. in moderately conc.  $\text{KOH} + \text{Aq}$ , but, when the  $\text{KOH} + \text{Aq}$  is very conc., is sol. if boiling.

**Tellurium oxide,  $2\text{TeO}_2$ ,  $\text{TeO}_2$ .**

"*Tellurium tellurata*."  
 (Metsner, A. ch. 1898, (7) **15**. 203.)

**Tellurium oxybromide.**

Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (5) **10**. 82.)

**Tellurium oxybromide sulphur trioxide,**  
 $\text{TeOBr}_2$ ,  $2\text{SO}_2$ .

Deliquescent. (Prandtl, Z. anorg. 1909, **62**. 247.)

**Tellurium oxychloride,  $\text{TeOCl}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Ditte.)

**Tellurium oxyfluoride,  $\text{TeF}_4$ ,  $\text{TeO}_2 + 2\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$  containing  $\text{HNO}_3$ . Decomp. by  $\text{H}_2\text{O}$ .

$2\text{TeF}_4$ ,  $3\text{TeO}_2 + 6\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Metsner, C. R. 1897, **125**. 25.)

**Tellurium sulphide,  $\text{TeS}$ .**

Insol. in  $\text{CS}_2$ ; very unstable. (Snelling, J. Am. Chem. Soc. 1912, **34**. 802.)

**Tellurium disulphide,  $\text{TeS}_2$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Sol. in alkali hydrates or sulphides  $+ \text{Aq}$ .

$\text{CS}_2$  dissolves out S, so that the substance is probably a mixture. (Becker, A. **180**. 257.)

**Tellurium trisulphide,  $\text{TeS}_3$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{K}_2\text{S} + \text{Aq}$ .

**Tellurium sulphoxide,  $\text{TeSO}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{SO}_4$ . (Weber, J. pr. (2) **25**. 218.)

Is tellurium sulphite. (Divers, Chem. Soc. **49**. 583.)

**Tellurous acid,  $\text{H}_2\text{TeO}_3$ .**

Appreciably sol. in  $\text{H}_2\text{O}$  and acids. Sol. in alkali hydrates or carbonates  $+ \text{Aq}$ .

**Tellurites.**

The neutral and acid tellurites of the alkali metals are sol. in  $\text{H}_2\text{O}$ . Ba, Sr, Ca, and Mg tellurites are al. sol., and the other salts insol. in  $\text{H}_2\text{O}$ . Most tellurites are sol. in  $\text{HCl} + \text{Aq}$ .

**Aluminum tellurite.**

Ppt. Insol. in Al salts + Aq. (Berzelius.)

**Ammonium tellurite,  $(\text{NH}_4)\text{HTeO}_3$ ,  $\text{H}_2\text{TeO}_3 + 3\frac{1}{2}\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by  $\text{NH}_4\text{Cl}$  + Aq or alcohol. (Berzelius.)

**Barium tellurite,  $\text{BaTeO}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$  when prepared in the moist way. (Berzelius.)

$\text{BaO}$ ,  $4\text{TeO}_3$ .

**Cadmium tellurite.**

Ppt. Sol. in  $\text{HNO}_3$ , and  $\text{HCl}$  + Aq. (Oppenheim.)

**Calcium tellurite,  $\text{CaTeO}_3$ .**

Sl. sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{CaO}$ ,  $4\text{TeO}_3$ .

**Chromium tellurite.**

Ppt. Sol. in excess of chromic salts + Aq.

**Cobaltous tellurite.**

Ppt.

**Cupric tellurite.**

Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Glucinum tellurite.**

Insol. in  $\text{H}_2\text{O}$ .

**Indium tellurite,  $\text{In}_2(\text{TeO}_3)_2$ ,  $2\text{In}(\text{OH})_3$ .**

Ppt. (Renz, Dissert. 1902.)

**Ferrous tellurite.**

Ppt.

**Ferric tellurite.**

Ppt.

**Lead tellurite,  $\text{PbTeO}_3$ .**

Ppt. Easily sol. in acids. (Berzelius.)

**Lithium tellurite,  $\text{Li}_2\text{TeO}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{Li}_2\text{O}$ ,  $2\text{TeO}_3$ . Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{Li}_2\text{TeO}_3$  and  $\text{Li}_2\text{O}$ ,  $4\text{TeO}_3$ . (B.)

$\text{Li}_2\text{O}$ ,  $4\text{TeO}_3$ . Sol. in hot, much less in cold  $\text{H}_2\text{O}$ . (B.)

**Magnesium tellurite,  $\text{MgTeO}_3$ .**

Precipitate. Much more sol. in  $\text{H}_2\text{O}$  than the Ba, Sr, or Ca salt. (Berzelius.)

**Manganous tellurite.**

Ppt.

**Mercurous tellurite.**

Ppt.

**Mercuric tellurite.**

Ppt.

**Nickel tellurite.**

Ppt.

**Potassium tellurite,  $\text{K}_2\text{TeO}_3$ .**

Not deliquescent. Slowly sol. in cold, more quickly in boiling  $\text{H}_2\text{O}$ . (Berzelius.)

$\text{K}_2\text{O}$ ,  $2\text{TeO}_3$ . Completely sol. in boiling  $\text{H}_2\text{O}$ , from which  $\text{K}_2\text{O}$ ,  $4\text{TeO}_3$  crystallises. (B.)

$\text{K}_2\text{O}$ ,  $4\text{TeO}_3 + 4\text{H}_2\text{O}$ . Decomp. by cold  $\text{H}_2\text{O}$  into  $\text{K}_2\text{O}$ ,  $\text{TeO}_3$ , and  $\text{K}_2\text{O}$ ,  $2\text{TeO}_3$ , which dissolve, and  $\text{H}_2\text{TeO}_3$ , which is insol. (B.)

**Potassium hexatellurite,  $\text{K}_2\text{O}$ ,  $6\text{TeO}_3 + 2\text{H}_2\text{O}$ .**

Not decomp. by, but sl. sol. in  $\text{H}_2\text{O}$ . (Klein and Morel, C. R. 100. 1140.)

**Silver tellurite,  $\text{Ag}_2\text{TeO}_3$ .**

Ppt. Sol. in  $\text{NH}_4\text{OH}$  + Aq. (Berzelius.)

The freshly pptd. salt is insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , acetic and tartaric acid; decomp. by  $\text{HCl}$ . (Lenher, J. Am. Chem. Soc. 1913, 35. 727.)

$\text{AgHTeO}_3$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$  + Aq. (Rose, Pogg. 18. 60.)

**Sodium tellurite,  $\text{Na}_2\text{TeO}_3$ .**

Slowly sol. in cold, more quickly in hot  $\text{H}_2\text{O}$ . Precipitated from aqueous solution by alcohol. (Berzelius.)

$\text{Na}_2\text{O}$ ,  $2\text{TeO}_3$ . Decomp. by  $\text{H}_2\text{O}$  as K salt. (B.)

$\text{Na}_2\text{O}$ ,  $4\text{TeO}_3 + 5\text{H}_2\text{O}$ . As above. (B.)

**Strontium tellurite,  $\text{SrTeO}_3$ .**

Resembles Ba salt.

$\text{SrH}_2\text{TeO}_6$ . Very al. sol. in  $\text{H}_2\text{O}$ , more easily in  $\text{HNO}_3$  + Aq.

**Thorium tellurite.**

Precipitate. Insol. in  $\text{H}_2\text{O}$  or Th salts + Aq.

**Stannous tellurite.**

Pptd. in presence of 60,000 pts.  $\text{H}_2\text{O}$ . (Fischer.)

**Uranium tellurite,  $\text{U}_3(\text{TeO}_3)_3$ .**

Ppt. Insol. in U salts + Aq.

**Yttrium tellurite.**

Precipitate.

**Zinc tellurite,  $\text{ZnTeO}_3$ .**

Ppt.

**Zirconium tellurite.**

Ppt.

**Terbium, Tb.**

Metal has not been isolated.

Has been decomp. into two or more elements by Krüss (Z. anorg. 4. 27).

**Terbium chloride,  $TbCl_3 \cdot 6H_2O$ .**

Sol. in  $H_2O$ ; very hygroscopic; sol. in alcohol. (Urbain, C. R. 1908, 146. 128.)

**Terbium hydroxide.**

Sol. in dilute acids. Decomposes  $NH_4$  salts + Aq.

**Terbium oxide,  $Tb_2O_3$ .**

Sol. in dil. acids, even after ignition.

**Terbium peroxide,  $Tb_2O_7$ .**

Sol. in  $HNO_3$  and in hot  $HCl$ . (Urbain, C. R. 1907, 146. 127.)

**Tetramine chromium compounds.**

See—

Bromotetramine chromium compounds.  
Chlorotetramine chromium compounds.  
Iodotetramine chromium compounds.

**Tetramine cobaltic compounds,**

$Co(NH_4)_4X_2$ .

See—

Bromotetramine cobaltic compounds.  
Carbonatotetramine cobaltic compounds.  
Chlorotetramine cobaltic compounds.  
Croceocobaltic compounds.  
Fuscocobaltic compounds.  
Flavocobaltic compounds.  
Iodotetramine cobaltic compounds.  
Nitratotetramine cobaltic compounds.  
Praseocobaltic compounds.  
Roseotetramine cobaltic compounds.  
Sulphatotetramine cobaltic compounds.

See also under octamine cobaltic salts for many tetramine salts as yet unclassified.

**Tetramine cobaltic nitrite with  $MNO_2$ ,**

$Co_2(NH_4)_4(NO_2)_4, 2MNO_2$ .

See Diamine cobaltic nitrite.

**Tetrathionic acid,  $H_2S_4O_6$ .**

Known only in aqueous solution.

Dil. solution can be boiled without decomp. Conc. solution decomp. by boiling.

Addition of  $H_2SO_4$  or  $HCl$  makes solution more stable. (Fordos and Gélis, C. R. 15. 920.)

**Tetrathionates.**

Tetrathionates are all easily sol. in  $H_2O$ , but insol. in alcohol

**Barium tetrathionate,  $BaS_4O_6 + 2H_2O$ .**

Very sol. in  $H_2O$ , but precipitated by addition of alcohol

**Cadmium tetrathionate.**

Deliquescent. Solution in  $H_2O$  gradually decomposes. (Kessler, Pogg. 74. 249.)

**Cesium tetrathionate,  $Cs_2S_4O_6$ .**

(J. Meyer, B. 1907, 40. 1361.)

**Cuprous tetrathionate,  $Cu_2S_4O_6$ .**

Decomp. by  $H_2O$ . (Chancel and Diacon, C. R. 1863, 56. 711.)

**Cupric tetrathionate,  $CuS_4O_6$ .**

Sol. in  $H_2O$ .

Decomp. by long boiling. (Curtius and Henkel, J. pr. 1888, (2) 37. 148.)

**Lead tetrathionate,  $PbS_4O_6 + 2H_2O$ .**

Sol. in  $H_2O$ .

**Manganous hydrogen tetrathionate,  $MnH_2(S_4O_6)_2$ .**

Deliquescent. Very sol. in  $H_2O$  and alcohol. (Curtius and Henkel, J. pr. (2) 37. 148.)

**Nickel tetrathionate ammonia,  $NiS_4O_6, 6NH_3$ .**

Ppt. Decomp. by  $H_2O$ . Insol. in alcohol. (Ephraim, B. 1913, 46. 3109.)

**Potassium tetrathionate,  $K_2S_4O_6$ .**

Soluble in  $H_2O$ . Insol. in alcohol.

Difficultly sol. in  $H_2O$ . (Kessler, Pogg. 1847, 74. 254.)

**Rubidium tetrathionate,  $Rb_2S_4O_6$ .**

Not hygroscopic. (J. Meyer, B. 1907, 40. 1356.)

**Sodium tetrathionate,  $Na_2S_4O_6$ .**

Sol. in  $H_2O$ . Precipitated therefrom by a great excess of alcohol. (Kessler, J. pr. 96. 13.)

+  $2H_2O$ . (Berthelot, A. ch. (6) 17. 450.)

**Strontium tetrathionate,  $SrS_4O_6 + 6H_2O$ .**

Sol. in  $H_2O$ . (Kessler, Pogg. 74. 255.)

More sol. in  $H_2O$  than Ba salt.

**Zinc tetrathionate.**

Sol. in  $H_2O$ . (Fordos and Gélis.)

**Zinc hydrogen tetrathionate,  $ZnH_2(S_4O_6)_2$ .**

Extremely sol. in  $H_2O$  and alcohol. (Curtius and Henkel, J. pr. (2) 37. 147.)

**Zinc tetrathionate ammonia,  $ZnS_4O_6, 3NH_3$ .**

Ppt. (Ephraim, B. 1915, 48. 641.)

**Thallic acid.****Potassium thallate.**

Known only in aqueous solution. (Carstanjen, J. pr. 101. 55.)

Does not exist. (Lepsius, Chem. Ztg. 1890, 1327.)

**Thallium, Tl.**

Not attacked by pure  $H_2O$ . Easily sol. in dil.  $H_2SO_4$  or  $HNO_3$ +Aq. Difficultly sol. in  $HCl$ +Aq. Absolute alcohol dissolves considerable quantity in a short time, also methyl alcohol, and acetic ether. (Böttger.)

Not easily attacked by  $HF$ +Aq. (Kühmann.)

Insol. in liquid  $NH_3$ . (Franklin, Am. Ch. J. 1898, 20, 830.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0424 g. Tl in 6 days. (Gates, J. phys. Chem. 1911, 15, 143.)

**Thallium arsenide,  $TlAs$ .**

Decomp. by  $H_2SO_4$ . (Carstanjen.)

**Thalious azoimide,  $TlN_3$ .**

Sl. sol. in  $H_2O$ .

0.1712 pt. is sol. in 100 pts.  $H_2O$  at  $0^\circ$ ;

0.1965 pt. is sol. in 100 pts.  $H_2O$  at  $5^\circ$ ;

0.3 pt. is sol. in 100 pts.  $H_2O$  at  $16^\circ$ .

Insol. in abs. alcohol and ether.

(Curtius, J. pr. 1898, (2) 53, 284.)

**Thallothallic azoimide,  $TlN_3$ ,  $TlN_3$ .**

Explosive. Decomp. by hot  $H_2O$  and by acids. (Dennis, J. Am. Chem. Soc. 1896, 18, 973.)

**Thalious bromide,  $TlBr$ .**

Nearly insol. in cold, sl. sol. in boiling  $H_2O$ . (Willm, Bull. Soc. (2) 2, 89.)

1 l.  $H_2O$  dissolves 0.00869 g. mol.  $TlBr$  at  $68.5^\circ$ . (Noyes, Z. phys. Ch. 6, 248.)

Sl sol. in  $H_2O$ .  $0.48 \times 10^{-2}$  g. is dissolved in a liter of sat. solution at  $20^\circ$ . (Röttger, Z. phys. Ch. 1903, 46, 603.)

1 l.  $H_2O$  dissolves 420 mg.  $TlBr$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50, 356.)

238 mg.  $TlBr$  are contained in 1 l. sat. solution at  $0.13^\circ$ ; 289 mg. at  $9.37^\circ$ ; 423 mg. at  $18^\circ$ ; 579 mg. at  $25.68^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64, 168.)

Solubility of  $TlBr$  in  $Tl(NO_3)$ +Aq at  $68.5^\circ$ .

g. mols. per l.		g. mols. per l.	
$TlNO_3$	$TlBr$	$TlNO_3$	$TlBr$
0	0.00869	0	2.469
0.0163	0.00410	4.336	1.164
0.0294	0.00289	7.820	0.821
0.0955	0.00148	25.400	0.420

(Noyes, Z. phys. Ch. 1890, 6, 248.)

Insol. in acetone (Naumann, B. 1904, 37, 4329); pyridine (Naumann, B. 1904, 37, 4610); acetone (Eidmann, C. C. 1899, II, 1014.)

**Thallic bromide,  $TlBr_3$ .**

Deliquescent. Easily sol. in  $H_2O$  and alcohol. (Willm.)

Insol. in methyl acetate. (Naumann, B. 1909, 42, 3790.)

+ $H_2O$ . Very unstable. Sol. in  $H_2O$ ,

alcohol and ether. (Meyer, Z. anorg. 1900, 24, 353.)

+ $4H_2O$ . Very sol. in  $H_2O$ . (Thomas, C. R. 1902, 134, 546.)

**Thallothallic bromide,  $TlBr$ ,  $TlBr_3$ .**

Decomp. by  $H_2O$ . (Meyer, Z. anorg. 1900, 24, 354.)

$3TlBr$ ,  $TlBr_3$ . Decomp. by  $H_2O$  into  $TlBr$  and  $TlBr_3$ .

**Thallic hydrogen bromide,  $TlBr_3$ ,  $HBr$ .**

Very sol. in  $H_2O$ . (Thomas, C. R. 1902, 134, 546.)

**Thallic bromide ammonia,  $TlBr_3$ ,  $8NH_3$ .**

Decomp. by  $H_2O$ .

**Thallium bromochloride,  $TlClBr$ .**

Decomp. by  $H_2O$ . (Thomas, C. R. 1901, 132, 1489.)

$TlClBr_3$ + $4H_2O$ . Ppt.

$TlCl_2Br$ + $4H_2O$ . Ppt. Decomp. by  $H_2O$ . (Thomas, C. R. 1902, 134, 546.)

$Tl_2Cl_2Br_4$ . Decomp. by  $H_2O$ ,  $H_2SO_4$  or  $HNO_3$ . (Thomas, C. R. 1900, 131, 894; C. R. 1901, 132, 1489.)

$Tl_2Cl_2Br_4$ . Sol. in  $H_2O$ . (Thomas, C. R. 1901, 132, 82.)

$TlClBr_3$ ,  $3TlCl$ . Cryst. from  $H_2O$  containing  $HNO_3$ . (Cushmann, Am. Ch. J. 1900, 24, 222.)

$TlCl$ ,  $3TlBr$ . Sol. in  $H_2O$  without decomp. (Cushmann.)

$TlBr_3$ ,  $3TlCl$ . Decomp. by  $H_2O$ . (Cushmann.)

$TlBr_3$ ,  $TlCl$ . Sol. in  $H_2O$  with decomp. (Cushmann.)

$TlCl_2$ ,  $2TlBr$ ,  $TlCl$ . Sol. in  $H_2O$ . (Meyer, Z. anorg. 1900, 24, 355-360.)

$TlBr_3$ ,  $2TlCl$ ,  $TlBr$ . Ppt. Decomp. by  $H_2O$ . (Meyer.)

$(TlCl_2, TlCl)$ ,  $2(TlBr_3, TlBr)$ . Ppt. (Meyer.)

$2(TlCl_2, TlCl)$ ,  $(TlBr_3, TlBr)$ . Ppt. Decomp. by hot  $H_2O$ . (Meyer.)

**Thallium bromofluoride,  $TlFBr_3$ .**

Decomp. in moist air.

Sol. in abs. alcohol. (Gewecke, A. 1909, 366, 233.)

**Thallium bromofluoride ammonia,**

$TlFBr_3$ ,  $4NH_3$ .

Decomp. by moisture.

Difficultly sol. in abs. alcohol. (Gewecke, A. 1909, 366, 234.)

**Thalious chloride,  $TlCl$ .**

Solubility in pts.  $H_2O$  at  $t^\circ$ , according to H = Heberling; C = Crookes; L = Lamy.

$0^\circ$	$15^\circ$	$16^\circ$	$16.5^\circ$
504	283.4	377	359 pts. $H_2O$ ,
H	C	H	H
----- $100^\circ$ -----	----- $100^\circ$ -----	----- $100^\circ$ -----	
about 59	52.5	63 pts. $H_2O$ .	
L	C	H	

1 l.  $H_2O$  dissolves 0.0161 g. mol.  $TiCl$  at  $25^\circ$ . (Noyes, Z. phys. Ch. 6. 249.)

$3.26 \times 10^{-2}$  grams are dissolved in 1 liter of sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $H_2O$  at  $25^\circ$  dissolves 0.01606 g. mol.  $TiCl$ . (Geffcken, Z. phys. Ch. 1904, 49. 296.)

Solubility in  $H_2O$  at  $t^\circ$ .

100 cc. sat. solution contain at:

$t^\circ$	$0^\circ$	$10^\circ$	$20^\circ$	$30^\circ$	$40^\circ$	$50^\circ$
g. $TiCl$	0.17	0.24	0.34	0.46	0.60	0.80

$t^\circ$	$60^\circ$	$70^\circ$	$80^\circ$	$90^\circ$	$99.3^\circ$
g. $TiCl$	1.02	1.29	1.60	1.97	2.41

(Berkeley, Trans. Roy. Soc. 1904, 203, A, 208.)

1 l.  $H_2O$  dissolves 3.040  $TiCl$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

2.27 g. are dissolved in 1 l. of sat. solution at  $9.54^\circ$ ; 3.06 g. at  $17.7^\circ$ ; 3.97 g. at  $25.76^\circ$ . (Kohlrausch, Z. phys. Ch. 1906, 64. 168.)

0.01629 mol. is sol. in 1 l.  $H_2O$  at  $25^\circ$ . (Hill, J. Am. Chem. Soc. 1910, 32. 1385.)

0.01607 g. equiv. is sol. in 1 l.  $H_2O$  at  $25^\circ$ . (Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33. 1665.)

Much less sol. in  $H_2O$  containing  $HCl$  or  $HNO_3$ .

Solubility in  $HCl + Aq$  at  $25^\circ$ . 1 l. dissolves g. mol.  $TiCl$ .

g. $HCl$ added	$TiCl$	g. $HCl$ added	$TiCl$
0	0.01610	0.1468	0.00316
0.0283	0.00836	1.000	0.00200
0.0560	0.00565	...	...

(Noyes, Z. phys. Ch. 6. 249.)

Solubility in  $HCl + Aq$  at  $25^\circ$ .

Concentration of $HCl$ , equivalents per liter	Solubility of $TiCl$ , equivalents per liter
0	0.01612
0.025	0.00809
0.05	0.00685
0.10	0.00384
0.20	0.00254

(Noyes, Z. phys. Ch. 1892, 9. 614.)

Solubility in  $HNO_3 + Aq$  at  $25^\circ$ .

Normality $HNO_3$	Sp. gr. of the solution	g. $TiCl$ dissolved per l.
0.000	0.996	3.952
0.4977	1.0184	5.937
1.0046	1.0359	6.883
2.0452	1.0705	8.143
4.017	1.1362	9.926

(Hill and Simmons, Z. phys. Ch. 1909, 67. 605.)

Nearly insol. in  $NH_4OH + Aq$ .

More sol. in  $K_2CO_3 + Aq$  than in  $H_2O$ . 3.86 g.  $TiCl$  are sol. in 1 l.  $H_2O$  at  $25^\circ$ . 21.84 g.  $TiCl$  are sol. in 1 l. 5N- $K_2CO_3 + Aq$  at  $25^\circ$ . (Spencer and Le Pla, C. C. 1908, II. 198.)

Solubility in  $KNO_3 + Aq$  at  $25^\circ$ .

Concentration of $KNO_3$ , milliequivalents per l.	Solubility of $TiCl$ , milliequivalents per l.
10	16.07
20	17.16
50	18.26
100	19.61
300	23.13
1000	30.72

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33. 1670.)

Solubility in  $K_2SO_4 + Aq$  at  $25^\circ$ .

Concentration of $K_2SO_4$ , milliequivalents per l.	Solubility of $TiCl$ , milliequivalents per l.
10	16.07
20	17.79
50	19.42
100	21.37
300	26.00
1000	34.16

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33. 1670.)

Solubility in  $Ti_2SO_4 + Aq$  at  $25^\circ$ .

Concentration of $Ti_2SO_4$ , milliequivalents per l.	Solubility of $TiCl$ , milliequivalents per l.
10	16.07
20	10.34
50	6.77
100	4.68

(Bray and Winninghoff, J. Am. Chem. Soc. 1911, 33. 1670.)

Solubility of  $TiCl$  in salts +  $Aq$  at  $25^\circ$ .

Salt	Concentration of salt g. equiv. per l.	$TiCl$ dissolved g. equiv. per l.
$NH_4Cl$	0.025	0.00872
	0.05	0.00593
	0.2	0.00271
$CaCl_2$	0.025	0.00899
	0.05	0.00624
	0.10	0.00417
	0.20	0.00234

Solubility of  $\text{TiCl}_3$  in salts + Aq at  $25^\circ$ .—  
*Continued.*

Salt	Concentration of salt g. equiv. per l.	$\text{TiCl}_3$ dissolved g. equiv. per l.
$\text{CdCl}_2$	0.025	0.01040
	0.05	0.0078
	0.10	0.00578
	0.20	0.00425
$\text{CuCl}_2$	0.025	0.00905
	0.05	0.00614
	0.10	0.00422
	0.20	0.00291
$\text{MgCl}_2$	0.025	0.00904
	0.05	0.00618
	0.10	0.00413
	0.20	0.00275
$\text{MnCl}_2$	0.025	0.00898
	0.05	0.00617
	0.10	0.00412
	0.20	0.00286
$\text{KCl}$	0.025	0.00872
	0.05	0.00593
	0.1	0.00399
	0.2	0.00265
$\text{NaCl}$	0.025	0.00869
	0.05	0.00592
	0.10	0.00395
	0.20	0.00271
$\text{ZnCl}_2$	0.025	0.00899
	0.05	0.00627
	0.10	0.00412
	0.20	0.00281
$\text{TiClO}_2$	0.025	0.00897
$\text{TiNO}_3$	0.025	0.00883
	0.05	0.00626
	0.10	0.00423

(Noyes, Z. phys. Ch. 1892, 9. 609.)

Solubility of  $\text{TiCl}_3$  in salts + Aq at  $25^\circ$ .

Salt	Mols $\text{TiCl}_3$ sol. in 1 liter of				
	0.5-N solution	N solution	2-N solution	3-N solution	4-N solution
$\text{NH}_4\text{NO}_3$	0.02587	0.03121	0.03066	...	...
$\text{KNO}_3$	0.02596	0.03077	0.03904	...	...
$\text{NaNO}_3$	0.02594	0.03064	0.03851	0.04544	0.05128
$\text{LiNO}_3$	0.02542	0.03085	0.03785	0.04438	...
$\text{KClO}_3$	0.02370	...	...	...	...
$\text{NaClO}_3$	0.02320	0.02687	0.03060	0.03303	0.03850

(Geffcken, Z. phys. Ch. 1904, 49. 295.)

Insol. in alcohol. Easily sol. in hot  $\text{HgCl}_2$  + Aq. (Carstanjen.)

Solubility of  $\text{TiCl}_3$  in  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq at  $25^\circ$ .  
(g. equiv. per l.)

Acid	$\text{TiCl}_3$
0.000	0.01629
0.5134	0.01580
1.013	0.01495
2.016	0.0132
4.180	0.0099
8.180	0.0054
11.49	0.0026
14.31	0.0012
16.01	0.0005

(Hill, J. Am. Chem. Soc. 1910, 32. 1189.)

Insol. in pyridine. (Naumann, B. 1904, 37. 4610); acetone. (Naumann, B. 1904, 37. 4329.)

**Thallic chloride,  $\text{TiCl}_3$ .**

*Anhydrous.*

Easily sol. in  $\text{H}_2\text{O}$  and in most ord. solvents.

In contact with moist air, it rapidly becomes hydrated. (Thomas, C. R. 1902, 135. 1053.)

Difficultly sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Very sol. in acetone. (Renz, B. 1902, 35. 1110.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

+  $\text{H}_2\text{O}$ . Deliquescent, and very easily sol. in  $\text{H}_2\text{O}$ . (Werther.)

Deliquescent, and very easily sol. in  $\text{H}_2\text{O}$ . (Werther.)

+  $4\text{H}_2\text{O}$ . 86.2 pts. are sol. in 100 pts.  $\text{H}_2\text{O}$  at  $17^\circ$ . Sp. gr. of sat. aq. solution at  $17^\circ = 1.85$ . (Thomas, C. R. 1902, 135. 1052.)

Very hygroscopic. (Meyer, Z. anorg. 1900, 24. 336.)

Very sol. in alcohol and ether. (Meyer, Z. anorg. 1900, 24. 338.)

+  $7\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. (Werther.)

**Thallothallic chloride,  $3\text{TiCl}_2, \text{TiCl}_3$ .**

1 pt. dissolves in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ , according to C = Crookes; H = Hebbeling; L = Lamy.

15°	17°	100°	100°
380.1	346	52.9	20-25 pts. $\text{H}_2\text{O}$ .
C	H	C	L

Sl. decomp. by dissolving. (Lamy.)

**Thallic hydrogen chloride,  $\text{TiCl}_3, \text{HCl}$  +  $3\text{H}_2\text{O}$ .**

Very hygroscopic.

Decomp. by  $\text{H}_2\text{O}$ . (Meyer, Z. anorg. 1900, 24. 337.)

**Thallium tungsten chloride,  $\text{Ti}_2\text{W}_2\text{Cl}_6$ .**

Nearly insol. in  $\text{H}_2\text{O}$ .

Sol. in a hot mixture of equal pts.  $\text{H}_2\text{O}$  and conc.  $\text{HCl}$ .



Sl. sol. in conc. HCl.  
Nearly insol. in most organic solvents.  
(Olsson, B. 1913, 46. 575.)

**Thallic zinc chloride**,  $2\text{TiCl}_3$ ,  $\text{ZnCl}_2 + 6\text{H}_2\text{O}$ .

Can be cryst. from  $\text{H}_2\text{O}$ . (Gewecke, A. 1909, 366. 224.)

**Thallic chloride ammonia**,  $\text{TiCl}_3$ ,  $3\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl} + \text{Aq}$  (Willm.)

**Thallium chlorofluoride**,  $\text{TlFCl}_2$ .

Very hygroscopic.

Decomp. by moist air.

Easily sol. in abs. alcohol. (Gewecke, A. 1909, 366. 230.)

+  $3\text{H}_2\text{O}$ . Not hygroscopic.

Decomp. by  $\text{H}_2\text{O}$ , alcohol and ether. (Gewecke.)

**Thallium chlorofluoride ammonia**,  $\text{TlFCl}_2$ ,  $4\text{NH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ .

Difficultly sol. in abs. alcohol and in ether. (Gewecke, A. 1909, 366. 232.)

**Thallium chlorofluoride potassium chloride**,  $2\text{TlFCl}_2$ ,  $\text{KCl}$ .

Ppt. (Gewecke, A. 1909, 366. 231.)

**Thallous fluoride**,  $\text{TlF}$ .

Sol. in  $1\frac{1}{2}$  pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and in much less hot  $\text{H}_2\text{O}$ . Difficultly sol. in alcohol. (Buchner, W. A. B. 52. 2. 644.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. (Willm.)

**Thallic fluoride**,  $\text{TlF}_3$ .

Insol. in  $\text{H}_2\text{O}$  and cold  $\text{HCl} + \text{Aq}$ . (Willm.)

Cannot be obtained in pure state. (Gewecke, A. 1909, 366. 218.)

**Thallous hydrogen fluoride**,  $\text{TlF}$ ,  $\text{HF}$ .

Sol. in 1 pt.  $\text{H}_2\text{O}$ . (Buchner.)

**Thallous tungstyl fluoride**,

See Fluorxytungstate, thallous.

**Thallous vanadium fluoride**.

See Fluovanadate, thallous.

**Thallous vanadyl fluoride**.

See Fluorxyvanadate, thallous.

**Thallous hydroxide**,  $\text{TlOH}$ .

Sol. in  $\text{H}_2\text{O}$  and alcohol.

Solubility of  $\text{TlOH}$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. equiv. $\text{TlOH}$ per l	Sp. gr. $15^\circ/4^\circ$
0	1.151	1.231
18.5	1.554	1.317
19.5	1.582	1.322
29	1.803	1.342
23.1	1.861	1.377
33.1	1.967	1.400
36	2.075	1.417
40	2.240	1.446
44.5	2.442	...
54.1	2.940	...
59.4	3.281	...
64.6	3.601	...
78.5	4.673	...
90.0	5.705	...
99.2	6.708	...

(Bahr, Z. anorg. 1911, 71. 87.)

The solubility of  $\text{Tl}_2\text{O}$  in  $\text{H}_2\text{O}$  at these temperatures is the same as that of  $\text{TlOH}$ .

+  $\text{H}_2\text{O}$ . (Willm, Bull. Soc. (2) 5. 354.)

**Thallic hydroxide**,  $\text{Tl}_2\text{O}_3$ ,  $\text{H}_2\text{O} = \text{TlO}(\text{OH})$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids and ammonium salts +  $\text{Aq}$ . Insol. in caustic alkali solutions.

$\text{Tl}(\text{OH})_3$ . Easily sol. in dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  +  $\text{Aq}$ . (Carnegie, C. N. 60. 113.)

**Thallous iodide**,  $\text{TlI}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ .

1 pt.  $\text{TlI}$  is sol. in pts.  $\text{H}_2\text{O}$  at  $t^\circ$ . C=according to Crookes; H=according to Hebbeling; L=according to Lamy; W=according to Wether.

$35^\circ$	$15^\circ$	$16^\circ$	$16-17^\circ$	$19.4^\circ$
20,000	4450	16,000	11,676	14,654
W	C	L	H	W
20°	23.4°	45°	100°	100°
11,954	10,482	5407	842	804
W	W	W	C	H

Sol. in 17,000 pts.  $\text{H}_2\text{O}$  at  $20^\circ$ . (Long, Z. anal. 30. 342.)

Sat. solution at  $20.15^\circ$  contains 63.6 mg. or  $1.92 \times 10^{-4}$  g. mol.  $\text{TlI}$  per l. (Böttger, Z. phys. Ch. 1903, 46. 603.)

1 l.  $\text{H}_2\text{O}$  dissolves 56 mg.  $\text{TlI}$  at  $18^\circ$ . (Kohlrausch, Z. phys. Ch. 1904, 50. 356.)

36.2 mg. are dissolved in 1 l. of sat. solution at  $9.90^\circ$ ; 56 mg. at  $18.1^\circ$ ; 84.7 mg. at  $26^\circ$ . (Kohlrausch, Z. phys. Ch. 1908, 64. 168.)

Solubility in  $\text{H}_2\text{O}$  at  $25^\circ = 1.76 \times 10^{-4}$  mol. per litre. (Spencer, Z. phys. Ch. 1912, 30. 708.)

Not decomp. by dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or alkalis +  $\text{Aq}$ . Decomp. by hot dil.  $\text{HNO}_3$  +  $\text{Aq}$ , and cold conc.  $\text{HNO}_3$ . Sol. in aqua regia.

Also less sol. in acetic acid than in  $\text{H}_2\text{O}$ . (Carstanjen.)

Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Werther.) Not wholly insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  and solubility is increased by presence of  $(\text{NH}_4)_2\text{SO}_4$  or  $\text{NH}_4\text{Cl.}$  (Baubigny, C. R. 113. 544.)

Sol. in 13,000 pts.  $\text{NH}_4\text{OH} + \text{Aq.}$  ( $6\frac{1}{2}\%$  or  $2\frac{1}{2}\%$   $\text{NH}_3$ ). Sol. in 17,000 pts.  $\text{NH}_4\text{OH} + \text{Aq.}$  ( $1\frac{1}{4}\%$   $\text{NH}_3$ ). (Long.)

Insol. in dil.  $\text{KI} + \text{Aq.}$  ( $1\%$   $\text{KI}$ ). (Baubigny.)

Much more insol. in  $\text{KI} + \text{Aq.}$  than in  $\text{H}_2\text{O.}$  1 pt. dissolves in 75,000 pts. dil.  $\text{KI} + \text{Aq.}$  (Lamy.)

Nearly insol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  and absolutely insol. therein in presence of  $\text{Pb}$  salts. (Werner, C. N. 53. 51.)

Sol. in 56,336 pts. 85% alcohol at  $13^\circ$ . (Werther.) Sol. in 18,934 pts. 98% alcohol at  $19^\circ$ . (Hebberling.)

When  $\text{TII}$  is shaken with alcohol of  $78^\circ\text{B}$  (1 vol.  $\text{H}_2\text{O} + 3$  vols. 98% alcohol) at  $22^\circ$ , and let stand with  $\text{TII}$  for 24 hours, and then evaporated to  $\frac{1}{4}$  vol., there is shown no ppt. by  $\text{NH}_4\text{SH} + \text{Aq.}$  (Baubigny.)

Sol. in 260,000 pts. 90% alcohol, and 37,000 pts. 50% alcohol at  $20^\circ$ . (Long.)

Insol. in methylene iodide. (Retgers, Z. anorg. 3. 343.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C., 1899, II. 1014.)

Insol. in pyridine. (Naumann, B. 1904, 37. 4601.)

#### Thallic iodide, $\text{TII}_3$ .

Sol. in alcohol.

Decomp. slowly in the air. (Wells, Z. anorg. 1894, 6. 313.)

Sol. in ether.

#### Thallothallic iodide, $\text{TI}_3\text{I}_4 = 5\text{TII}, \text{TII}_3$ .

Sol. in  $\text{H}_2\text{O.}$  (Jørgensen, J. pr. (2) 6. 82.)

#### Thallium nitride.

Very unstable. (Franz Fischer, B. 1901, 43. 1470.)

#### Thallous oxide, $\text{TI}_2\text{O.}$

Deliquescent. Sol. in  $\text{H}_2\text{O.}$

See Thallous hydroxide.

#### Thallic oxide, $\text{TI}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O.}$  Not attacked by cold  $\text{H}_2\text{SO}_4$ . Sol. in hot  $\text{H}_2\text{SO}_4$ . Sol. in cold  $\text{HCl} + \text{Aq.}$

Insol. in alkalis +  $\text{Aq.}$  (Werther, J. pr. 91. 385.)

#### Black modification.

Less sol. in dil. acids than the brown modification. Solution is accompanied by a slight reduction to thallous salt.

More sol. in 10%  $\text{HCl}$  than in 10%  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$ .

More sol. in conc. than in dil. acids. (Rabe, Z. anorg. 1906, 48. 431.)

#### Brown modification.

Easily sol. in dil. mineral acids on warming, with slight reduction to thallous salt.

More sol. in conc. acid. (Rabe.)

#### Thallium dioxide, $\text{TI}_2\text{O}_3$ .

Insol. in  $\text{H}_2\text{O.}$  (Piccini, Gazz. ch. it. 17. 450.)

#### Thallic oxide ammonia, $\text{TI}_2\text{O}_3, 6\text{NH}_3$ .

Decomp. by much  $\text{H}_2\text{O.}$  Insol. in alcohol. (Carstanjen.)

#### Thallic oxyfluoride, $\text{TIOF.}$

Insol. in  $\text{H}_2\text{O.}$  Slowly decomp. by boiling with  $\text{H}_2\text{O.}$

Sol. in mineral acids. Almost insol. in  $\text{HF.}$  (Gewecke, A. 1909, 366. 226.)

#### Thallium phosphide (?).

Ppt. (Crookes.)

#### Thallous selenide, $\text{TI}_2\text{Se.}$

Insol. in  $\text{H}_2\text{O.}$  Scarcely attacked by cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  but dissolves when heated. (Carstanjen.)

#### Thallothallic selenide.

Not attacked by cold conc. or boiling dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Conc.  $\text{H}_2\text{SO}_4$  decomposes. (Carstanjen.)

#### Thallous sulphide, $\text{TI}_2\text{S.}$

Insol. in  $\text{H}_2\text{O.}$   $(\text{NH}_4)_2\text{S} + \text{Aq.}$   $\text{NH}_4\text{OH} + \text{Aq.}$   $\text{KCN} + \text{Aq.}$  and in alkali carbonates, and hydrates +  $\text{Aq.}$  Difficultly sol. in a solution of oxalic acid or acetic acid. (Crookes.) Easily sol. in  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Difficultly sol. in  $\text{HCl} + \text{Aq.}$  (Willm.)

Sl. sol. in  $\text{H}_2\text{O.}$

$0.21 \times 10^{-4}$  g. is dissolved in 1 l. sat. solution at  $20^\circ$ . (Böttger, Z. phys. Ch. 1903, 46. 603.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

#### Thallic sulphide, $\text{TI}_2\text{S}_3$ .

Insol. in  $\text{H}_2\text{O.}$  Insol. in cold, sol. in warm dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$  without separation of  $\text{S.}$  Sol. in other dilute acids with separation of  $\text{S.}$  (Carstanjen.)

#### Thallium pentasulphide, $\text{TI}_2\text{S}_5$ .

Ppt. (Hofmann, B. 1903, 36. 3092.)

#### Thallothallic sulphide, $5\text{TI}_2\text{S}, 3\text{TI}_2\text{S}_3$ .

Very slowly decomp. by cold dil.  $\text{H}_2\text{SO}_4 + \text{Aq.}$

$\text{TI}_2\text{S}, \text{TI}_2\text{S}_3$ . (Carstanjen.)

$\text{TI}_2\text{S}, 2\text{TI}_2\text{S}_3$ . Decomp. by dil. acids. (Schneider, J. pr. (2) 10. 55.)

#### Thallium telluride, $\text{TI}_2\text{Te.}$

(Fabre, C. R. 106. 673.)

**Thio-**

*For compounds with prefix thio-, see also under sulpho-.*

**Thioantimonic acid.**

*See Sulphantimonic acid.*

**Thioarsenic acid.**

*See Sulpharsenic acid.*

**Thiomolybdic acid.**

*See Sulphomolybdic acid.*

**Thionamic acid,  $\text{NH}_2\text{SO}_2 = \text{NH}_2\text{SO}(\text{OH})$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

$\text{H}_2\text{O}$  solution decomp. gradually. (Rose, Pogg. 33. 275; 42. 425.)

**Ammonium thionamate,  $\text{NH}_2\text{SO}(\text{ONH}_2)$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$ ; easily decomp. when in solution. (Rose.)

Very sol. in alcohol with decomp. Sl. sol. in dry ether. (Divers and Ogawa, C. C. 1900, I. 1259.)

**Dithionic acid.**

*See Dithionic acid.*

**Trithionic acid.**

*See Trithionic acid.*

**Tetrathionic acid.**

*See Tetrathionic acid.*

**Pentathionic acid.**

*See Pentathionic acid.*

**Thionyl bromide,  $\text{SOBr}_2$ .**

Unstable.

Decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 1896, 122. 322.)

**Thionyl bromochloride,  $\text{SOClBr}$ .**

Decomp. slowly in the cold, rapidly at  $115^\circ$ .

Decomp. by  $\text{H}_2\text{O}$ . (Besson C. R. 1896, 122. 321.)

**Thionyl chloride,  $\text{SOCl}_2$ .**

Sol. in  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$ . (Oddo, Gazz. ch. it. 1899, 29. (2) 318.)

**Thionyl fluoride,  $\text{SOF}_2$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{AsCl}_3$ ,  $\text{C}_6\text{H}_6$ , ether and oil of turpentine. (Moissan, C. R. 1900, 130. 1439.)

**Thiophosphamic acid,  $\text{H}_2\text{PNH}_2\text{O}_2\text{S}$  (?).**

Known only in its salts. (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Cadmium thiophosphamate,  $\text{CdPNH}_2\text{O}_2\text{S}$ .**

Sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (G. and H.)

**Lead —,  $\text{PbPNH}_2\text{O}_2\text{S}$ .**

Ppt. Sol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Thiophosphodiamic acid,  $\text{H}_2\text{PN}_2\text{H}_2\text{OS}$ .**

Known only in solution, which soon decomposes. (G. and H.)

**Cadmium thiophosphodiamate,  $\text{Cd}(\text{PN}_2\text{H}_2\text{OS})_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (G. and H.)

**Cupric —,  $\text{Cu}(\text{PN}_2\text{H}_2\text{OS})_2$ .**

Insol. in  $\text{H}_2\text{O}$ , dil.  $\text{HCl}$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  Sol. in  $\text{KCN} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Lead —,  $\text{Pb}(\text{PN}_2\text{H}_2\text{OS})_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq.}$

**Nickel —,  $\text{Ni}(\text{PN}_2\text{H}_2\text{OS})_2$ .**

Sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes, Chem. Soc. (2) 3. 1.)

**Zinc —,  $\text{Zn}(\text{PN}_2\text{H}_2\text{OS})_2$ .**

Ppt. Sol. in dil. acids, and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Gladstone and Holmes.)

**Thiophosphonitrile,  $\text{PSN}$ .**

Not decomp. by cold  $\text{H}_2\text{O}$ . Slowly decomp. by boiling  $\text{H}_2\text{O}$ . Easily decomp. by boiling dil.  $\text{HCl}$ . (Stock, B. 1906, 39. 1974.)

**Thiophosphoric acid,  $\text{H}_2\text{PSO}_3 = \text{PS}(\text{OH})_2$ .**

Known only in its salts.

**Ammonium magnesium thiophosphate,  $\text{NH}_4\text{MgPSO}_3 + 9\text{H}_2\text{O}$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Kubierschky, J. pr. (2) 31. 100.)

**Barium —,  $\text{Ba}_2(\text{PSO}_3)_2$ .**

Insol. in  $\text{H}_2\text{O}$ . (Wurts, A. ch. (3) 20. 473.)

**Cobalt —.**

Insol. in  $\text{H}_2\text{O}$ , but partially decomp. when boiled therewith. (Wurts.)

**Cupric —.**

Insol. in  $\text{H}_2\text{O}$ ; very easily decomp. (Wurts.)

**Ferric —.**

Insol. in  $\text{H}_2\text{O}$ . (Wurts.)

**Magnesium —,  $\text{Mg}_2(\text{PSO}_3)_2 + 20\text{H}_2\text{O}$ .**

Sl. sol. in cold  $\text{H}_2\text{O}$ . (Kubierschky, J. pr. (2) 31. 99.)

**Nickel thiophosphate.**

Insol. in  $H_2O$ , but decomp. when boiled therewith. (Wurts.)

**Potassium —,  $K_2PSO_3$ .**

Very sol. in  $H_2O$ . Known only in aqueous solution. (Wurts.)

**Sodium —,  $Na_2PSO_3 + 12H_2O$ .**

Easily sol. in boiling  $H_2O$ . Cryst. out on cooling. (Wurts, A. ch. (3) 20. 472.)

Insol. in alcohol.

**Strontium —.**

Insol. in  $H_2O$ . (Wurts.)

**Dithiometaphosphoric acid.****Ammonium dithiometaphosphate,  $NH_4PS_2O_3$ .**

Decomp. by  $H_2O$ . (Stock, B. 1906, 39. 1990.)

**Monothioorthophosphoric acid.****Monoammonium monothioorthophosphate,  $O:P(SNH_4)(OH)_2$ .**

Sol. in  $H_2O$ .

Insol. in alcohol. (Stock, B. 1906, 39. 1990.)

**Triammonium monothioorthophosphate,  $SNH_4.PO.(ONH_4)_2$ .**

(Stock.)

**Dithioorthophosphoric acid.****Ammonium dithiophosphate,  $(NH_4)_2PS_2O_3 + 2H_2O$ .**

Sl. efflorescent. Sol. in  $H_2O$ . (Kubierschky, J. pr. (2) 31. 93.)

**Ammonium magnesium —,  $NH_4MgPS_2O_3 + 6H_2O$ .**

Sl. sol. in cold,  $H_2O$ . (Kubierschky.)

**Barium —,  $Ba_3(PS_2O_3)_2 + 8H_2O$ .**

Precipitate. (Kubierschky, J. pr. (2) 31. 103.)

+18 $H_2O$ . As the trithio compound. (Ephraim, B. 1910, 43. 287.)

**Calcium —.**

Very easily decomposed. (Kubierschky.)

**Sodium —,  $Na_2PS_2O_3 + 11H_2O$ .**

Very sol. in  $H_2O$ . (Kubierschky, J. pr. (2) 31. 93.)

**Trithioorthophosphoric acid.****Ammonium trithioorthophosphate,  $(NH_4)_3PS_3O + H_2O$ .**

(Stock, B. 1906, 39. 1985.)

**Barium trithioorthophosphate,  $Ba_3(PS_3O)_2 + 20H_2O$ .**

Decomp. by  $H_2O$  and dil. acids.

Sol. in conc.  $HNO_3$  with oxidation of the sulphur to  $H_2SO_4$ . (Ephraim, B. 1910, 43. 286.)

**Magnesium —,  $Mg_3(PS_2O_3)_2 + 20H_2O$ .**

Decomp. by  $H_2O$  and dil. acids. (Ephraim.)

**Thiophosphorous acid.****Ammonium thiophosphite (?),  $(NH_4)_2P_2S_2O_3 + 3H_2O$ .**

Sol. in  $H_2O$ . (Lemoine, C. R. 98. 45.) +6 $H_2O$ .

**Sodium thiophosphite (?),  $Na_2P_2S_2O_3 + 5H_2O = P_2O_3, 2Na_2S + 5H_2O$ .**

Sol. in  $H_2O$ . (Lemoine, C. R. 98. 45.)

$Na_2P_2S_2O_3 + 4H_2O = P_2O_3, 3Na_2O, 2H_2S + 2H_2O$ . Sol. in  $H_2O$ . (Lemoine, l. c.)

**Thiophosphoryl triamide,  $PS(NH_2)_3$ .**

Rapidly decomp. by  $H_2O$ . Scarcely sol. in alcohol, ether, or  $CS_2$ . (Chevrier, C. R. 66. 748.)

**Metathiophosphoryl bromide,  $PS_2Br$ .**

Decomp. by  $H_2O$ . Insol. in ether. (Michaelis, A. 164. 9.)

**Orthothiophosphoryl bromide,  $PSBr_2$ .**

Slowly decomp. by cold, rapidly by hot  $H_2O$  but volatile with only partial decomp. with steam. Easily sol. in ether,  $CS_2$ ,  $PCl_3$ ,  $PBr_3$ . Decomp. by cold alcohol. Forms hydrate  $PSBr_2 + H_2O$ . (Michaelis, A. 164. 9.)

**Pyrothiophosphoryl bromide,  $P_2S_2Br_4$ .**

Decomp. by  $H_2O$  and alcohol. Sol. in  $CS_2$  and ether. (Michaelis.)

**Thiophosphoryl phosphorus bromide,  $PSBr_3, PBr_3$ .**

Decomp. by  $H_2O$  into  $PSBr_2$ . (Michaelis.)

**Thiophosphoryl dibromochloride,  $PSClBr_2$ .**

Decomp. by  $H_2O$  and alkalis.

Fumes in the air. (Besson, C. R. 1896, 122. 1059.)

**Thiophosphoryl bromodichloride,  $PSCl_2Br$ .**

Decomp. by  $H_2O$  and alkalis. Reacts violently with  $HNO_3$ . (Besson, C. R. 1896, 120. 1058.)

**Thiophosphoryl chloride,  $PSCl_3$ .**

Very slowly decomp. by  $H_2O$ , and may be distilled with steam without much decomp. Decomp. by alcohol. Miscible with  $CS_2$ . (Baudrimont, J. pr. 87. 301.)

Sol. in  $CCl_4$  and  $C_6H_6$ . (Oddo, Gazz. ch. it. 1899, 29. (2) 318.)

**Thiophosphoryl pentachloride,  $\text{PS}_2\text{Cl}_5$  (?).**

Decomp. by  $\text{H}_2\text{O}$ . Sol. in alkalis with residue of S. Attacked violently by  $\text{HNO}_3$ , alcohol, ether, oil of turpentine. Miscible with  $\text{CS}_2$ . (Gladstone, Chem. Soc. 3. 5.)

**Thiophosphoryl fluoride,  $\text{PSF}_3$ .**

Slowly sol. in  $\text{H}_2\text{O}$  with decomp. Sl. sol. in ether.

Insol. in  $\text{H}_2\text{SO}_4$ ,  $\text{CS}_2$ , or benzene. (Thorpe and Rodger, Chem. Soc. 55. 306.)

More sol. in  $\text{KOH}$  or  $\text{NaOH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .

**Thiophosphoryl iodide,  $\text{PSI}_3$ .**

Very sol. in  $\text{CS}_2$ . Unstable when heated. Fumes in the air. (Besson, C. R. 1896, 122. 1201.)

**Thiosulphuric (formerly Hyposulphurous) acid,  $\text{H}_2\text{S}_2\text{O}_3$ .**

Known only in aqueous solution, which is extremely unstable, and decomposes very quickly after its formation. The time before decomposition is exactly proportional to the ratio of the weight of  $\text{H}_2\text{O}$  to the weight of  $\text{H}_2\text{S}_2\text{O}_3$  present; i. e., if one solution contains twice as much  $\text{H}_2\text{O}$  for a given amt. of  $\text{H}_2\text{S}_2\text{O}_3$  as a second solution, the first solution will decompose in twice the length of time. The length of time is about 20 secs. at  $10^\circ$ , and 2 secs. at  $50^\circ$  for conc. solutions, to 120 secs. at  $10^\circ$  and 12 secs. at  $50^\circ$  for very dilute solutions. (See Landolt (B. 16. 2958) for further figures; also Winkelmann (B. 18. 406).)

**Thiosulphates.**

The thiosulphates of the alkalis and of Ca and Sr are easily sol. in  $\text{H}_2\text{O}$ ; Ba and Sr salts are sl. sol. and the other salts insol. The salts of the metals dissolve in alkali thiosulphates + Aq. All are insol. in alcohol.

Double Salts of Thiosulphuric acid. It is impossible to determine whether substances of this class are true chem. individuals. Many described by Svensson and others are doubtless isomorphic mixtures, whose comp. depends on the temp. and conc. of the solution in which pptd. (Rosenheim, Z. anorg. 1900, 25. 72.)

**Ammonium thiosulphate,  $(\text{NH}_4)_2\text{S}_2\text{O}_3$ .**

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$ .

Not deliquescent. (Fock and Klüss, B. 1899, 22. 3099.)

Crystallises with  $\frac{1}{2}\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 56. 298.) Anhydrous. (Arrpe, A. 96. 113.)

Insol. in alcohol. (Arrpe.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014.)

Difficultly sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Ammonium cadmium thiosulphate,  $3(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 3\text{H}_2\text{O}$ .**

Can be recryst. from warm  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 23. 1758.)

+  $\text{H}_2\text{O}$ . (F. and K.)

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{CdS}_2\text{O}_3$ . (F. and K.)

**Ammonium cuprous thiosulphate,**

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Less sol. in  $\text{H}_2\text{O}$  than  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 91.)

$2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 1\frac{1}{2}\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Rosenheim and Steinhäuser.)

**Ammonium cuprous thiosulphate cuprous iodide,  $7(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3, 8\text{CuI} + 4\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . (Brun, C. R. 1892, 114. 668.)

Could not be obtained. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 107.)

**Ammonium cuprous sodium thiosulphate ammonia,  $3\text{Cu}_2\text{S}_2\text{O}_3, 4\text{Na}_2\text{S}_2\text{O}_3, (\text{NH}_4)_2\text{S}_2\text{O}_3, 6\text{NH}_3$ .**

Ppt. When dry is fairly stable in the air. Partially decomp. by  $\text{H}_2\text{O}$ .

Sol. in dil.  $\text{H}_2\text{SO}_4$  or acetic acid. (Shinn, J. Am. Chem. Soc. 1904, 26. 948.)

**Ammonium lead thiosulphate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 3\text{H}_2\text{O}$ .**

Easily and completely sol. in cold  $\text{H}_2\text{O}$ , but deposits  $\text{PbS}_2\text{O}_3$  by standing or warming. (Rammelsberg, Pogg. 56. 312.)

**Ammonium magnesium thiosulphate,**

$(\text{NH}_4)_2\text{Mg}(\text{S}_2\text{O}_3)_2 + 6\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Kessler, Pogg. 74. 283.)

Not deliquescent. (Fock and Klüss, B. 23. 540.)

**Ammonium mercuric thiosulphate,**

$4(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{HgS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ , from which it is precipitated by alcohol. Extremely easily decomp. (Rammelsberg, Pogg. 56. 318.)

**Ammonium potassium thiosulphate,**

$\text{NH}_4\text{KS}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 23. 536.)

**Ammonium silver thiosulphate,  $2(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + z\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . Somewhat sol. in alcohol. (Herschel, Edinb. Phil. J. 1. 398.)

$(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + z\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , from which it is reprecipitated by an acid. (Herschel.)

**Ammonium zinc thiosulphate,**  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{ZnS}_2\text{O}_3 + \text{H}_2\text{O}.$ 

Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim and Davidsohn, Z. anorg. 1904, **41**, 238.)

**Ammonium thiosulphate ammonium cuprous bromide,**  $\text{CuBr}, \text{NH}_4\text{Br}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1900, **25**, 107.)

The double salts of ammonium thiosulphate with silver and copper haloids are true chemical compounds and may be recryst. from  $\text{H}_2\text{O}$  without decomp. (Rosenheim, Z. anorg. 1900, **25**, 100.)

**Ammonium thiosulphate ammonium silver bromide,**  $\text{AgBr}, \text{NH}_4\text{Br}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous chloride,**  $\text{CuCl}, \text{NH}_4\text{Cl}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$  and in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium silver chloride,**  $\text{AgCl}, \text{NH}_4\text{Cl}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in cold  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$ .  
Decomp. by boiling with  $\text{H}_2\text{O}$  and by dil. acids. (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous cyanide.**

Composition not constant. (Rosenheim.)

**Ammonium thiosulphate ammonium silver cyanide.**

Composition not constant. (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous iodide,**  $\text{CuI}, \text{NH}_4\text{I}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous iodide,**  $4(\text{NH}_4)_2\text{S}_2\text{O}_3, \text{NH}_4\text{I}, \text{CuI}.$ 

Very sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling. (Brun, C. R. 1892, **114**, 668.)

**Ammonium thiosulphate ammonium silver iodide,**  $\text{AgI}, \text{NH}_4\text{I}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium cuprous sulphocyanide,**  $\text{CuSCN}, \text{NH}_4\text{SCN}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Ammonium thiosulphate ammonium silver sulphocyanide,**  $\text{AgSCN}, \text{NH}_4\text{SCN}, 4(\text{NH}_4)_2\text{S}_2\text{O}_3.$ 

Sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Ammonium thiosulphate cuprous iodide,**  
 $(\text{NH}_4)_2\text{S}_2\text{O}_3, 2\text{CuI} + \text{H}_2\text{O}.$ 

Insol. in  $\text{H}_2\text{O}$ . (Brun, C. R. 1892, **114**, 668.)

Could not be obtained. (Rosenheim and Steinhäuser.)

**Barium thiosulphate,**  $\text{BaS}_2\text{O}_3 + \text{H}_2\text{O}.$ 

Sl. sol. in  $\text{H}_2\text{O}$ . (Rose, Pogg. **21**, 437.)

Insol. in alcohol.

1 pt. cannot be dissolved in 2000 pts.  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl} + \text{Aq}$  without decomposition. (Herschel, 1819.)

Pptd. from  $\text{BaS}_2\text{O}_3 + \text{Aq}$  by dil. alcohol. (Sobrero and Selmi, A. ch. (3) **28**, 211.)

Insol. in acetone. (Naumann, B. 1904, **37**, 4329.)

**Barium bismuth thiosulphate,**  $\text{Ba}_3[\text{Bi}(\text{S}_2\text{O}_3)_2]_2.$ 

Sol. in  $\text{H}_2\text{O}$  with decomp. (Hauser, Z. anorg. 1903, **35**, 9.)

**Barium cadmium thiosulphate,**  $2\text{BaS}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 8\text{H}_2\text{O}.$ 

Sl. sol. in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. **23**, 1761.)

$3\text{BaS}_2\text{O}_3, \text{CdS}_2\text{O}_3 + 8\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ .

**Barium cuprous thiosulphate.**

Easily sol. in hot, difficultly sol. in cold  $\text{H}_2\text{O}$ . (Cohen, Chem. Soc. **51**, 38.)

$2\text{BaS}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 7\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Vortmann, M. **9**, 165.)

**Barium gold thiosulphate.**

Sl. sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Fordos and Gélis.)

**Barium lead thiosulphate.**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. **56**, 313.)

**Barium thiosulphate chloride,**  $\text{BaS}_2\text{O}_3, \text{BaCl}_2 + 2\text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. **23**, 3001.)

**Bismuth caesium thiosulphate,**  $\text{Cs}_3\text{Bi}(\text{S}_2\text{O}_3)_3.$ 

Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Hauser, Z. anorg. 1903, **35**, 8.)

**Bismuth potassium thiosulphate,**  $\text{K}_3\text{Bi}(\text{S}_2\text{O}_3)_3 + \frac{1}{2}\text{H}_2\text{O}.$ 

Solubility in  $\text{H}_2\text{O}$ .

100 cc. of the sat. solution contain 3.5 g. at  $2^\circ$ ; 7.0 g. at  $18^\circ$ . At  $18^\circ$  the solution decomposes.

More sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  than in pure  $\text{H}_2\text{O}$ .

Insol. in alcohol. (Hauser, Z. anorg. 1903, **35**, 5.)

$+ \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Carnot, C. R. **83**, 390.)

**Bismuth rubidium thiosulphate,**  
 $\text{Rb}_2\text{Bi}(\text{S}_2\text{O}_3)_2 + \frac{1}{2}\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ .

Insol. in acid alcohol. (Hauser, Z. anorg. 1903, 35. 7.)

+  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Hauser, Z. anorg. 1903, 35. 8.)**Bismuth sodium thiosulphate,**Very sol. in  $\text{H}_2\text{O}$ , and also in alcohol. (Carnot, C. R. 83. 338.) $\text{Na}_2\text{Bi}(\text{S}_2\text{O}_3)_2$ . Decomp. by  $\text{H}_2\text{O}$ . Easily sol. in 50% alcohol. (Hauser, Z. anorg. 1903, 35. 3.)**Cadmium thiosulphate,**  $\text{CdS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Vortmann and Padberg, B. 22. 2638.)**Cadmium potassium thiosulphate,**  $3\text{CdS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_8$ .

Cannot be recryst. without decomp. (Fock and Klüss, B. 23. 1753.)

 $\text{CdS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_8 + 2\text{H}_2\text{O}$ . Can be crystallised from  $\text{H}_2\text{O}$  without decomp. (F. and K.)**Cadmium sodium thiosulphate,**  $\text{CdS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_8 + 16\text{H}_2\text{O}$ .Not deliquescent. Sol. in  $\text{H}_2\text{O}$ . (Jochum, C. C. 1885, 642.)+  $\text{H}_2\text{O}$ . (Vortmann and Padberg, B. 22. 2639.)+  $3\text{H}_2\text{O}$ . Deliquescent. (Fock and Klüss, B. 23. 1157.) $2\text{CdS}_2\text{O}_3, \text{Na}_2\text{S}_2\text{O}_8 + 7\text{H}_2\text{O}$ . (V. and P.) $3\text{CdS}_2\text{O}_3, \text{Na}_2\text{S}_2\text{O}_8 + 9\text{H}_2\text{O}$ . (V. and P.)**Cadmium strontium thiosulphate,**  $\text{CdS}_2\text{O}_3, 3\text{SrS}_2\text{O}_8 + 10\text{H}_2\text{O}$ .

(Fock and Klüss, B. 23. 1763.)

**Cesium thiosulphate,**  $\text{Cs}_2\text{S}_2\text{O}_3$ .Easily sol. in  $\text{H}_2\text{O}$ . (Chabrie, C. R. 1901, 133. 297.)+  $2\text{H}_2\text{O}$ . Very hygroscopic. (J. Meyer, B. 1907, 40. 1360.)**Cesium cuprous thiosulphate,**  $\text{Cs}_2\text{S}_2\text{O}_3, \text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$  with decomp. (J. Meyer, B. 1907, 40. 1361.)**Cesium lead thiosulphate,**  $\text{Cs}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Not hygroscopic.

 $2\text{Cs}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 3\text{H}_2\text{O}$ . Hygroscopic. (J. Meyer.)**Cesium magnesium thiosulphate,**  $\text{Cs}_2\text{S}_2\text{O}_3, \text{MgS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ . (Meyer.)**Cesium silver thiosulphate,**  $2\text{Cs}_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$ .

Not hygroscopic.

Decomp. by hot  $\text{H}_2\text{O}$ . (J. Meyer.)**Calcium thiosulphate,**  $\text{CaS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .Sol. in 1 pt.  $\text{H}_2\text{O}$  at  $3^\circ$ .Aqueous solution saturated at  $10^\circ$  has sp. gr. 1.300. Solution with sp. gr. 1.11437 at  $15.5^\circ$  contains 0.2081 of its weight in  $\text{CaS}_2\text{O}_3$ .

Decomp. on heating. Insol. in alcohol (sp. gr. 0.8234). (Herschel, A. ch. 14. 355.)

100 g. sat. solution contains 29.4 g.  $\text{CaS}_2\text{O}_3$  at  $9^\circ$  and 34.7 g.  $\text{CaS}_2\text{O}_3$  at  $25^\circ$ . (Kremann and Rodemund, M. 1914, 35. 1065.)Solubility of  $\text{CaS}_2\text{O}_3 + \text{Na}_2\text{SO}_3$  in  $\text{H}_2\text{O}$ .

$t^\circ$	% $\text{Na}_2\text{SO}_3$	% $\text{CaS}_2\text{O}_3$	Solid phase
9	0	29.4	$\text{CaS}_2\text{O}_3, 6\text{H}_2\text{O}$
	11.04	22.64	" + $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$ $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
	25.21	15.84	
	31.01	7.70	
25	0	34.7	$\text{CaS}_2\text{O}_3, 6\text{H}_2\text{O}$
	9.24	29.69	"
	15.67	21.41	"
	18.34	25.18	"
	28.24	21.14	"
	30.19	20.33	" + $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$ $\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$
	31.24	18.43	
	35.04	11.61	"

(Kremann and Rodemund, M. 1914, 35. 1065.)

**Calcium lead thiosulphate,**  $2\text{CaS}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 4\text{H}_2\text{O}$ .Decomp. by  $\text{H}_2\text{O}$ . (Rammelsberg.)**Calcium potassium thiosulphate,**  $\text{CaS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_8 + 5\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Fock and Klüss, B. 24. 3016.)**Calcium silver thiosulphate,**  $2\text{CaS}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$ .Easily sol. in  $\text{H}_2\text{O}$ ; less sol. in alcohol. $\text{CaS}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + x\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ , abundantly in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Herschel, 1819.)**Calcium sodium thiosulphate nitrate,** $\text{CaNa}_2(\text{S}_2\text{O}_3)_2\text{NO}_3 + 11\text{H}_2\text{O}$ .

(Kremann and Rodemund, M. 1914, 35. 1065.)

**Cobaltous thiosulphate,**  $\text{CoS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)**Cobaltous sodium thiosulphate,**  $2\text{CoS}_2\text{O}_3, 5\text{Na}_2\text{S}_2\text{O}_8 + 25\text{H}_2\text{O}$ .Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Jochum.)

Could not be obtained by Vortmann and Padberg.

$\text{CoS}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 15\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Vortmann and Padberg, B. 22. 2641.)

**Cuprous thiosulphate**,  $\text{Cu}_2\text{O}$ ,  $3\text{S}_2\text{O}_3 + 2\text{H}_2\text{O} = \text{Cu}_2\text{H}_4(\text{S}_2\text{O}_3)_2$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Abundantly sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  or  $\text{Aq}$ ,  $\text{NH}_4\text{Cl}$  +  $\text{Aq}$ ,  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ , or  $(\text{NH}_4)_2\text{CO}_3$  +  $\text{Aq}$ . Sol. in  $\text{HCl}$  or  $\text{HNO}_3$  +  $\text{Aq}$ . (v. Hauer, W. A. B. 13. 443.)

**Cuprous hydrazine thiosulphate**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $(\text{N}_2\text{H}_4)_2\text{H}_2\text{S}_2\text{O}_3 + \frac{1}{2}\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{NH}_4\text{OH}$  +  $\text{Aq}$  and in dil. acids. (Ferratini, C. C. 1912, I. 1281.)

**Cupric lead thiosulphate**,  $\text{Pb}(\text{CuS}_2\text{O}_3)_2 + 3\text{H}_2\text{O}$ . (?)

Very sol. in  $\text{H}_2\text{O}$  and quickly decomp. (Girard, C. C. 1904, I. 253.)

**Cuprous mercurous thiosulphate**,  $5\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Hg}_2\text{S}_2\text{O}_3$ .

Insol. or sl. sol. in cold, decomp. by boiling  $\text{H}_2\text{O}$ .  $\text{HNO}_3$  +  $\text{Aq}$  dissolves out  $\text{Cu}$ . (Rammelsberg, Pogg. 56. 319.)

**Cuprous potassium thiosulphate**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; decomp. on heating with pptn. of  $\text{CuS}$ . Easily sol. in  $\text{K}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ . (Rammelsberg, Pogg. 56. 321.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{K}_2\text{S}_2\text{O}_3$ . Very sol. in cold  $\text{H}_2\text{O}$ ; insol. in  $\text{K}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ . (Cohen, Chem. Soc. 51. 39.)

+  $3\text{H}_2\text{O}$ . Scarcely sol. in cold, sol. with sl. decomp. in hot  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$  +  $\text{Aq}$  with evolution of  $\text{SO}_2$ .

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{K}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Solution is not decomp. by boiling. Sol. in excess of  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ . (Rammelsberg.)

**Cuprous rubidium thiosulphate**,  $\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Ppt. (J. Meyer, B. 1907, 40. 1357.)

$2\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Ppt. (J. Meyer.)

$3\text{Rb}_2\text{S}_2\text{O}_3$ ,  $\text{Cu}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Ppt. (J. Meyer.)

**Cuprous silver sodium thiosulphate ammonia**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Ag}_2\text{S}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3$ ,  $6\text{NH}_3$ .

Ppt. Becomes dark when exposed to light. Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ . (Shinn, J. Am. Chem. Soc. 1904, 26. 949.)

**Cuprous sodium thiosulphate**,  $2\text{Cu}_2\text{S}_2\text{O}_3$ ,  $7\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Ppt. from aqueous solution by alcohol. (Jochum, C. C. 1885, 642.)

+  $12\text{H}_2\text{O}$ . Sol. in very dil.  $\text{HCl}$  +  $\text{Aq}$ . (Jochum.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Rammelsberg.)

+  $6\text{H}_2\text{O}$ . (Jochum.)

$3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Vortmann.)

+  $5\text{H}_2\text{O}$ . (Lenz, A. 40. 99.) Formula according to Jochum is—

$5\text{Cu}_2\text{S}_2\text{O}_3$ ,  $4\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in  $\text{HCl}$  +  $\text{Aq}$  without evolution of  $\text{SO}_2$ , also in dil.  $\text{H}_2\text{SO}_4$  or  $\text{HNO}_3$  +  $\text{Aq}$ . Sol. in  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ . (Jochum.)

+  $6\text{H}_2\text{O}$ . As above. (Jochum.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ . (Russell, Ch. 7tg. 9. 233.)

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. by dil. acids. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 84.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Bhaduri, Z. anorg. 1898, 17. 1.)

+  $3\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Vortmann, M. 1888, 9. 168.)

$3\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ . (Gerard, C. C. 1904, I. 253.)

+  $5\text{H}_2\text{O}$ . Sol. in 352 pts.  $\text{H}_2\text{O}$ . (Russell, Ch. Z. 1885, 9. 223.)

100 cc. 5%  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$  dissolve 12.28 g.

" " 7.5% " " 17.46 g.

" " 10% " " 22.54 g.

(Russell, Ch. Z. 1885, 9. 223.)

$4\text{Cu}_2\text{S}_2\text{O}_3$ ,  $3\text{Na}_2\text{S}_2\text{O}_3 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and alcohol.

Decomp. by dil. acids. (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 84.)

+  $9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. (Bhaduri, Z. anorg. 1898, 17. 1.)

$7\text{Cu}_2\text{S}_2\text{O}_3$ ,  $5\text{Na}_2\text{S}_2\text{O}_3 + 16\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  and by alcohol. (Bhaduri, Z. anorg. 1898, 17. 1.)

It is impossible to determine whether any of these compds. are complex or double salts. As a class they are not easily sol. and decomp. in solution. They may therefore be mixtures whose comp. depended upon the temp. and conc. of the solution in which they were pptd. (Rosenheim, Z. anorg. 1900, 25. 81.)

**Cuprocupric sodium thiosulphate ammonia**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{CuS}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $4\text{NH}_3$ .

Insol. in, but decomp. by hot  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{H}_2\text{O}$  +  $\text{Aq}$ . Sol. in  $\text{NH}_4\text{OH}$  +  $\text{Aq}$  or  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ . (Schütte, C. R. 42. 1267.)

**Cuprous sodium thiosulphate cuprous chloride**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3$ ,  $2\text{CuCl}$ .

(Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 86.)

**Cupric sodium thiosulphate cupric sulphide**,  $\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $\text{CuS} + 4\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ ; easily sol. in  $\text{Na}_2\text{S}_2\text{O}_3$  +  $\text{Aq}$ , and  $\text{NH}_4\text{OH}$  +  $\text{Aq}$ ; insol. in alcohol. (Lenz, A. 40. 99.)

$\text{Cu}_2\text{S}_2\text{O}_3$ ,  $\text{Na}_2\text{S}_2\text{O}_3$ ,  $2\text{CuS}$ . Sol. in  $\text{H}_2\text{O}$  or dil.  $\text{HCl}$  +  $\text{Aq}$ . (Kessel, B. 11. 1585.)



**Cuprous sodium thiosulphate sodium chloride**,  $3\text{Cu}_2\text{S}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3, 4\text{NaCl} + 8\text{H}_2\text{O}$ .

Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  (Siewert, Zeit. ges. Naturwiss. **26**. 486.)

Ppt. (Bhaduri, Z. anorg. 1898, **17**. 3.)

**Cupric thiosulphate ammonia**,  $\text{CuS}_2\text{O}_3, 4\text{NH}_3$ .

100 pts.  $\text{H}_2\text{O}$  dissolve 21.79 pts. at  $25^\circ$ . (Pudschies, Dissert.)

**Cuprocupric thiosulphate ammonium chloride**,  $\text{Cu}_2\text{O}, \text{CuO}, 3\text{S}_2\text{O}_3, 2\text{NH}_4\text{Cl}$ .

Sol. in  $\text{HNO}_3 + \text{Aq}$  with separation of S. (v. Hauer, W. A. B. **13**. 447.)

**Glucinum thiosulphate**,  $\text{GlS}_2\text{O}_3 + 11\text{H}_2\text{O}$ .

(Faktor, C. C. **1901**, II. 878.)

**Gold (aurous) hydrogen thiosulphate**,  $\text{Au}_2\text{S}_2\text{O}_3, 3\text{H}_2\text{S}_2\text{O}_3$ .

Known only in solution. (Fordos and Gélis, A. ch. (**3**) **13**. 394.)

**Gold (aurous) sodium thiosulphate**,  $\text{Au}_2\text{S}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; solution decomp. on heating. Insol. in absolute, sl. sol. in dil. alcohol. (Fordos and Gélis.)

$\text{Au}_2\text{S}_2\text{O}_3, 6\text{Na}_2\text{S}_2\text{O}_3 + 10\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (Jochum, C. C. **1885**. 642.)

**Iron (ferrous) thiosulphate**,  $\text{FeS}_2\text{O}_3 + 5\text{H}_2\text{O}$ .

Deliquescent. Very sol. in  $\text{H}_2\text{O}$  or alcohol. (Koene, Pogg. **63**. 241.)

**Iron (ferrous) sodium thiosulphate**,  $\text{FeS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ , and easily decomp. (Vortmann and Padberg, B. **22**. 2641.)

**Lead thiosulphate**,  $\text{PbS}_2\text{O}_3$ .

\* Sol. in 3266 pts.  $\text{H}_2\text{O}$ . Sol. in alkali thiosulphates  $+ \text{Aq.}$  (Rammelsberg, Pogg. **56**. 308.)

**Lead lithium thiosulphate**,  $\text{PbS}_2\text{O}_3, \text{Li}_2\text{S}_2\text{O}_3$ .

Very hygroscopic.

Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{PbS}$ . (J. Meyer, B. **1907**, **40**. 1355.)

**Lead potassium thiosulphate**,  $\text{PbS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  with partial separation of  $\text{PbS}_2\text{O}_3$ . Sol. in  $\text{K}_2\text{S}_2\text{O}_3 + \text{Aq.}$  (Rammelsberg, Pogg. **56**. 310.)

**Lead rubidium thiosulphate**,  $2\text{Rb}_2\text{S}_2\text{O}_3, \text{PbS}_2\text{O}_3 + 2\text{H}_2\text{O}$ .

Difficultly sol. in cold  $\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (J. Meyer, B. **1907**, **40**. 1358.)

**Lead sodium thiosulphate**,  $\text{PbS}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Very easily sol. in  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2$  and  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  (Lenz, A. **40**. 98.)

Insol. in alcohol.

$2\text{PbS}_2\text{O}_3, 5\text{Na}_2\text{S}_2\text{O}_3 + 60\text{H}_2\text{O}$ . Easily decomp. (Jochum, C. C. **1885**. 642.)

$\text{PbS}_2\text{O}_3, 3\text{Na}_2\text{S}_2\text{O}_3 + 12\text{H}_2\text{O}$ . Decomp. in boiling aqueous solution. (Vortmann and Padberg, B. **22**. 2637.)

**Lead strontium thiosulphate**.

Sol. in  $\text{H}_2\text{O}$ . Precipitated as a syrup by alcohol. (Rammelsberg.)

**Lithium thiosulphate**,  $\text{Li}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$  and absolute alcohol. (Fock and Klüss, B. **22**. 3099.)

**Lithium silver thiosulphate**,  $\text{Li}_2\text{S}_2\text{O}_3, \text{Ag}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ .

Hygroscopic.

Decomp. by boiling  $\text{H}_2\text{O}$  and by acids. (Meyer and Eggeling, B. **1907**, **40**. 1355.)

**Magnesium thiosulphate**,  $\text{MgS}_2\text{O}_3 + 6\text{H}_2\text{O}$ .

Very easily sol. in  $\text{H}_2\text{O}$ . Precipitated from conc. solution by alcohol. (Rammelsberg, Pogg. **56**. 303.)

**Magnesium potassium thiosulphate**,  $\text{MgK}_2(\text{S}_2\text{O}_3)_2 + 6\text{H}_2\text{O}$ .

Deliquescent, and sol. in  $\text{H}_2\text{O}$ . Less sol. than  $\text{K}_2\text{S}_2\text{O}_3$ . (Rammelsberg, Pogg. **56**. 304.)

Not deliquescent. (Fock and Klüss, B. **23**. 539.)

**Magnesium rubidium thiosulphate**,  $\text{MgS}_2\text{O}_3, \text{Rb}_2\text{S}_2\text{O}_3 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Meyer, B. **1907**, **40**. 1358.)

**Manganous thiosulphate**,  $\text{MnS}_2\text{O}_3$ .

Sol. in  $\text{H}_2\text{O}$ , from which it is pptd. by alcohol. (Rammelsberg, Pogg. **56**. 305.)

$+ 5\text{H}_2\text{O}$ . Decomp. very easily. (Vortmann and Padberg, B. **322**. 2641.)

**Manganous sodium thiosulphate**,  $\text{MnS}_2\text{O}_3, 2\text{Na}_2\text{S}_2\text{O}_3 + 16\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Insol. or but sl. sol. in alcohol. (Jochum, C. C. **1885**. 642.)

**Mercuric potassium thiosulphate**,  $3\text{HgS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_3$ .

Sol. in 10 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , and  $\frac{1}{2}$  pt. at  $100^\circ$ . Aqueous solution decomp. on standing or heating.

Insol. in alcohol. (Kirchhoff, Scher. J. **2**. 30.)

$\text{HgS}_2\text{O}_3, 3\text{K}_2\text{S}_2\text{O}_3 + 3\text{H}_2\text{O}$ . (Fock and Klüss, B. **24**. 1353.)

$\text{HgS}_2\text{O}_3, 5\text{K}_2\text{S}_2\text{O}_3 + \text{H}_2\text{O}$ . (F. and K.)

**Nickel thiosulphate,  $\text{NiS}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ .**

Permanent. Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, Pogg. 56. 306.)

**Nickel sodium thiosulphate,  $2\text{NiS}_2\text{O}_3 \cdot 5\text{Na}_2\text{S}_2\text{O}_3 \cdot 25\text{H}_2\text{O}$ .**

Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Jochum.)

**Nickel thiosulphate ammonia,  $\text{NiS}_2\text{O}_3 \cdot 4\text{NH}_3 \cdot 6\text{H}_2\text{O}$ .**

Decomp. on air. Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 56. 306.)

$\text{NiS}_2\text{O}_3 \cdot 5\text{NH}_3 \cdot \text{H}_2\text{O}$ . (Ephraim, B. 1913, 46. 3108.)

$\text{NiS}_2\text{O}_3 \cdot 6\text{NH}_3 \cdot 3\text{H}_2\text{O}$ . (Vortmann and Padberg, B. 22. 2641.)

**Platinous sodium thiosulphate.**

See Platothiosulphate, sodium.

**Potassium thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$  and  $2\text{H}_2\text{O}$ .**

Very deliquescent. Very sol. in  $\text{H}_2\text{O}$  with absorption of heat. Solution is stable on the air. Insol. in alcohol.

100 pts.  $\text{H}_2\text{O}$  dissolve pts.  $\text{K}_2\text{S}_2\text{O}_3$  at  $t^\circ$ .

$t^\circ$	Pts. $\text{K}_2\text{S}_2\text{O}_3$	Solid phase
0	96.1	$\text{K}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$
17	150.5	$3\text{K}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$
20	155.4	"
25	165.0	"
30	175.7	"
35	202.4	$3\text{K}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O} + \text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
40	204.7	$\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
45	208.7	"
50	215.2	"
55	227.7	"
60	238.3	"
56.1	234.5	$\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O} + 3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
65	245.8	$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$
70	255.2	"
75	268.0	"
78.3	292.0	$3\text{K}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O} + \text{K}_2\text{S}_2\text{O}_3$
80	293.1	$\text{K}_2\text{S}_2\text{O}_3$
85	298.5	"
90	312.0	"

(Inohiko Io, Mem. Coll. Sc. Kyoto, 1911, 3. 212.)

Sol. in dil.  $\text{HCl}$ ,  $\text{H}_2\text{O}_2 + \text{Aq}$  without decomp. (Mathieu-Plessy, C. R. 101. 59.)

Insol. in ethyl acetate. (Casaseca, C. R. 30. 821.)

**Potassium silver thiosulphate,  $2\text{K}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3$ .**

Sol. in  $\text{H}_2\text{O}$ . (Cohen.)

$\text{K}_2\text{S}_2\text{O}_3$ ,  $\text{Ag}_2\text{S}_2\text{O}_3$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Herschel.)

$3\text{K}_2\text{S}_2\text{O}_3$ ,  $\text{Ag}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . Rather sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim and Steinhäuser, Z. anorg. 1900, 25. 76.)

Sl. sol. in  $\text{H}_2\text{O}$ . (Rosenheim.)

**Potassium silver thiosulphate ammonia,  $\text{KAgS}_2\text{O}_3 \cdot 2\text{NH}_3$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in hot  $\text{NH}_4\text{OH} + \text{Aq}$ . (Schwicker, B. 22. 1735.)

$5\text{K}_2\text{S}_2\text{O}_3$ ,  $3\text{Ag}_2\text{S}_2\text{O}_3$ ,  $\text{NH}_3$ . Difficultly sol. in  $\text{H}_2\text{O}$  with decomp.

Sol. in hot  $\text{NH}_4\text{OH} + \text{Aq}$  with partial decomp. (J. Meyer, B. 1907, 40. 1359.)

**Potassium sodium thiosulphate.**

(a)  $\text{KNaS}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 213.7 pts. salt at  $15^\circ$ . (Schwicker, B. 22. 1733.)

(b)  $\text{NaKS}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 205.3 pts. salt at  $15^\circ$ . (Schwicker.)

**Potassium strontium thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{SrS}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Fock and Küss, B. 24. 3017.)

**Potassium zinc thiosulphate,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{ZnS}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim and Davidsohn, Z. anorg. 1904, 41. 238.)

**Potassium thiosulphate sodium chloride,  $\text{K}_2\text{S}_2\text{O}_3 \cdot \text{NaCl}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Pape, Pogg. 139. 238.)

**Rubidium thiosulphate,  $\text{Rb}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ .**

• Very hygroscopic; easily sol. in  $\text{H}_2\text{O}$ . (J. Meyer, B. 1907, 40. 1356.)

**Rubidium silver thiosulphate,  $2\text{Rb}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ .**

Ppt. Not hygroscopic. Difficultly sol. in cold  $\text{H}_2\text{O}$ . Decomp. by warm  $\text{H}_2\text{O}$ . (J. Meyer.)

**Rubidium silver thiosulphate ammonia,  $\text{Rb}_2\text{S}_2\text{O}_3 \cdot \text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{NH}_3$ .**

Ppt. (J. Meyer.)  
 $3\text{Rb}_2\text{S}_2\text{O}_3$ ,  $4\text{Ag}_2\text{S}_2\text{O}_3$ ,  $\text{NH}_3$ . Ppt. Decomp. in the air. (J. Meyer.)

**Samarium thiosulphate.**

(Cleve.)

**Scandium thiosulphate, basic,  $\text{Sc}(\text{OH})\text{S}_2\text{O}_3$ .**

Ppt. (R. J. Meyer, Z. anorg. 1914, 86. 282.)

**Silver thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$  or alkali thiosulphates +  $\text{Aq}$ . (Herschel, Edinb. Phil. J. 1. 26.)

**Silver sodium thiosulphate,  $\text{Ag}_2\text{S}_2\text{O}_3 \cdot \text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ , also in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq}$  to form—  
 $\text{Ag}_2\text{S}_2\text{O}_3$ ,  $2\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ . (Easily sol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4\text{OH} + \text{Aq}$ ; somewhat sol. in al-

cohol, especially if warm or dilute. (Lens, A. 40. 94.)

$\text{Ag}_2\text{S}_2\text{O}_3, 6\text{Na}_2\text{S}_2\text{O}_3 + 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Jochum, C. C. 1885. 642.)

**Silver sodium thiosulphate acetylde acetylene**,  $2\text{Na}_2\text{S}_2\text{O}_3, 7\text{Ag}_2\text{S}_2\text{O}_3, 18\text{Ag}_2\text{C}_2, 32\text{C}_2\text{H}_2$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Insol. in alkalis. (Bhaduri, Z. anorg. 1913, 79. 356.)

$7\text{Na}_2\text{S}_2\text{O}_3, 5\text{Ag}_2\text{S}_2\text{O}_3, 86\text{Ag}_2\text{C}_2, 13\text{C}_2\text{H}_2$ . (Bhaduri.)

**Silver sodium thiosulphate ammonia**,  $\text{NaAgS}_2\text{O}_3, \text{NH}_3$ .

Very unstable. (Schwicker, B. 22. 1736.)

**Silver strontium thiosulphate**,  $\text{Ag}_2\text{S}_2\text{O}_3, \text{SrS}_2\text{O}_3$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{SrS}_2\text{O}_3 + \text{Aq}$ ; easily sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Herschel.)

**Sodium thiosulphate**,  $\text{Na}_2\text{S}_2\text{O}_3$ , and +1, 2 and  $5\text{H}_2\text{O}$ .

100 pts.  $\text{H}_2\text{O}$  dissolve:

At  $16^\circ$ , 65 pts.  $\text{Na}_2\text{S}_2\text{O}_3$ .

"  $20^\circ$ , 69 " "

"  $25^\circ$ , 75 " "

"  $30^\circ$ , 82 " "

"  $35^\circ$ , 89 " "

"  $40^\circ$ , 98 " "

"  $45^\circ$ , 109 " "

"  $47^\circ$ , 114 " "

(Mulder.)

100 pts.  $\text{H}_2\text{O}$  dissolve at  $0^\circ$  47.6 pts.  $\text{Na}_2\text{S}_2\text{O}_3$ ; at  $20^\circ$ , 69.5 pts.; at  $40^\circ$ , 104 pts.; at  $60^\circ$ , 192.3 pts. (Kremers, Pogg. 99. 50.)

100 pts.  $\text{H}_2\text{O}$  dissolve 171 pts. cryst. (=108.9 pts. anhydrous) salt at  $19.5^\circ$  to form a solution of 1.3875 sp. gr. (Schiff, A. 113. 350.)

By supersaturation 100 pts.  $\text{H}_2\text{O}$  may dissolve 217.4 pts.  $\text{Na}_2\text{S}_2\text{O}_3$  at  $0^\circ$ . (Kremers.)

Solubility in  $\text{H}_2\text{O}$ .

$t^\circ$	% $\text{Na}_2\text{S}_2\text{O}_3$	Solid phase
0	34.43	$\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$
10	37.89	"
20	41.17	"
30	45.86	"
40	50.65	"
45	54.49	"
50	62.92	$\text{Na}_2\text{S}_2\text{O}_3 + 2\text{H}_2\text{O}$
60	67.39	"
72	70.39	"
80.5	71.33	"
90.5	71.76	"
100	72.68	"

(Taylor, Proc. Edinburgh Soc. 1898, 22. 49.)

Solubility of anhydrous  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.	
	Solution	H O
40	67.40	206.70
45	67.60	208.60
50	67.76	210.20
55	68.15	214.00
60	68.48	217.30
65	68.80	220.50
70	69.05	223.10
75	69.35	226.30
80	69.80	231.80

(Young and Burke, J. Am. Chem. Soc. 1906, 28. 327.)

The solubility of the hydrates of  $\text{Na}_2\text{S}_2\text{O}_3$  are exceedingly complicated. There are five groups of hydrates, (I) primary, (II) secondary, (III) tertiary, (IV) quaternary, and (V), quintary, and transitions occur between members of the same and different groups.  $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O}$  (I) is the commercial thiosulphate. The relations and solubility of the various hydrates is shown in the following table.

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .

I. Primary hydrates.

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.		Solid phase
	Solution	$\text{H}_2\text{O}$	
0	33.40	50.15	$\text{Na}_2\text{S}_2\text{O}_3, 5\text{H}_2\text{O}$ (I)
5	35.33	54.64	"
10	37.37	59.69	"
15	39.11	64.22	"
20	41.20	70.07	"
25	43.15	75.90	"
30	45.19	82.45	"
35	47.71	91.24	"
40	50.83	105.37	"
45	55.33	123.87	"
48.17	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3, 2\text{H}_2\text{O}$ (I)
0	52.73	111.60	$\text{Na}_2\text{S}_2\text{O}_3, 2\text{H}_2\text{O}$ (I)
5	53.45	114.90	"
10	53.94	117.10	"
20	55.15	122.68	"
25	56.03	127.43	"
30	57.13	133.27	"
40	59.38	146.20	"
45	60.73	154.70	"
50	62.28	165.11	"
55	63.85	176.60	"
60	65.68	191.30	"
65	68.04	212.90	"
66.5	...	...	" + $\text{Na}_2\text{S}_2\text{O}_3$

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .—  
*Continued.*

## II. Secondary hydrates.

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
0	41.96	72.30	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}(\text{II})$
5	43.56	77.17	"
10	45.25	82.65	"
15	47.27	89.36	"
20	49.38	97.55	"
25	52.15	108.98	"
30	56.57	130.26	"
30.22	...	....	" $\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}(\text{II})$
33.5	58.59	141.48	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 4\text{H}_2\text{O}(\text{II})$
36.2	60.51	153.23	"
38.6	62.80	168.82	"
40.65	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3, \text{H}_2\text{O}(\text{II})$

0	60.47	153.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{II})$
5	60.74	154.70	"
10	61.04	156.70	"
15	61.57	160.20	"
20	62.11	163.90	"
25	62.73	168.30	"
30	63.56	174.40	"
35	64.32	180.20	"
40	65.22	187.60	"
45	66.02	194.30	"
50	66.82	201.40	"
55	67.90	211.50	"
56.5	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3$

## III. Tertiary hydrates.

0	46.14	85.67	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 6\text{H}_2\text{O}$ (III and IV)
5	48.44	93.95	"
10	51.66	106.80	"
13	54.96	122.00	"
14.35	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{IV})$
14.3	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{III})$

0	57.42	134.80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{3}{2}\text{H}_2\text{O}(\text{III})$
5	57.84	137.20	"
10	58.28	139.70	"
15	58.80	142.70	"
20	59.28	145.60	"
25	60.18	151.10	"
30	60.78	155.00	"
35	61.57	160.20	"
40	62.60	167.40	"
45	63.97	177.50	"
47.5	64.68	183.00	"
48.5	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3, \text{H}_2\text{O}(\text{III})$

47.5	64.78	183.90	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{III})$
50	65.30	188.20	"
52.5	65.89	193.20	"
55	66.45	198.10	"
60	68.07	213.10	"
61	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3$

Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  in  $\text{H}_2\text{O}$  at  $t^\circ$ .—  
*Continued.*

## IV. Quaternary hydrate.

$t^\circ$	g. $\text{Na}_2\text{S}_2\text{O}_3$ per 100 g.		Solid phase
	Solu- tion	$\text{H}_2\text{O}$	
0	57.63	136.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{IV})$
5	58.06	138.60	"
10	58.49	140.90	"
15	59.00	143.90	"
20	59.57	147.30	"
25	50.35	152.30	"
30	61.03	156.60	"
35	61.94	162.80	"
40	62.95	169.90	"
45	64.22	179.50	"
50	65.45	189.50	"
55	67.07	203.70	"
58	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3$

## V. Quintary hydrates.

0	57.63	136.00	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 2\text{H}_2\text{O}(\text{V})$
5	58.23	139.40	"
10	59.05	144.20	"
15	60.02	150.10	"
20	61.02	156.50	"
25	62.30	165.30	"
30	63.56	174.40	"
35	65.27	188.00	"
27.5	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3, \text{H}_2\text{O}(\text{V})$

30	63.34	172.80	$\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{H}_2\text{O}(\text{V})$
35	64.07	178.40	"
40	64.75	183.70	"
45	65.58	190.50	"
50	66.58	199.20	"
55	67.59	208.50	"
43	...	....	" $+\text{Na}_2\text{S}_2\text{O}_3 \cdot \frac{1}{2}\text{H}_2\text{O}(\text{V})$

(Young and Burke, J. Am. Chem. Soc. 1906, 28, 321.)

Heat is absorbed by dissolving in  $\text{H}_2\text{O}$ . 110 pts.  $\text{Na}_2\text{S}_2\text{O}_3 + 5\text{H}_2\text{O} + 100$  pts.  $\text{H}_2\text{O}$  lower temp. from  $10.7^\circ$  to  $8^\circ$ . (Rüdorff, B. 2, 68.)

$+\frac{1}{2}\text{H}_2\text{O}$ . (Young and Burke, J. Am. Chem. Soc. 1906, 28, 321.)

$+\text{H}_2\text{O}$ .

$+\frac{1}{2}\text{H}_2\text{O}$ . (Young and Burke.)

$+\frac{1}{2}\text{H}_2\text{O}$ . (Young and Burke.)

+2H<sub>2</sub>O.  
+4H<sub>2</sub>O. M.-pt. 41.60°. (Young and Burke.)

+5H<sub>2</sub>O. M.-pt. 45° (Kopp); 48° (Kremers), 50° (Mulder); 48.5° (Tilden, Chem. Soc. 45. 409); 47.9° (Taylor, Proc. Edinburgh, Soc. 1898, 22. 249); 48.09° (Richards and Churchill, Z. phys. Ch. 1899, 28. 314); 48.45° (Young and Burke, J. Am. Chem. Soc. 1906, 28. 324.)

Labile modification melts at 32°. (Parnettier and Amat, C. R. 98. 735.)

Sp. gr. of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq at 19°.

% = %Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 5H<sub>2</sub>O.

%	Sp. gr.	%	Sp. gr.	%	Sp. gr.
1	1.0052	18	1.0975	35	1.1986
2	1.0105	19	1.1031	36	1.2048
3	1.0158	20	1.1087	37	1.2110
4	1.0211	21	1.1145	38	1.2172
5	1.0264	22	1.1204	39	1.2234
6	1.0317	23	1.1263	40	1.2297
7	1.0370	24	1.1322	41	1.2362
8	1.0423	25	1.1381	42	1.2427
9	1.0476	26	1.1440	43	1.2492
10	1.0529	27	1.1499	44	1.2558
11	1.0584	28	1.1558	45	1.2624
12	1.0639	29	1.1617	46	1.2690
13	1.0695	30	1.1676	47	1.2756
14	1.0751	31	1.1738	48	1.2822
15	1.0807	32	1.1800	49	1.2888
16	1.0863	33	1.1862	50	1.2954
17	1.0919	34	1.1924	..	...

(Schiff, A. 113. 118.)

B.-pt. of Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq. P = pts. Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> to 100 pts. H<sub>2</sub>O.

B.-pt.	P	B.-pt.	P	B.-pt.	P
101°	14	110°	104	119°	201
102	27	111	113	120	214.5
103	39	112	122	121	229
104	49.5	113	131.5	122	244
105	59	114	141.5	123	262
106	68	115	152	124	283
107	77	116	164	125	311
108	86	117	175.75	126	348
109	95	118	188	...	...

(Gerlach, Z. anal. 26. 436.)

Moderately sol. in liquid NH<sub>3</sub>. (Franklin, Am. Ch. J. 1898, 20. 829.)

100 pts. absolute ethyl alcohol dissolve at room temperature 2.5 mg. Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>. (Böttker, Z. phys. Ch. 1897, 22. 410.)

100 pts. absolute ethyl alcohol dissolve at room temperature 3.4 mg. Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 5H<sub>2</sub>O. (Böttker, Z. phys. Ch. 1897, 22. 510.)

Sol. in oil of turpentine (Edison, Am. Chemist, 7. 127). Insol. therein (Techn. J. B. 27. 1003).

Insol. in ethyl acetate. (Casaseca, C. R. 30. 821.)

**Sodium thalious thiosulphate**, 3Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, 2Tl<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 10H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Werther.)

+8H<sub>2</sub>O. (Jochum.)

2Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, Tl<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + 8H<sub>2</sub>O. (Vortmann and Padberg, B. 22. 2638.)

**Sodium zinc thiosulphate**, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, 2ZnS<sub>2</sub>O<sub>3</sub>, + 23H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Jochum, C. C. 1835. 642.)

3Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, 2ZnS<sub>2</sub>O<sub>3</sub> + 10H<sub>2</sub>O. Deliquescent. (Vortmann and Padberg, B. 22. 2640.)

**Sodium thiosulphate mercuric iodide**, 2Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, HgI<sub>2</sub>.

Decomp. by H<sub>2</sub>O and by alcohol. (Eder and Ulm, M. 1882, 3. 197.)

**Strontium thiosulphate**, SrS<sub>2</sub>O<sub>3</sub> + 5H<sub>2</sub>O.

Permanent. Sol. in 6 pts. cold H<sub>2</sub>O (Gay-Lussac); in 4 pts. H<sub>2</sub>O at 13°, and 1.75 pts. boiling H<sub>2</sub>O (Herschel, 1819).

1 g. is sol. in 3.7 cc. H<sub>2</sub>O at room temp. (Antenrieth, Z. anal. 1898, 37. 293.)

Gradually efflorescent. Insol. in alcohol. (Herschel.)

**Thalious thiosulphate**.

Ppt. Sl. sol. in cold, easily sol. in hot H<sub>2</sub>O. (Crookes.)

Easily sol. in Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> + Aq. (Jochum.)

**Tin thiosulphate (?)**.

Sol. in H<sub>2</sub>O.

**Uranyl thiosulphate**, (UO<sub>2</sub>)S<sub>2</sub>O<sub>3</sub>.

Ppt. (Faktor, C. C. 1901, II. 878.)

**Zinc thiosulphate**, ZnS<sub>2</sub>O<sub>3</sub> + xH<sub>2</sub>O.

Very deliquescent, and very sol. in H<sub>2</sub>O and alcohol. (Rammelsberg.)

**Zinc thiosulphate ammonia**, ZnS<sub>2</sub>O<sub>3</sub>, 2NH<sub>3</sub>.

Decomp. by H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH + Aq, from which it is pptd. by alcohol. (Rammelsberg, Pogg. 56. 62.)

**Thio/rithiazyl bromide**, N<sub>2</sub>S<sub>4</sub>Br.

Decomp. H<sub>2</sub>O and alkalis.

Stable in the air. (Muthmann, B. 1897, 30. 630.)

**Thiodithiazyl dichloride**, S<sub>2</sub>N<sub>2</sub>Cl<sub>2</sub>.

See Nitrogen sulphochloride.

**Thio/rithiazyl chloride**, S<sub>2</sub>N<sub>2</sub>Cl.

See Nitrogen sulphochloride.

**Thio/rithiazyl iodide**, N<sub>2</sub>S<sub>4</sub>I.

Decomp. spontaneously in the air. Very unstable. (Muthmann, B. 1897, 30. 631.)

**Thio-trithiazyl nitrate,  $S_4N_4NO_3$ .**

Sol. in  $H_2O$  with decomp. Sol. in  $HNO_3$  + Aq. (Demarçay, C. R. 91. 1066.)

Sol. in cold  $H_2O$  with decomp.

Completely insol. in organic solvents, as  $CS_2$ ,  $CHCl_3$ , acetone, and acetic ether. (Muthmann and Seitter, B. 1897, 30. 629.)

**Thio-trithiazyl sulphate  $(S_4N_4)HSO_4$ .**

Stable on air. Sol. in  $H_2O$  with decomp. (Demarçay, C. R. 91. 854. 1066.)

**Thio-trithiazyl sulphocyanide,  $N_4S_4CNS$ .**

Stable in the air.

Sol. in benzene and chloroform. (Muthmann and Seitter, B. 1897, 30. 631.)

**Dithiotetrathiazyl dichloride,  $S_4N_4Cl_2$ .**

See Nitrogen sulphochloride.

**Thorium, Th.**

Not oxidised by boiling  $H_2O$ .

Quickly sol. (Chydenius, Pogg. 119. 43), very slowly sol. by long boiling (Berzelius, Pogg. 16. 385) in  $HNO_3$  + Aq. Insol. in cold, easily sol. in warm dil.  $H_2SO_4$  + Aq. Slowly sol. in cold, rapidly in hot  $HCl$  + Aq. Easily oxidised by aqua regia. Insol. in  $KOH$  + Aq or  $HF$  + Aq.

Sl. sol. in dil.  $H_2SO_4$  + Aq; decomp. by conc.  $H_2SO_4$ . Very sl. sol. in dil., and less in conc.  $HNO_3$  + Aq. Easily sol. in conc.  $HCl$  + Aq, and aqua regia. (Nilson, B. 15. 2521.)

**Thorium B.**

Somewhat sol. in hot  $H_2O$ , which dissolves 70% in an hour. More rapidly sol. in dil. acids or hot  $KI$  + Aq. Somewhat sol. in organic solvents. Insol. in  $CS_2$  and in methylene iodide. (Hogley, Phil. Mag. 1913, (6) 25. 331.)

**Thorium C.**

Somewhat sol. in hot  $H_2O$ . More rapidly sol. in hot  $KI$  + Aq. and in dil. acids. More sol. in organic solvents than thorium B. 20% sol. in  $CS_2$  or methylene iodide in 10 minutes. (Hogley, Phil. Mag. 1913, (6) 25. 331.)

**Thorium tetraboride,  $ThB_4$ .**

Sol. in cold conc.  $HNO_3$  and  $HCl$  and in hot conc.  $H_2SO_4$ . (Jassonneix, C. R. 1905, 141. 192.)

**Thorium hexaboride,  $ThB_6$ .**

Sol. in hot dil. or conc.  $HNO_3$ ; insol. in  $H_2SO_4$ ,  $HCl$ ,  $HF$  and aq. alkalies. (Jassonneix, C. R. 1905, 141. 193.)

**Thorium dibromide,  $ThBr_2$ .**

Sol. in  $H_2O$  with partial decomp. (Troost and Ouvrard, A. ch. (6) 17. 227.)

**Thorium tetrabromide,  $ThBr_4$ .**

Sol. in  $H_2O$ . (Berzelius.)

Very hygroscopic, and sol. in  $H_2O$  with partial decomp. (Troost and Ouvrard, A. ch. (6) 17. 229.)

Sl. sol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)

+7 $H_2O$ . Sol. in alcohol. (Rosenheim, B. 1900, 33. 979.)

+8 $H_2O$ . Very sol. in alcohol and  $H_2O$ . Insol. in chloroform and light petroleum. (Lesinsky, Z. anorg. 1897, 15. 82.)

**Thorium tetrabromide ammonia,  $ThBr_4 \cdot 3NH_3$ .**

Insol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)

**Thorium carbide,  $ThC_2$ .**

Almost insol. in conc. acids; decomp. by  $H_2O$  and by dil. acids. (Moissan, C. R. 1896, 122. 577.)

**Thorium tetrachloride,  $ThCl_4$ .**

Anhydrous. Extremely deliquescent, and sol. in  $H_2O$  with evolution of heat. Sol. in alcohol.

Sol. in ether. (Matthews, J. Am. Chem. Soc. 1898, 20. 824.)

+7 $H_2O$ . Deliquesces in the air. Very sol. in  $H_2O$  and alcohol. Insol. in ether. (Krüss, Z. anorg. 1897, 14. 368.)

+8 $H_2O$ . Hygroscopic. Easily sol. in  $H_2O$  and absolute alcohol. Not pptd. from solution in alcohol by ether.

+9 $H_2O$ . As above. (Rosenheim, Z. anorg. 1903, 35. 426.)

**Thorium tetrachloride ammonia,  $ThCl_4 \cdot 6NH_3$ .**

Insol. in ether. Decomp. by  $H_2O$ .

$ThCl_4 \cdot 8NH_3$ . Fumes in moist air. Decomp. by  $H_2O$ . (Matthews, J. Am. Chem. Soc. 1898, 20. 824.)

The compds. of  $ThCl_4$  with  $NH_3$  are of the type  $ThCl_4 \cdot nNH_3$  and may be classified into three groups.

(1)  $n = 4, 6, 7, 12, 18$ . Compds. are decomp. by  $H_2O$ .

(2)  $n = 4, 6, 7$ . Compds. are not decomp. by  $H_2O$ .

(3)  $n = 6, 7, 12, 18$ . The first two compds. of this series are identical with the last two of group (2).

$ThCl_4 \cdot 4NH_3$  of group (2) is the only one in the whole series stable above 120°. (Chauvenet, C. R. 1910, 151. 387.)

**Thorium fluoride,  $ThF_4 \cdot 4H_2O$ .**

Insol. in  $H_2O$  or  $HF$  + Aq.

**Thorium hydride,  $ThH_3$ .**

Decomp. by dil.  $HCl$  + Aq. (Winkler, B. 24. 873.)

**Thorium hydroxide,  $\text{Th}(\text{OH})_4$ .**

Insol. in  $\text{H}_2\text{O}$ .

Sol. in acids, except oxalic, molybdic, and hydrofluoric acids.

Insol. in alkali hydroxides, but easily sol. in alkali carbonates + Aq. More sol. in  $\text{NH}_4\text{OH} + (\text{NH}_4)_2\text{CO}_3$  + Aq than in  $(\text{NH}_4)_2\text{CO}_3$  + Aq. alone. (Berzelius.) Not pptd. in presence of tartaric and citric acids. (Chydenius, Pogg. 119. 43.)

$4\text{ThO}_2, \text{H}_2\text{O}$ . Insol. in water and acids at boiling temp.

**Thorium hydroxybromide,  $\text{Th}(\text{OH})_2\text{Br}_2 + 11\text{H}_2\text{O}$ .**

Sol. in alcohol. (Rosenheim, B. 1900, 33. 979.)

**Thorium hydroxychloride,  $(\text{OH})\text{ThCl}_2 + 11\text{H}_2\text{O}$ .**

Sol. in alcohol. (Rosenheim, B. 1900, 33. 978.)

$\text{Th}(\text{OH})_2\text{Cl}_2 + 5\text{H}_2\text{O}$ . Slowly takes up  $\text{H}_2\text{O}$  from the air.

Sol. in  $\text{H}_2\text{O}$  without decomp.

Sol. in alcohol. Pptd. from solution in alcohol by ether. (Rosenheim, Z. anorg. 1903, 35. 425.)

+  $8\text{H}_2\text{O}$ . Hygroscopic; sol. in alcohol. (Rosenheim, B. 1900, 33. 978.)

**Thorium hydroxyiodide,  $\text{Th}(\text{OH})\text{I}_3 + 10\text{H}_2\text{O}$ .**

Evolves iodine in the light. (Rosenheim, Z. anorg. 1903, 35. 430.)

**Thorium iodide.**

Sol. in  $\text{H}_2\text{O}$ .

**Thorium nitride,  $\text{Th}_3\text{N}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Matignon, C. R. 1901, 133. 37.)

**Thorium oxide,  $\text{ThO}_2$ .**

When ignited is insol. in  $\text{HCl}$ , and  $\text{HNO}_3$  + Aq. Sol. in  $\text{H}_2\text{SO}_4$  by heating to boiling and subsequent addition of  $\text{H}_2\text{O}$ . Insol. in alkali hydrates or carbonates + Aq.

**Thorium metoxide,  $\text{Th}_2\text{O}_3 + \text{H}_2\text{O}$ .**

Sl. sol. in  $\text{HCl}$ . (Locke, Z. anorg. 1894, 7. 348.)

+  $2\text{H}_2\text{O}$ . Loses 1  $\text{H}_2\text{O}$  at  $100^\circ$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in  $\text{NH}_4\text{OH}$  + Aq. (Locke.)

**Metathorium oxide.**

Sol. in  $\text{H}_2\text{O}$  after having been treated with conc.  $\text{HNO}_3$  or  $\text{HCl}$  + Aq, even if previously ignited.

$\text{ThO}_2, x\text{Th}(\text{OH})_4$ . Compare  $\text{Th}_2\text{O}_3$ . (Locke) (Stevens, Z. anorg. 1901, 27. 42.)

**Thorium peroxide,  $\text{Th}_2\text{O}_7$ .**

Precipitate. (Cleve, C. R. 100. 605.)

**Thorium oxychloride.**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{ThCl}_4$  and  $\text{ThO}_2$ .  $\text{ThOCl}_2$ . Sol. in  $\text{H}_2\text{O}$ .

Insol. in abs. alcohol. (Matignon, A. ch. 1907, (8) 10. 133.)

+  $3\text{H}_2\text{O}$ .

+  $5\text{H}_2\text{O}$ . (Matignon, A. ch. 1907, (8) 10. 135.)

**Metathorium oxychloride,  $\text{ThO}_2, x\text{ThCl}_4$ .**

Hygroscopic; sol. in  $\text{H}_2\text{O}$ ; insol. in abs. alcohol. (Stevens, Z. anorg. 1901, 27. 47.)

**Thorium oxyfluoride,  $\text{ThOF}_2$ .**

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{SO}_4$  with decomp. (Chauvenet, C. R. 1908, 146. 974.)

**Thorium oxysulphide,  $\text{ThS}_2, 2\text{ThO}_2$ .**

(Chydenius.)

**Thorium phosphide.**

Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Thorium silicide,  $\text{ThSi}_2$ .**

Sol. in aq. min. acids; insol. in aq. alkalis. Decomp. by fusion with  $\text{NaOH}$  or  $\text{KOH}$ . (Hönigschmid, C. R. 1906, 142. 158.)

**Thorium sulphide,  $\text{ThS}_2$ .**

Insol. in warm  $\text{H}_2\text{SO}_4$ . Very slightly attacked by  $\text{HNO}_3$  or  $\text{HCl}$  + Aq. Sol. in hot aqua regia. (Berzelius.)

**Thoromolybdic acid.****Ammonium thoromolybdate,**

$(\text{NH}_4)_2\text{Th}(\text{Mo}_2\text{O}_7)_2 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri, C. A. 1913. 372.)

$(\text{NH}_4)_2\text{H}_2\text{Th}(\text{Mo}_2\text{O}_7)_2 + 11\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri.)

**Silver thoromolybdate,  $\text{Ag}_2\text{Th}(\text{Mo}_2\text{O}_7)_2$ .**

Insol. in  $\text{H}_2\text{O}$ ; sl. sol. in  $\text{HNO}_3$  + Aq, but nearly insol. in presence of  $\text{AgNO}_3$ . (Barbieri.)

**Sodium thoromolybdate,  $\text{Na}_2\text{Th}(\text{Mo}_2\text{O}_7)_2 + 15\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri.)  $\text{Na}_2\text{H}_2\text{Th}(\text{Mo}_2\text{O}_7)_2 + 17\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Barbieri.)

**Thulium,  $\text{Tm}$ .****Thulium chloride,  $\text{Tm}_2\text{Cl}_3 + 14\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$  and in alcohol. (James, J. Am. Chem. Soc. 1911, 33. 1342.)

**Thulium hydroxide.**

Easily sol. in dil. acids. (James, J. Am. Chem. Soc. 1911, 33. 1342.)

**Thulium oxide,  $Tm_2O_3$ .**

Slowly sol. in hot conc. acids. (James, J. Am. Chem. Soc. 1911, **33**, 1342.)

**Tin, Sn.**

Insol. in  $H_2O$ . Tin is not attacked by distilled  $H_2O$  when air is passed through it for a week.

Slowly sol. in dil. cold  $HCl + Aq$ , but rapidly sol. if hot and conc. Slowly sol. in hot dil.  $H_2SO_4 + Aq$ , but decomp. by hot conc.  $H_2SO_4$ .

Readily sol. in cold aqua regia. Attacked violently by conc.  $HNO_3 + Aq$  with pptn. of  $SnO_2$ . Completely sol. in dil. cold  $HNO_3 + Aq$  (1 pt.  $HNO_3$ : 1 pt.  $H_2O$ ) at  $22^\circ$ . (Hay, C. N. **22**, 298.) Not attacked by pure conc.  $HNO_3 + Aq$  of 1.512-1.419 sp. gr., but violently attacked by less conc. acid. Also attacked by most conc. acid if it contains  $NO_2$ . (Millon, A. ch. (3) **6**, 95.)

If Sn is placed in dil.  $HNO_3 + Aq$  of 1.15 sp. gr. it is al. dissolved, but soon pptd. again as  $SnO_2$ . If a small amt. of  $NH_4Cl$  is added, the Sn remains permanently in solution;  $HCl + Aq$  has a similar action. (Ordway, Am. J. Sci. (2) **23**, 220.) Easily sol. in the cold in mixture of 1 vol.  $H_2SO_4$ , 2 vols.  $HNO_3$ , and 3 vols.  $H_2O$ . (Basset, C. N. **53**, 172.)

$HNO_3 + Aq$  containing less than 12%  $HNO_3$  attacks Sn and forms a stannous salt, which decomposes, giving a turbid solution.  $HNO_3 + Aq$  (12-45%  $HNO_3$ ) completely dissolves Sn, but solution becomes turbid on standing.  $HNO_3 + Aq$  containing more than 45%  $HNO_3$  does not dissolve Sn, but forms a white substance, which is sol. in  $H_2O$  if over 70% acid is used; this solution soon becomes turbid. (Montemartini, Gazz. ch. it. **22**, 384.)

Sn dissolves in  $HNO_3 + Aq$  at low temps. ( $0-21^\circ$ ). When very dil.  $HNO_3 + Aq$  (14%  $HNO_3$ ) is used, the amount of stannous salt formed decreases only slightly with increase of temp. while with 30-40% acid it falls to zero at  $21^\circ$ . (Walker, J. Soc. Chem. Ind. **1893**, 845.)

In presence of Fe, Cr or Al,  $HNO_3 + Aq$  acts on Sn to form soluble products, from which conc.  $HNO_3$  ppts. all Sn as metastannic acid. (van Leent, C. C. **1899**, I, 101.)

Much more sol. in acids when small quantities of metallic salts have been added. This is most noticeable when  $PtCl_4$  or tartar emetic is added to  $HCl + Aq$ .  $HCl + Aq$  with tartar emetic exerts 11 times, and with  $PtCl_4$  13 times the action exhibited by pure acid. (Millon, C. R. **21**, 47.)

Sol. in  $2N HClO_4 + Aq$ . (Hendrixson, J. Am. Chem. Soc. 1904, **26**, 755.)

Pyrosulphuric acid dissolves Sn on warming. (Divers, Chem. Soc. 1885, **47**, 639.)

Hot telluric acid attacks Sn. (Hutchins, J. Am. Chem. Soc. 1905, **27**, 1183.)

Sn is attacked by 17%  $HN_3 + Aq$ . (Cur-tius and Rissom, J. pr. **1898**, (2) **58**, 299.)

Sol. in a solution of Na in liquid  $NH_3$ .

(Kraus, J. Am. Chem. Soc. 1907, **29**, 1562.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. **1898**, **20**, 830.)

Sol. in boiling alum +  $Aq$  (1 pt. alum to 4 pts.  $H_2O$ ).

Sol. in  $KHSO_4$ ,  $NH_4Cl$  (1:4), and  $K_2C_2H_3O_6 + Aq$ . Sl. sol. in  $KC_2H_3O_6 + Aq$ , but not attacked by  $MgSO_4$ ,  $K_2SO_4$ ,  $KNO_3$ , or  $Na_2SO_4 + Aq$ . (Cludius, J. pr. **9**, 161.)

Sol. in alkalis +  $Aq$ .

Attacked easily by conc.  $NaCl$ ,  $KCl$ , or  $NH_4NO_3 + Aq$ ; not attacked by  $NH_4Cl + Aq$ . (Hallock, Am. Ch. J. **6**, 52.)

Sol. in  $Fe(NO_3)_3 + Aq$  in presence of  $HNO_3$ , +  $Aq$  in proportion of 1 atom Sn to 1 atom Fe. (Lopez and Storch, W. A. B. **98**, 2b, 268.)

Solubility in dil. saline solutions.

100 ccm.  $H_2O$  containing 0.5 g.  $NaCl$  or  $KCl$  dissolve 6 mg. Sn from 11.8 sq. cm. in one week when air without  $CO_2$  is passed through the solution, but none at all when the air contains  $CO_2$ .

100 ccm.  $H_2O$  containing 1 g.  $NH_4Cl$  dissolve 5 mg. Sn under above conditions without  $CO_2$ , and none with  $CO_2$ .

With 1 g.  $MgCl_2$ , 1 mg. Sn was dissolved without  $CO_2$ , and none with  $CO_2$ .

With 1 g.  $K_2SO_4$ , 2 mg. Sn were dissolved without  $CO_2$ , and none with  $CO_2$ .

With 1 g.  $KNO_3$ , 3 mg. Sn were dissolved without  $CO_2$ , and 1 mg. with  $CO_2$ .

With 1 g.  $Na_2CO_3$ , 7 mg. Sn were dissolved without  $CO_2$ .

With 1 g.  $NaOH$ , 220 mg. Sn were dissolved without  $CO_2$ .

$CaO, H_2 + Aq$  did not dissolve. (Wagner, Dingl. **221**, 260.)

Not attacked by sugar +  $Aq$ . (Klein, C. R. **102**, 1170.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0134 g. Sn in 6 days. (Gates, J. phys. Chem. 1911, **15**, 143.)

**Tin antimonide,  $SnSb$ .**

(Stead, J. Soc. Chem. Ind. 1897, **16**, 205.)

**Tin arsenide,  $Sn_3As_2$ .**

(Stead, J. Soc. Chem. Ind. 1897, **16**, 206.)

**Tin (stannous) bromide,  $SnBr_2$ .**

Sol. in  $H_2O$ .

Sol. in pyridine. (Naumann, B. 1904, **37**, 4609.)

Mol. weight determined in pyridine and ethyl sulphide. (Werner, Z. anorg. 1897, **15**, 23.)

**Tin (stannic) bromide, basic,  $SrBr_2 \cdot OH + 3H_2O$ .**

Sol. in  $H_2O$ . Decomp. in aq. solution when warmed.

Sol. in ether, methyl alcohol, ethyl alcohol, acetone, acetic acid and esters of organic acids. Nearly insol. in benzene, ligroin and  $CHCl_3$ . (Pfeiffer, Z. anorg. 1914, **67**, 242.)



**Tin (stannic) bromide,  $\text{SnBr}_4$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  without evolution of heat. (Balard.)

Decomp. by  $\text{H}_2\text{O}$  much more quickly than  $\text{SnCl}_4$ . (Lorenz, Z. anorg. 1895, 9. 378.)

Easily sol. in  $\text{AsBr}_3$ . (Walden, Z. anorg. 1902, 29. 374.);  $\text{PCl}_3$ ,  $\text{PBr}_3$  and  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

+ $4\text{H}_2\text{O}$ . (Preis and Raymann, C. C. 1882. 773.)

**Stannic hydrogen bromide,  $\text{SnBr}_4 \cdot 2\text{HBr}$ .**

See Bromostannic acid.

**Stannic bromide with  $\text{MBr}$ .**

See Bromostannate, M.

**Tin (stannic) bromochloride,  $\text{SnClBr}_3$ .**

Fumes in moist air; decomp. by  $\text{H}_2\text{O}$ . (Besson, C. R. 1897, 124. 685.)

$\text{SnCl}_2\text{Br}_2$ . Fumes in moist air. Decomp. by  $\text{H}_2\text{O}$ . (Besson.)

$\text{SnCl}_2\text{Br}$ . Fumes in moist air. Decomp. by  $\text{H}_2\text{O}$ . (Besson.)

**Tin (stannic) bromiodide,  $\text{SnBr}_2\text{I}_2$ .**

Sol. in cold  $\text{H}_2\text{O}$ . Decomp. in aq. solution at  $80^\circ$ .

$\text{SnBr}_2\text{I}$ .

$\text{SnBrI}_3$ . (Lenormand, C. C. 1899, II. 521; J. Pharm. 1899, 10. 114.)

**Tin (stannous) chloride,  $\text{SnCl}_2$ , and + $2\text{H}_2\text{O}$ .**

Not deliquescent. 100 pts.  $\text{H}_2\text{O}$  dissolve 83.9 pts.  $\text{SnCl}_2$  at  $0^\circ$ . (Engel, A. ch. (6) 17. 347.) 100 pts.  $\text{H}_2\text{O}$  dissolve 269.8 pts.  $\text{SnCl}_2$  at  $15^\circ$ , and sat. solution has sp. gr. 1.827. (Michel and Krafft, A. ch. (3) 41. 478.) Sol. in a certain amount of  $\text{H}_2\text{O}$  without decomp., but more  $\text{H}_2\text{O}$  causes pptn. of  $\text{SnO}$ ,  $\text{SnCl}_2$ .

$\text{SnCl}_2 + \text{Aq}$  absorbs O from air.

Melts in crystal  $\text{H}_2\text{O}$  at  $46^\circ$ . (Ordway.)

Sat. solution boils at  $121.7^\circ$ .

Sp. gr. of  $\text{SnCl}_2 + \text{Aq}$  at  $15^\circ$  containing:

5 10 15 20 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1.0331 1.0684 1.1050 1.1442

25 30 35 40 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1.1855 1.2300 1.2779 1.3298

45 50 55 60 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ ,  
1.3850 1.4451 1.5106 1.5823

65 70 75 %  $\text{SnCl}_2 + 2\text{H}_2\text{O}$ .  
1.6598 1.7452 1.8399

(Gerlach, Dingl. 186. 131.)

Solubility of  $\text{SnCl}_2$  in  $\text{HCl} + \text{Aq}$ .  $\frac{\text{SnCl}_2}{2} =$

$\frac{1}{2}$  molecules  $\text{SnCl}_2$  in milligrammes in 10 ccm. solution;  $\text{HCl}$ =molecules  $\text{HCl}$  in milligrammes in ditto;  $\text{H}_2\text{O}$ =amt.  $\text{H}_2\text{O}$  present in grammes.

$\frac{\text{SnCl}_2}{2}$	$\text{HCl}$	Sum of equiv.	Sp. gr. of solution	$\text{H}_2\text{O}$
74	0	74	1.532	8.33
66.7	6.6	73.3	1.489	8.35
63.75	13.54	77.29	1.472	8.198
68.4	24.8	93.2	1.524	7.869
81.2	34.9	116.1	1.625	7.305
94.2	40.0	134.2	1.724	6.880
117.6	44	161.6	1.883	6.108
147.6	49.4	197.0	2.114	5.387
156.4	66	222.4	2.190	4.715
157	78	235	2.199	4.309

(Engel, A. ch. (6) 17. 347.)

Solubility is thus diminished by  $\text{HCl} + \text{Aq}$ , while there are less than 8-10 mols.  $\text{HCl}$  for 1 mol.  $\text{SnCl}_2$ . When that limit is passed the solubility rapidly increases. (Engel.)

Sol. in very dil.  $\text{HCl}$  or tartaric acid +  $\text{Aq}$ . Sol. in  $\text{KOH} + \text{Aq}$ . Sol. in conc.  $\text{SnOCl}_2 + \text{Aq}$ . (Gerlach.) Sol. in  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Anhydrous  $\text{SnCl}_2$  is partially sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Sol. in absolute alcohol. Insol. in oil of turpentine.

11.41 pts.  $\text{SnCl}_2$  are sol. in 100 pts. ether at  $0^\circ$ .

11.38 pts.  $\text{SnCl}_2$  are sol. in 100 pts. ether at  $16^\circ$ .

11.38 pts.  $\text{SnCl}_2$  are sol. in 100 pts. ether at  $35.5^\circ$ . (Laszcynski, B. 1894, 27. 2286.)

Anhydrous  $\text{SnCl}_2$  is sol. in ether. (de Jong, Z. anal. 1902, 41. 596.)

1 g. anhydrous  $\text{SnCl}_2$  is sol. in 1.8 g. acetone at  $18^\circ$ . Sp. gr. of sat. solution  $18^\circ/4^\circ = 1.6$ .

(Naumann, B. 1904, 37. 4336.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Anhydrous  $\text{SnCl}_2$  is sol. in methyl acetate to the extent of 15.7%. (Schröder and Steiner, J. pr. 1909, (2) 79. 63.)

31.20 pts.  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol. in 100 pts. ethyl acetate at  $-2^\circ$ .

35.53 pts.  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol. in 100 pts. ethyl acetate at  $+22^\circ$ .

73.44 pts.  $\text{SnCl}_2 + 2\text{H}_2\text{O}$  are sol. in 100 pts. ethyl acetate at  $82^\circ$ . (Laszcynski, B. 1894, 27. 2286.)

1 pt. anhydrous  $\text{SnCl}_2$  is sol. in 22.40 pts. ethyl acetate at  $18^\circ$ .  $D_{18^\circ/4^\circ} = 0.9215$ .

(Naumann, B. 1910, 43. 319.)

Insol. in ethyl amine (Shinn, J. phys. Ch. 1907, 11. 538); pyridine (Naumann, B. 1904, 37. 4609); benzonitrile (Naumann, B. 1914, 47. 1369.)

Insol. in  $\text{CS}_2$ . (Arcotowski, Z. anorg. 1894, 6. 257.)  
Sol. in urethane. (Castoro, Z. anorg. 1899, 20. 61.)  
Mol. weight determined in pyridine and ethyl sulphide. (Werner, Z. anorg. 1897, 15. 22.)

**Tin (stannic) chloride, basic,  $\text{SnCl}_4\text{OH} + 3\text{H}_2\text{O}$ .**

Hydroscopic.  
Sol. in  $\text{H}_2\text{O}$ .  
Sol. in ether, alcohol, acetone, acetic acid.  
Nearly insol. in ligroin and benzene. (Pfeiffer Z. anorg, 1914, 37. 241.)

**Tin (stannic) chloride,  $\text{SnCl}_4$ .**

(a) *Ordinary modification.*—Deliquescent. Sol. in  $\text{H}_2\text{O}$ . On diluting  $\text{SnCl}_4 + \text{Aq}$  and boiling,  $\text{SnO}_2$  separates out.  $\text{SnCl}_4 + \text{Aq}$  is not pptd. by  $\text{HNO}_3$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ ;  $\text{H}_3\text{PO}_4 + \text{Aq}$  ppts. in a few days, and  $\text{H}_2\text{AsO}_4 + \text{Aq}$  in a short time. No ppt. is formed by  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{NH}_4\text{Cl}$ ,  $\text{KNO}_3$ , etc. +  $\text{Aq}$ .

Sp. gr. of  $\text{SnCl}_4 + \text{Aq}$  at  $15^\circ$ .

% $\text{SnCl}_4$ + $5\text{H}_2\text{O}$	Sp. gr.	% $\text{SnCl}_4$ + $5\text{H}_2\text{O}$	Sp. gr.	% $\text{SnCl}_4$ + $5\text{H}_2\text{O}$	Sp. gr.
2	1.012	34	1.226	66	1.538
4	1.024	36	1.242	68	1.543
6	1.036	38	1.259	70	1.567
8	1.048	40	1.276	72	1.614
10	1.059	42	1.293	74	1.641
12	1.072	44	1.310	76	1.669
14	1.084	46	1.329	78	1.698
16	1.097	48	1.347	80	1.727
18	1.110	50	1.366	82	1.759
20	1.124	52	1.386	84	1.791
22	1.137	54	1.406	86	1.824
24	1.151	56	1.426	88	1.859
26	1.165	58	1.447	90	1.894
28	1.180	60	1.468	92	1.932
30	1.195	62	1.491	94	1.969
32	1.210	64	1.514	95	1.988

(Gerlach, Dingl. 178. 49.)

Sp. gr. of  $\text{SnCl}_4 + \text{Aq}$ .

Deg. Baumé	% Sn	Deg. Baumé	% Sn	Deg. Baumé	% Sn
65.7	29.45	55	24.47	34	14.90
65	29.12	54	24.02	33	14.45
64	28.64	53	23.56	32	14.00
63	28.17	52	23.11	31	13.56
62	27.70	51	22.65	30	13.11
61	27.24	50	22.20	29	12.67
60	26.77	49	21.74	28	12.23
59	26.30	48	21.29	27	11.79
58	25.84	47	20.83	26	11.35
57	25.38	46	20.38	25	10.91
56	24.93				

(Heermann, Ch. Z. 1907, 31. 680.)

Sol. in  $\text{S}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 217.)

Easily sol. in  $\text{PCl}_5$  and  $\text{PBr}_3$ . (Walden, Z. anorg. 1900, 25. 211.)

Very sol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1899, 20. 830.)

Very sol. in absolute alcohol, from which it is pptd. by  $\text{H}_2\text{O}$ . Easily sol. in ether; decomp. by oil of turpentine. Miscible with  $\text{CS}_2$  and  $\text{Br}_2$ .

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in ethyl acetone. (Naumann, B. 1904, 37. 3601.)

Distribution of  $\text{SnCl}_4$  between  $\text{H}_2\text{O}$  and xylene.

n = pts. by wt. of Cl in 100 pts. of  $\text{H}_2\text{O}$  layer.

m = pts. by wt. of Cl in 100 pts. of xylene layer.

k = partition coefficient.

50 cc. xylene + 60 g.  $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ .

$t^\circ$	n	m	k
66°	40.35	0.08	504.4
80°	39.95	0.175	228.5
97.5°	40.24	0.33	122.1
111°	40.27	0.68	59.3

(Smirnov, Z. phys. Ch. 1907, 53. 377.)

50 cc. xylene + 60 g.  $\text{SnCl}_4 \cdot 4\text{H}_2\text{O}$ .

$t^\circ$	n	m	k
66°	41.905	0.925	45.3
80°	41.915	1.555	27.0
100°	41.845	2.515	16.7
111°	41.68	3.235	12.9

(Smirnov.)

50 cc. xylene + 60 g.  $\text{SnCl}_4 \cdot 3\text{H}_2\text{O}$ .

$t^\circ$	n	m	k
80°	43.205	9.95	4.4
94°	42.545	9.325	4.6
100°	42.645	10.56	5.1
111°	42.31	10.03	4.2

(Smirnov.)

+  $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

+  $3\text{H}_2\text{O}$ . Tr. pt.  $83^\circ$ . (Meyerhoffer, Bull. Soc. 1891 (3) 6, 85.)

+  $4\text{H}_2\text{O}$ . Tr. pt.  $83^\circ$ . (Meyerhoffer.)

+  $5\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . Decomp. by alcohol. Sol. in  $\text{HCl} + \text{Aq}$ . Tr. pt.  $56^\circ$ . (Meyerhoffer.)

+  $8\text{H}_2\text{O}$ . More deliquescent than the  $5\text{H}_2\text{O}$  salt. Tr. pt.  $19^\circ$ . (Meyerhoffer.)

+  $9\text{H}_2\text{O}$ . (Nöllner, Z. Ch. 1895. 45.)

(b) *Metastannic chloride*.—Sol. in cold  $\text{H}_2\text{O}$ ; solution coagulates on boiling. Conc.  $\text{HCl}$  + Aq ppts. from  $\text{SnCl}_4$  + Aq. When solution does not contain  $\text{HCl}$ , the addition of  $\text{HCl}$  + Aq causes a ppt., which dissolves in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ , and  $\text{H}_2\text{SO}_4$  + Aq also ppt.  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$ , and  $\text{NaCl}$  + Aq produce ppts., insol. in  $\text{H}_2\text{O}$ , but sol. in  $\text{HCl}$  + Aq.  $\text{NH}_4\text{Cl}$  or  $\text{KCl}$  + Aq do not ppt.  $\text{KNO}_3$  + Aq ppts. slowly. (Rose.)

**Tin (stannous) hydrogen chloride**,  $\text{SnCl}_2$ ,  $\text{HCl} + 3\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Melts at  $-25^\circ$ . (Engel, C. R. 106. 1398.)

**Tin (stannic) hydrogen chloride.**

See Chlorostannic acid.

**Tin (stannous) hydrazine chloride**,  $\text{SnCl}_2$ ,  $2\text{N}_2\text{H}_4$ ,  $\text{HCl}$ .

Very hygroscopic.

Sol. in  $\text{H}_2\text{O}$  and abs. alcohol. (Curtius, J. pr. 1894, (2) 50. 341.)

**Tin (stannic) chloride with  $\text{MCl}$ .**

See Chlorostannate, M.

**Tin (stannous) chloride ammonia**,  $\text{SnCl}_2$ ,  $\text{NH}_3$ .

(Berzelius.)

$\text{SnCl}_2$ ,  $4\text{NH}_3$ . Ppt. (Naumann, B. 1904, 37. 4336.)

**Tin (stannic) chloride ammonia**,  $\text{SnCl}_4$ ,  $2\text{NH}_3$ .

Sol. in cold  $\text{H}_2\text{O}$  without decomp., but decomposes by heating.

**Tin (stannous) chloride arsenate.**

See Arsenate chloride, stannous.

**Tin (stannic) chloride cyanhydric acid**,  $\text{SnCl}_4$ ,  $2\text{HCN}$ .

Decomp. on moist air or with  $\text{H}_2\text{O}$ . (Klein, A. 74. 85.)

**Tin (stannous) chloride hydrazine**,  $\text{SnCl}_2$ ,  $2\text{N}_2\text{H}_4$ .

Decomp. by  $\text{H}_2\text{O}$ .

Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Franzen, Z. anorg. 1908, 60. 286.)

**Tin (stannic) chloride nitrogen sulphide**,  $\text{SnCl}_4$ ,  $2\text{N}_2\text{S}_4$ .

Insol. in most solvents.

Decomp. by warm  $\text{NH}_4\text{OH}$  + Aq.

Decomposes in the air. (Wölbling, Z. anorg. 1908, 37. 284.)

Decomp. by  $\text{H}_2\text{O}$ . (Davis, Chem. Soc. 1906, 89. 1576.)

**Tin (stannic) chloride phosphine**,  $3\text{SnCl}_4$ ,  $2\text{PH}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Rose, Pogg. 24. 159.)

**Tin (stannous) chloride potassium stannous sulphate.**

See Sulphate, potassium stannous stannous chloride.

**Tin (stannic) chloride sulphur tetrachloride**,  $\text{SnCl}_4$ ,  $2\text{SCl}_4$ .

Very hygroscopic.

Sol. in  $\text{CHCl}_3$ , ligroin, petroleum ether,  $\text{CS}_2$ ,  $\text{POCl}_3$ ; very sol. in completely dry absolute ether, in benzene, acetacetic ester and in  $\text{EtCl}_2$ . (Ruff, B. 1904, 37. 4517.)

**Tin (stannic) chloride sulphide**,  $2\text{SnCl}_4$ ,  $\text{SnS}_2$ .

See Stannic sulphochloride.

**Tin (stannic) chlorobromide**,  $\text{SnClBr}_3$ .

Decomp. by  $\text{H}_2\text{O}$ . (Ladenburg, A. suppl. 8. 60.)

$\text{SnCl}_2\text{Br}_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Ladenburg.)

**Tin (stannous) chloriodide**,  $\text{SnClI}_2$ .

Decomp. immediately by  $\text{H}_2\text{O}$ . (Henry, Phil. Trans. 1845. 363.)

**Tin (stannic) chloriodide**,  $\text{SnCl}_2\text{I}_4$ .

Fumes in the air.

Decomp. by  $\text{H}_2\text{O}$ . (Lenormand, J. Pharm. 1898. 8.)

$\text{SnClI}_3$ . (Lenormand, J. Pharm. 1899, 10. 114.)

**Tin (stannous) fluoride**,  $\text{SnF}_2$ .

Easily sol. in  $\text{H}_2\text{O}$ . (Berzelius, Pogg. 1. 34.)

**Tin (stannic) fluoride**,  $\text{SnF}_4$ .

Very hygroscopic.

Sol. in  $\text{H}_2\text{O}$ . Slowly decomp. in aq. solution with separation of  $\text{SnO}_2$ . (Ruff, B. 1904, 37. 681.)

**Tin (stannic) fluoride with MF.**

See Fluostannate, M.

**Tin (stannous) hydroxide**,  $2\text{SnO}$ ,  $\text{H}_2\text{O}$ .

Decomp. to  $\text{SnO}$  when boiled with  $\text{H}_2\text{O}$ . More easily sol. in acids than  $\text{Sn}$  or  $\text{SnO}$ . Sol. in  $\text{NaOH}$ , and  $\text{KOH}$  + Aq, even when dil. Insol. or very sl. sol. in  $\text{NH}_4\text{OH}$ ,  $(\text{NH}_4)_2\text{CO}_3$ , and  $\text{K}_2\text{CO}_3$  + Aq; sol. in cold  $\text{CaO}_2\text{H}_2$ , and  $\text{BaO}_2\text{H}_2$ , with decomposition on boiling. (Fremy, A. ch. (3) 12. 460.) Only al. sol. in  $\text{NH}_4\text{Cl}$  + Aq hot or cold. (Brett.) Sl. sol. in  $\text{NaC}_2\text{H}_3\text{O}_2$  + Aq. (Mercer.)

## Solubility in NaOH + Aq.

G. Na in 20 ccm.	G. Sn in 20 ccm.
0.2480	0.1904
0.3680	0.2614
0.6394	0.4304
0.8326	0.5560
0.9661	0.7849
2.1234	1.8934

(Rubenbauer, Z. anorg. 1902, 30. 335.)

Not pptd. in presence of Na citrate. (Spiller.)

Sol. in water-glass + Aq. (Ordway.)

$\text{SnO}_2\text{H}_2$ . Solubility in 1 l.  $\text{H}_2\text{O}$  = 0.0000135 g. mol. at 25°. (Goldschmidt, Z. phys. Ch. 1906, 56. 389.)

**Tin hydroxide**,  $\text{SnO}$ ,  $6\text{SnO}_2 + 5\text{H}_2\text{O}$ .

+  $9\text{H}_2\text{O}$ . (Schiff, A. 120. 153.)

**Tin sesquihydroxide**,  $\text{Sn}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fuchs, J. pr. 5. 318.)

**Tin (stannic) hydroxide**.

" $\alpha$ " modification.

Obtained by pptn. by alkali in stannic chloride solution.

Freshly pptd. substance when air dried contains 73.5%  $\text{H}_2\text{O}$ ; when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum for 1 month 12.6%  $\text{H}_2\text{O}$ . Heated to glowing loses all  $\text{H}_2\text{O}$  and passes into the anhydride. The " $\alpha$ " form is capable of existing in all degrees of hydration. (Lorenz, Z. anorg. 1895, 9. 372-375.)

" $\alpha$ " stannic hydrate is a white amorphous substance which is very sol. in  $\text{HNO}_3$  when moist; sol. in  $\text{H}_2\text{SO}_4$  even dil.; sol. in  $\text{HCl}$  and not pptd. by an excess. Very sol. in  $\text{NaOH} + \text{Aq}$ . and is not pptd. by an excess.

A solution of  $\alpha$  stannic acid in  $\text{HCl}$  is identical with a solution of freshly prepared aqueous stannic chloride and gives no ppt. with dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , or arsenic acid even on long standing.

" $\beta$ " modification.

Obtained by oxidizing and dissolving Sn in  $\text{HNO}_3$ , and from solution of sodium stannate by pptn. Freshly pptd. from  $\text{HNO}_3$  when air dried contains 21.3%  $\text{H}_2\text{O}$ , and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum 11.3%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$ , respectively.

Freshly pptd. from sodium stannate solution and air dried contains 22.5%  $\text{H}_2\text{O}$  and when dried over  $\text{H}_2\text{SO}_4$  or in a vacuum contains 12.1%,—corresponding to  $\text{Sn}(\text{OH})_4$  and  $\text{SnO}(\text{OH})_2$ . Passes into the anhydride when heated to glowing.

The " $\beta$ " form is capable of existing in all degrees of hydration. It is a white amorphous substance which is insol. in  $\text{HNO}_3$ ; in-

sol in  $\text{H}_2\text{SO}_4$  even when conc.; insol. in  $\text{HCl}$  but changed by contact with the acid in that when the acid has been removed the ppt. is readily sol. in  $\text{H}_2\text{O}$ , though pptd. again from solution by addition of  $\text{HCl}$ . When freshly prepared the " $\beta$ " form is sol. in  $\text{NaOH} + \text{Aq}$ . but is pptd. by an excess of  $\text{NaOH}$ .

A solution of " $\beta$ " stannic acid in  $\text{HCl}$  behaves quite differently from an aq. solution of stannic chloride in that it ppts. metastannic sulphate when treated with  $\text{H}_2\text{SO}_4$ .

This ppt. dissolves when heated with dilute  $\text{HNO}_3$  or  $\text{HCl}$ , but the solution on standing spontaneously forms another ppt. A solution of " $\beta$ " stannic acid in  $\text{HCl}$  gives a ppt. when treated with arsenic acid. (Lorenz, Z. anorg. 1895, 9. 372.)

See also Stannic acid.

**Tin hydroxyl chloride**,  $\text{SnO}(\text{OH})\text{Cl}$ .

See Chlorostannic acid.

**Tin (stannous) iodide**,  $\text{SnI}_2$ , and +  $2\text{H}_2\text{O}$ .

Sl. sol. in cold, more abundantly in hot  $\text{H}_2\text{O}$ , without decomp.

Solubility in  $\text{H}_2\text{O}$ .

$^{\circ}$	Pts. $\text{SnI}_2$ in 100 pts. solution	$^{\circ}$	Pts. $\text{SnI}_2$ in 100 pts. solution
98.5	3.43	97.3	3.70
84.9	3.05	87.4	3.24
73.9	2.56	77.6	2.75
60.1	2.09	67.5	2.34
51.5	1.79	59.7	2.03
41.0	1.50	49.5	1.72
30.5	1.21	39.4	1.38
20.8	1.03	29.6	1.11
...	...	19.8	0.96

(Young, J. Am. Chem. Soc. 1897, 19. 846.)

Solubility of  $\text{SnI}_2$  in  $\text{HI} + \text{Aq}$  at  $^{\circ}$ .

Pts.  $\text{SnI}_2$  per 100 pts. solvent.

$^{\circ}$	5.83% HI	9.60% HI	16.20% HI	20.44% HI	24.80% HI	30.40% HI	36.82% HI
20	0.98	0.20	0.60	1.81	4.20	10.86	25.31
30	1.16	0.23	0.64	1.81	4.06	10.28	23.46
40	1.40	0.33	0.71	1.90	4.12	10.06	23.15
50	1.69	0.46	0.82	2.12	4.34	10.35	23.76
60	2.07	0.66	1.11	2.51	4.78	11.03	24.64
70	2.48	0.91	1.37	2.92	5.43	11.97	25.72
80	2.95	1.23	1.83	3.70	6.38	13.30	27.23
90	3.46	1.65	2.40	4.58	7.82	15.52	29.84
100	4.03	2.23	3.63	5.82	9.60	...	34.05

(Young, J. Am. Chem. Soc. 1897, 19. 851.)

Solubility of  $\text{SnI}_2$  at low temp. in 29.95%  $\text{HI} + \text{Aq.}$ 

Temp.	Pts. in 100 pts. solution	Pts. in 100 pts. solvent
1.5	12.96	14.89
1.5	13.15	15.14
6.0	12.35	14.09
10.5	11.01	12.36
15.2	10.48	11.70
24.8	9.36	10.33
30.7	8.78	9.62
34.8	8.70	9.50
40.3	9.51	10.50

(Young, J. Am. Chem. Soc. 1897, 19. 854.)

Solubility of  $\text{SnI}_2$  at low temp. in 39.6%  $\text{HI} + \text{Aq.}$ 

Temp.	Pts. in 100 pts. of solution		Pts. in 100 pts. of solvent
	I	II	
0°	13.52	13.56	15.66
5.7°	16.44	16.37	19.71
10.5°	19.47	19.60	24.27
15.7°	23.56	23.68	30.92
20.3°	25.50	25.60	34.30

(Young, J. Am. Chem. Soc. 1897, 19. 852-853.)

Sol. in  $\text{SnCl}_2 + \text{Aq.}$  Sol. in warm alkali chlorides or iodides + Aq; also in dil.  $\text{HCl} + \text{Aq.}$  Very sl. sol. in  $\text{CHCl}_3$ ,  $\text{CS}_2$ , or  $\text{C}_6\text{H}_6$ . (Personne, C. R. 54. 216.)

Sol. in  $\text{KOH} + \text{Aq.}$  (Rose.)

Sol. in acetone. (Naumann, B. 1904, 37. 4328.)

**Tin (stannic) iodide,  $\text{SnI}_4$ .**Decomp. by  $\text{H}_2\text{O}$  into  $\text{SnO}_2$  and  $\text{HI}$ .Very sol. in  $\text{PCl}_5$ . (Beckmann, Z. anorg. 1906, 51. 110.)Sol. in  $\text{POCl}_3$ . (Walden, Z. anorg. 1900, 25. 212.)Easily sol. in  $\text{PCl}_5$  and  $\text{PBr}_5$ . (Walden, Z. anorg. 1900, 25. 211.)Sol. in liquid  $\text{AsBr}_3$  forming a solution with sp. gr. = 3.731 at 15°. (Retgers, Z. phys. Ch. 1893, 11. 342.)Sol. in  $\text{SOCl}_2$ ,  $\text{S}_2\text{Cl}_2$  and  $\text{SO}_2\text{Cl}_2$ . (Walden, Z. anorg. 1900, 25. 215.)Sol. in  $\text{SnCl}_4$ . (Walden.)Sol. in anhydrous alcohol, ether, and benzene. 1 pt.  $\text{CS}_2$  dissolves 1.45 pts.  $\text{SnI}_4$  at ordinary temp. (Schneider, Pogg. 127. 624.)100 pts. methylene iodide,  $\text{CH}_2\text{I}_2$ , dissolve 22.9 pts.  $\text{SnI}_4$  at 10°. Sp. gr. of solution = 3.481. (Retgers, Z. anorg. 3. 343.)

## Solubility in organic solvents at t°.

Solvent	t°	G. $\text{SnI}_4$ in 100 g. of the sat. solution	Sp. gr. of the sat. solution
$\text{CCl}_4$	22.4	5.25	1.59
$\text{CCl}_4$	50.0	12.50	1.63
$\text{CHCl}_3$	28.0	8.21	1.50
$\text{C}_6\text{H}_6$	20.2	12.65	0.95

(McDermott, J. Am. Chem. Soc. 1911, 33. 1964.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in acetone. (Eidman, C. C. 1899, II. 1014.)

Solubility in  $\text{CS}_2$ .

100 g. of the sat. solution contain at:

-58° -84° -89° -94° -114.5°  
16.27 10.22 9.68 10.65 9.41 g.  $\text{SnI}_4$ .

(Arctowski, Z. anorg. 1896, 11. 274.)

Sol. in allyl mustard oil. (Mathews, J. phys. Ch. 1905, 9. 647.)

**Tin (stannous) hydrogen iodide,  $\text{SnI}_2$ ,  $\text{HI}$ .**

Not obtained in pure state. (Young, J. Am. Chem. Soc. 1897, 19. 856.)

**Tin (stannous) iodide ammonia,  $\text{SnI}_2$ ,  $2\text{NH}_3$ .**(Ephraim and Schmidt, B. 1909, 42. 3857.)  
 $\text{SnI}_4$ ,  $8\text{NH}_3$ . (Ephraim and Schmidt.)**Tin (stannic) iodide ammonia,  $\text{SnI}_4$ ,  $3\text{NH}_3$ .**

(Personne, C. R. 54. 218.)

 $\text{SnI}_4$ ,  $4\text{NH}_3$ . (Personne.) $\text{SnI}_4$ ,  $8\text{NH}_3$ . (Rammelsberg, Pogg. 48. 169.)**Tin iodosulphide,**

See Tin sulphoidide.

**Tin monoxide (Stannous oxide),  $\text{SnO}$ .**Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Very sl. sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Rose.) Insol. in  $\text{NaOH}$  or  $\text{KOH} + \text{Aq.}$ Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329.)

**Tin dioxide (Stannic oxide),  $\text{SnO}_2$ .**Insol. in  $\text{H}_2\text{O}$  or conc. acids except conc  $\text{H}_2\text{SO}_4$ . Insol. in conc. alkalies or  $\text{NH}_4\text{OH} + \text{Aq.}$ Ngt absolutely insol. in dil.  $\text{HNO}_3 + \text{Aq.}$  (Mulder.)Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Min. Cassiterite (Tin stone). Not attacked by acids.

**Tin sesquioxide,  $\text{Sn}_2\text{O}_3$ .**

While moist, easily sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$   
Sl. sol. in dil., more easily in conc.  $\text{HCl} + \text{Aq.}$   
(Berzelius.)

**Tin (stannic) oxybromide,  $\text{Sn}_2\text{Br}_2\text{O} + 12\text{H}_2\text{O}$ .**

Decomp. by  $\text{H}_2\text{O}$  into  $\text{SnBr}_2$  and  $\text{H}_2\text{SnO}_3$ .  
 $\text{Sn}_2\text{Br}_2\text{O}_2$ . As above. (Preis and Raymann, C. C. 1882. 773.)

**Tin (stannic) oxybromide nitrogen pentoxide,  $\text{SnO}_2, 3\text{Br}_2, \text{N}_2\text{O}_5$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Thomas, C. R. 1896, 122. 33.)

**Tin (stannous) oxychloride,  $\text{SnO}, \text{SnCl}_2 + 3\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , and dil.  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq.}$  (J. Davy, Schw. J. 10. 325.)

$\text{Sn}_2\text{Cl}_4\text{O}_5 + 10\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$  or alcohol.

Can be recrystallized from alcohol but not from  $\text{H}_2\text{O}$ . (Tschermak, W. A. B. 44. 2. 736.)

$3\text{SnO}_2, 2\text{SnCl}_2 + 6\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Ditte, A. ch. 1882, (5) 27. 146.)

$4\text{SnO}, \text{SnCl}_2 + 6\text{H}_2\text{O}$ . (Ditta.)

**Tin (stannic) oxychloride,  $\text{SnO}_2, \text{SnCl}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Scheurer-Kestner, A. ch. (3) 47. 6.)

**Tin (metastannic) oxychloride,  $3\text{SnO}_2, \text{SnCl}_4 + 3\text{H}_2\text{O}$ .**

Sol. in little, decomp. by much  $\text{H}_2\text{O}$ . (Weber, Pogg. 122. 368.)

$4\text{SnO}_2, \text{SnCl}_4 + 7\text{H}_2\text{O}$ . (Weber.)

"Metastannyl chloride  $\beta$ ,"  $\text{Sn}_2\text{O}_3\text{Cl}_2$ . Deliquescent. Sol. without decomp. in a small amount of  $\text{H}_2\text{O}$  or in a large amount of  $\text{H}_2\text{O}$  containing a few drops  $\text{HCl}$ .

Sol. in abs. alcohol. (Engel, C. R. 1897, 124. 767.)

$+4\text{H}_2\text{O}$  and  $+9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  acidified with one drop of  $\text{HCl}$ . Pptd. by excess  $\text{HCl}$ . (Engel, C. R. 1897, 124. 768.)

"Parastannyl chloride,"  $\text{Sn}_2\text{O}_3\text{Cl}_2 + 2\text{H}_2\text{O}$ . Decomp. by excess  $\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ ; pptd. by  $\text{HCl}$ . (Engel, C. R. 1897, 125. 465.)

**Tin (stannic) oxychloride nitrogen pentoxide,  $\text{SnOCl}_2, 3\text{SnCl}_4, \text{N}_2\text{O}_5$ .**

Hydroscopic; sol. in  $\text{H}_2\text{O}$ .

Decomp. by heat. (Thomas, C. R. 1896, 122. 32.)

**Tin (stannous) oxyiodide,  $\text{SnO}, 3\text{SnI}_2, 2\text{SnO}, 3\text{SnI}_2, \text{SnO}, \text{SnI}_2$ ; and  $2\text{SnO}, \text{SnI}_2$ .**

Decomp. by much  $\text{H}_2\text{O}$ . (Personne, C. R. 54. 216.)

**Tin oxysulphide,  $\text{Sn}_2\text{S}_2\text{O} + 11\text{H}_2\text{O}$ .**

Very sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$ ; slowly sol. in  $\text{H}_2\text{O}$ . (Schmidt, B. 1894, 27. 2739.)

**Tin phosphide,  $\text{Sn}_3\text{P}$ .**

(Ragg, C. C. 1898, II. 170.)

$\text{SnP}$ . Sol. in  $\text{HCl} + \text{Aq.}$  Insol. in  $\text{HNO}_3 + \text{Aq.}$

$\text{SnP}_2$ . Not attacked by  $\text{HCl}$ . Easily attacked by aqua regia. (Emmerling, B. 1879, 12. 155.)

$\text{SnP}_3$ . Insol. in  $\text{HCl}$ . Slowly attacked by dil.  $\text{HNO}_3$  at  $50^\circ$ . Oxidized by fuming  $\text{HNO}_3$  with ignition. (Jolibois, C. R. 1909, 148. 638.)

$\text{Sn}_2\text{P}_3$ . Insol. in mercury.

Decomp. by  $\text{HCl}$ . (Stead, J. Soc. Chem. Ind. 1897, 16. 206.)

$\text{Sn}_4\text{P}_3$ . Attacked by  $\text{HCl}$ ,  $\text{HNO}_3$ , and alkalies. (Jolibois, C. R. 1909, 148. 637.)

The only true compounds are  $\text{Sn}_3\text{P}_2$  and  $\text{SnP}_3$ . (Jolibois, C. R. 1909, 148. 637.)

**Tin phosphochloride,  $\text{Sn}_3\text{P}_2\text{Cl}_4$ .**

(Mahn, Jena. Zeit. 5. 1660.)

**Tin (stannous) selenide,  $\text{SnSe}$ .**

Decomp. by boiling  $\text{HCl} + \text{Aq.}$  Slowly oxidised by boiling  $\text{HNO}_3 + \text{Aq.}$  and easily dissolved in aqua regia (Schneider, Pogg. 127. 624.) Easily sol. in alkalies  $+ \text{Aq.}$  (Uelsmann, A. 116. 122), or scarcely even on boiling (Schneider), according to method of preparation. Sol. in alkali sulphides or selenides  $+ \text{Aq.}$

**Tin (stannic) selenide,  $\text{SnSe}_2$ .**

Not attacked by  $\text{H}_2\text{O}$  or dil. acids; scarcely attacked by boiling conc.  $\text{HCl} + \text{Aq.}$ ; gradually decomp. by hot  $\text{HNO}_3 + \text{Aq.}$ ; easily dissolved by warm aqua regia, and hot conc.  $\text{H}_2\text{SO}_4$ .

Sol. in cold, more easily in warm  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Uelsmann, A. 116. 122.)

**Tin (stannous) sulphide,  $\text{SnS}$ .**

1 l.  $\text{H}_2\text{O}$  dissolves  $0.14 \times 10^{-4}$  mols.  $\text{SnS}$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, 58. 294.)

Insol. in dil., sol. in conc.  $\text{HCl} + \text{Aq.}$  Sl. sol. in hot conc.  $\text{HNO}_3 + \text{Aq.}$  Insol. in  $\text{KOH} + \text{Aq.}$

$+ \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{S} + \text{Aq.}$  or dil. acids; sol. with decomp. in conc. acids; easily sol. in hot conc.  $\text{HCl} + \text{Aq.}$  Insol. in  $\text{H}_2\text{SO}_4 + \text{Aq.}$  Insol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  Insol. in  $\text{NH}_4\text{Cl}$ , or  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  Scarcely sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq.}$  but easily sol. in the same on addition of S. (Rose.)

10%  $\text{NaOH} + \text{Aq.}$  dissolves  $\text{SnS}$  by violent boiling.

Insol. in cold, sl. sol. in hot  $\text{Na}_2\text{SO}_3 + \text{Aq.}$  (Materne, C. C. 1906, II. 557.)

Sol. in alkali polysulphides  $+ \text{Aq.}$

Insol. in acetone. (Eidmann, C. C. 1899,

II. 1014); (Naumann, B. 1904, **37**. 4329.); ethyl acetate. (Naumann, B. 1910, **43**. 314.)

### Tin (stannic) sulphide, $\text{SnS}_2$ .

*Anhydrous.* (*Mosaic gold.*) Insol. in HCl or  $\text{HNO}_3$  + Aq, but decomp. by aqua regia. Sol. in hot  $\text{KOH}$  + Aq or  $\text{K}_2\text{CO}_3$  + Aq; also in hot  $\text{K}_2\text{S}$ ,  $\text{Na}_2\text{S}$  + Aq, and  $(\text{NH}_4)_2\text{S}$  + Aq.

1 l.  $\text{H}_2\text{O}$  dissolves  $1.13 \times 10^{-4}$  mols.  $\text{SnS}_2$  at  $18^\circ$ . (Weigel, Z. phys. Ch. 1907, **53**. 294.)

+  $\text{xH}_2\text{O}$ . Sl. sol. in  $\text{NH}_4\text{OH}$  + Aq, but readily in  $\text{KOH}$ ,  $\text{K}_2\text{S}$ , or  $\text{Na}_2\text{S}$  + Aq; also in hot conc.  $\text{HCl}$  + Aq. Decomp. by hot  $\text{HNO}_3$  + Aq. Insol. in  $\text{KHSO}_4$  + Aq. Sol. in  $\text{K}_2\text{CO}_3$  + Aq. Insol. in  $\text{NH}_4\text{Cl}$ , and  $\text{NH}_4\text{NO}_3$  + Aq. (Brett.)

Pptd.  $\text{SnS}_2$  is insol. in cold, sol. in hot  $\text{Na}_2\text{B}_4\text{O}_7$  + Aq. Sol. in  $\text{Na}_2\text{CO}_3$  + Aq. Very sol. in  $\text{NaOH}$  + Aq. (Materne, C. C. 1906, II. 557.)

Sol. in boiling conc.  $\text{H}_2\text{C}_2\text{O}_4$  + Aq. (Clarke, C. N. **21**. 124.)

Insol. in methyl acetate (Naumann, B. 1909, **42**. 3790); ethyl acetate (Naumann, B. 1910, **43**. 314.); acetone (Naumann, B. 1904, **37**. 4329; Eidmann, C. C. 1899, II. 1014.)

### Tin sesquisulphide, $\text{Sn}_2\text{S}_3$ .

Sol. in moderately conc. HCl. (Antony and Niccoli, Gazz. ch. it. 1892, **22**. (2) 406.)

### Tin sulphochloride, $\text{SnS}_2 \cdot 2\text{SnCl}_4$ .

$\text{H}_2\text{O}$  dissolves out  $\text{SnCl}_4$ . (Dumas, Schw. J. **66**. 409.)

$\text{Sn}_2\text{Cl}_{11} = \text{SnCl}_4 \cdot 2\text{SnCl}_4$ . Sol. in  $\text{H}_2\text{O}$  with separation of S.

Gradually sol. in dil.  $\text{HNO}_3$  + Aq.

Sol. in  $\text{POCl}_3$ . (Casselmann, A. **83**. 267.)

### Tin sulphotelluride, $\text{SnS}_2\text{Te}$ .

Decomp. by  $\text{H}_2\text{O}$  into  $\text{SnO}_2$ , S, and HI; by cold conc.  $\text{HCl}$  + Aq with separation of S, also by aqua regia, and  $\text{HNO}_3$  + Aq.

Cold  $\text{KOH}$  + Aq separates S and  $\text{SnO}_2$ .

Completely sol. in hot  $\text{KOH}$  + Aq.

Sol. in cold, more easily in hot  $\text{CS}_2$  or  $\text{CHCl}_3$ .

Decomp. by alcohol. (Schneider, Pogg. **111**. 249.)

### Tin sulphophosphide, $\text{Sn}_2\text{P}_2\text{S}_5$ .

Insol. in HCl,  $\text{HNO}_3$ , and aqua regia.

Sol. in aq. alkali hydroxides, containing Cl, or Br, in solution. (Granger, C. R. 1896, **122**. 322.)

### Tin (stannous) telluride, $\text{SnTe}$ .

Not attacked by conc.  $\text{HCl}$  + Aq. (Ditte, C. R. **97**. 42.)

### Titanic acid, $\text{TiO}_2 \cdot \text{xH}_2\text{O}$ .

*$\alpha$ -Titanic acid.*—Insol. in  $\text{H}_2\text{O}$  or alcohol. When dried in the cold, is completely sol. in

acids, especially HCl, or dil.  $\text{H}_2\text{SO}_4$  + Aq, but when the solution in acids is boiled, it is converted into  $\beta$ -titanic acid. Very sl. sol. even when moist in  $\text{H}_2\text{SO}_4$  + Aq. (Berthier.) Sl. sol. in alkali carbonates + Aq. A complete solution in an alkali carbonate + Aq can only be obtained by adding a Ti salt drop by drop to the alkaline solution, and allowing the ppt. to dissolve entirely before adding more Ti salt. On boiling the solution in  $(\text{NH}_4)_2\text{CO}_3$  + Aq (or in  $\text{K}_2\text{CO}_3$  or  $\text{Na}_2\text{CO}_3$  + Aq with  $\text{NH}_4\text{Cl}$ ) the titanic acid is pptd.

Relatively easily sol. in mineral acids, decreasing in the following order HCl,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . Insol. in perchloric acid. (Lan-decker, Z. anorg. 1909, **64**. 67.)

Sol. in dil.  $\text{H}_2\text{SO}_4$ . 40 g.  $\text{H}_2\text{O}$  + 70 g.  $\text{H}_2\text{SO}_4$  (sp. gr. 1.145) dissolves 0.33 g.  $\text{TiO}_2$  in 15 min. (Hall and Smith, Proc. Am. Phil. Soc. 1905, **44**. 193.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, **20**. 830.)

*$\beta$ -Titanic acid, Metatitanic acid.*—Insol. in  $\text{H}_2\text{O}$ , acids except HF, or alkali hydrates or carbonates + Aq. When digested with conc.  $\text{H}_2\text{SO}_4$  until acid is evaporated, the residue is sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

*$\gamma$ -Titanic acid.*—Sol. in pure  $\text{H}_2\text{O}$ , but  $\beta$ -acid is pptd. by boiling. (Knop, A. **123** 351.)

Colloidal  $\text{TiO}_2 \cdot \text{xH}_2\text{O}$  + Aq has been prepared by Graham (Chem. Soc. **17**. 325.)

### Barium titanate, $2\text{BaO} \cdot 3\text{TiO}_2$ .

(Bourgeois, C. R. **103**. 141.)

### Barium pertitanate peroxide.

See Pertitanate, barium peroxide.

### Calcium titanate, $\text{CaTiO}_3$ .

(Ebelmen, C. R. **32**. 711.)

Min. *Perovskite*. Scarcely attacked by  $\text{HCl}$  + Aq or other acids, except hot  $\text{H}_2\text{SO}_4$ , which decomposes it.

$\text{CaO} \cdot 2\text{TiO}_2$ . Min. *Titanomorphite*. Partially decomp. by  $\text{HCl}$  + Aq, completely by  $\text{H}_2\text{SO}_4$ .

### Cobaltous titanate, $\text{CoTiO}_3$ .

(Bourgeois, C. C. 1898, I. 226.)

### Ferrous orthotitanate, $\text{Fe}_2\text{TiO}_4$ .

(Hautefeuille, C. R. **59**. 733.)

### Ferroferric titanate, $\text{FeTiO}_3 \cdot \text{xFe}_2\text{O}_3$ .

Min. *Menaccanite*. Very sl. sol. in HCl or aqua regia with separation of  $\text{TiO}_2$ .

### Ferric titanate.

Not attacked by boiling  $\text{H}_2\text{SO}_4$  or conc.  $\text{HCl}$  + Aq. (Wöhler and Liebig, Pogg. **21**. 578.)

**Magnesium titanate,  $MgTiO_3$ .**

Insol. in  $H_2O$  and acids. (Hautefeuille, A. ch. (4) 4. 189.)

Min. *Geikielite*.

When finely powdered, is easily sol. in hot  $HCl$ , or in cold  $HF$  in a few hours. (Dick, Miner, Mag. 1894, 10. 146.)

$Mg_2TiO_4$ . Slowly decomp. by boiling with  $HNO_3$  + Aq. (Hautefeuille, A. ch. (4) 4. 189.)

**Potassium titanate,  $K_2TiO_3$ .**

*Anhydrous*. Decomp. with  $H_2O$ .

+ $4H_2O$ . Deliquescent. Very sol. in  $H_2O$ . Precipitated from aqueous solution by alcohol. (Demoly, Compt. chim. 1849. 325.)

**Potassium titanate, acid,  $K_2O, 3TiO_2 + 2H_2O$** 

Insol. in  $H_2O$ . (Demoly.)

$K_2O, 6TiO_2 + 2H_2O$ . (Demoly.)

$K_2O, 3TiO_2 + 3H_2O$ . Insol. in  $H_2O$ . Completely sol. in  $HCl$  + Aq if only cold  $H_2O$  is used for washing. When heated to  $100^\circ$ , no longer completely sol. in  $HCl$  + Aq. (Rose, Pogg. 74. 563.)

$K_2O, 12TiO_2$ . (Rose, Gilb. Ann. 73. 78.)

**Sodium titanate,  $Na_2TiO_3$ .**

*Anhydrous*. Decomp. by  $H_2O$  into  $NaOH$ , and an acid titanate, insol. in  $H_2O$ .

+ $4H_2O$ . Deliquescent. Very sol. in  $H_2O$ . Precipitated from aqueous solution by alcohol. (Demoly.)

**Sodium titanate, acid,  $2Na_2O, 9TiO_2 + 5H_2O$ .**

If not heated to  $100^\circ$ , is sol. in cold  $HCl$  + Aq. (Rose, Gilb. Ann. 73. 78.)

$2Na_2O, 3TiO_2$ . Insol. in  $H_2O$ ; slowly sol. in cold, easily in hot  $HCl$  + Aq. (Cormimboeuf, C. R. 115. 823.)

$Na_2O, 2TiO_2$ . As above. (C.)

$Na_2O, 3TiO_2$ . Insol. in  $H_2O$ , and nearly so in boiling  $HCl$  + Aq. (C.)

**Strontium titanate,  $2SrO, 3TiO_2$ .**

(Bourgeois, C. R. 103. 141.)

**Zinc titanate,  $ZnO, TiO_2(?)$ .**

(Lévy, A. ch. (6) 24. 456.)

$2ZnO, TiO_2(?)$ . (Lévy.)

$3ZnO, 2TiO_2$ . Slowly attacked by warm  $H_2SO_4$  or  $HNO_3$  + Aq, and by  $H_2SO_4$  +  $HF$ . Wholly sol. in cold  $HCl$  + Aq. (Lévy.)

$4ZnO, 5TiO_2$ . Not attacked by cold conc. acids, but sol. by boiling except in  $HCl$  + Aq. (Lévy.)

$ZnO, 3TiO_2$ . Insol. in  $H_2O$ , alcohol, or ether. Dil.  $HNO_3$ ,  $H_2SO_4$ , or  $HCl$  + Aq do not attack even on boiling; boiling  $H_2SO_4$  dissolves with difficulty; not attacked by conc. boiling alkalis + Aq. (Lévy, A. ch. (6) 25. 471.)

**Pertitanic acid.**

See Pertitanic acid.

**Titanium, Ti.**

Decomp.  $H_2O$  even under  $100^\circ$  (Wöhler); not attacked by  $H_2O$  under  $500^\circ$ . (Kern, C. N. 33. 57.)

Does not decomp.  $H_2O$  at  $100^\circ$ . (Schneider, Z. anorg. 1894, 8. 85.)

Sol. in  $HCl$  + Aq if warmed. Rapidly sol. in  $HF$  + Aq. Sol. in cold dil.  $H_2SO_4$  + Aq,  $HNO_3$  + Aq, or  $HC_2H_3O_2$  + Aq. Dissolves almost instantaneously in  $HF$  + Aq. (Merz.)

Sol. in molten lead and iron; sol. in  $HCl$ ,  $HNO_3$ , and aqua regia. (Moissan, C. R. 1895, 120. 293.)

*Amorphous*. Loses its spontaneous inflammability when left for a time in contact with  $H_2O$ . (Schneider, Z. anorg. 1895, 8. 85.)

**Titanium amide,  $Ti(NH_2)_4$ .**

Violently attacked by  $H_2O$ . (Stähler, B. 1905, 38. 2629.)

**Titanium tribromide,  $TiBr_3 + 6H_2O$ .**

Very hygroscopic. (Stähler, B. 1904, 37. 4409.)

**Titanium tetrabromide,  $TiBr_4$ .**

Deliquescent. Decomp. by  $H_2O$ . (Duppa, C. R. 42. 352.)

Sol. in absolute alcohol and in dry ether. (Rosenheim and Schütte, Z. anorg. 1900, 24. 238.)

**Titanium bromonitride,  $TiNBr$ .**

Decomp. by a small amount of  $H_2O$ . On addition of more  $H_2O$ , a part dissolves forming a solution which decomp. on warming with separation of titanic acid. It behaves similarly toward dil.  $HNO_3$ , dil.  $HCl$  and dil.  $H_2SO_4$ . Completely sol. in warm dil.  $H_2SO_4$ . (Ruff, B. 1906, 41. 2262.)

**Titanium carbide,  $TiC$ .**

Sol. in  $HNO_3$  + Aq. (Shimer, C. N. 55. 71.)

Insol. in  $HCl$ . Slowly sol. in aqua regia. (Moissan, C. R. 1895, 120. 295.)

**Titanium carbide nitride,  $Ti_2C_2N_2 = Ti(CN)_2, 3Ti_2N_2$ .**

Insol. in, and not attacked by boiling  $HNO_3$  or  $H_2SO_4$  (Wollaston), but sol. in  $HNO_3$  +  $HF$  (Berzelius).

**Titanium dichloride,  $TiCl_2$ .**

Very deliquescent. Decomposes  $H_2O$  with violence. Insol. in ether,  $CS_2$ , or  $CHCl_3$ . Decomp. by 99.5% alcohol.

**Titanium trichloride,  $TiCl_3$ .**

Deliquescent. Sol. in  $H_2O$  with evolution of heat.

+ $4H_2O$ . (Glatzel, B. 9. 1829.)

+ $6H_2O$ . Very sol. in  $H_2O$ . (Polidori, Z. anorg. 1898, 19. 307.)



**Titanium tetrachloride,  $\text{TiCl}_4$ .**

Anhydrous. Sol. in  $\text{H}_2\text{O}$  with evolution of much heat.

+ $5\text{H}_2\text{O}$ . Deliquescent.

**Titanium sulphuryl chloride,  $\text{TiCl}_4\text{SO}_2 = \text{TiCl}_4\text{OSO}_2\text{Cl}$ .**

Deliquesces gradually in moist air. (Clausnitzer, B. 11. 2011.)

**Titanium chloride ammonia,  $\text{TiCl}_4 \cdot 4\text{NH}_3$ .**

Deliquescent. Solution in  $\text{H}_2\text{O}$  is not quite clear. (Rose.)

According to Persoz (A. ch. 46. 315), is  $\text{TiCl}_4 \cdot 6\text{NH}_3$ .

$\text{TiCl}_4 \cdot 6\text{NH}_3$  and  $\text{TiCl}_4 \cdot 4\text{NH}_3$ .

Both compds. are unstable in moist air; insol. in ether. (Rosenheim, Z. anorg. 1901, 26. 245.)

$\text{TiCl}_4 \cdot 8\text{NH}_3$ . Violently decomp. by  $\text{H}_2\text{O}$ . (Stähler, B. 1905, 38. 2627.)

**Titanium tetrachloride cyanobromide,  $\text{TiCl}_4 \cdot \text{NCClBr}$ .**

(Schneider, Z. anorg. 1894, 8. 92.)

**Titanium chloride cyanhydric acid,  $\text{TiCl}_4 \cdot 2\text{HCN}$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat. (Wöhler, A. 73. 226.)

**Titanium trichloride nitrogen sulphide,  $2\text{TiCl}_3 \cdot \text{N}_2\text{S}_4$ .**

Decomp. rapidly in air. (Davis, Chem. Soc. 1906, 89. (2) 1576.)

**Titanium tetrachloride nitrogen sulphide,  $\text{TiCl}_4 \cdot \text{N}_2\text{S}_4$ .**

Hydroscopic.

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ,  $\text{KOH}$  and alcohol. (Wölbling, Z. anorg. 1908, 57. 282.)

**Titanium chloride phosphine.**

Decomp. by  $\text{H}_2\text{O}$ ,  $\text{HCl} + \text{Aq}$ ,  $\text{KOH} + \text{Aq}$ ,  $\text{K}_2\text{CO}_3 + \text{Aq}$ , or  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Rose.)

**Titanium tetrachloride phosphoryl chloride,  $\text{TiCl}_4 \cdot 2\text{POCl}_3$ .**

(Ruff, B. 1903, 36. 1783.)

**Titanium chloronitride,  $\text{TiNCl}$ .**

Decomp. by small amount cold  $\text{H}_2\text{O}$ . On the addition of more  $\text{H}_2\text{O}$  it is only partially decomp. For complete solution, the addition of dil.  $\text{HCl}$  or a mixture of warm dil.  $\text{H}_2\text{SO}_4$  and  $\text{HF}$  is necessary. Easily sol. in conc.  $\text{HNO}_3$  and in conc.  $\text{H}_2\text{SO}_4$ . (Ruff, B. 1903, 41. 2259.)

**Titanium difluoride.**

(Hautefeuille, C. R. 57. 151.)

Probably sesquifluoride.

**Titanium sesquifluoride,  $\text{Ti}_2\text{F}_3$ .**

Appears to be two modifications, one sol. in  $\text{H}_2\text{O}$ , and the other insol. in  $\text{H}_2\text{O}$ . (Hautefeuille, C. R. 59. 189.)

Insol. in  $\text{H}_2\text{O}$ . (Weber, Pogg. 120. 292.)

**Titanium tetrafluoride,  $\text{TiF}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Unverdorben.)

Sol. in  $\text{H}_2\text{O}$ , but solution decomp. upon evaporation. (Marignac, Ann. Min. (5) 15. 258.)

Sol. in  $\text{H}_2\text{O}$ . (Emich, M. 1904, 25. 910.)

Very hygroscopic.

Sol. in  $\text{H}_2\text{O}$ . Sl. sol. in conc.  $\text{HF} + \text{Aq}$ .

Sol. in cold  $\text{POCl}_3$  without decomp. Decomp. in warm  $\text{POCl}_3$ .

Sol. in alcohol and dry pyridine.

Insol. in ether,  $\text{CS}_2$ ,  $\text{CCl}_4$ ,  $\text{SiCl}_4$ ,  $\text{SiBr}_4$ ,  $\text{SO}_2\text{Cl}_2$ ,  $\text{SOCl}_2$ ,  $\text{SCl}_2$ ,  $\text{AsCl}_3$ ,  $\text{SO}_3$ ,  $\text{CrO}_3$ ,  $\text{PCl}_5$ . (Ruff, B. 1903, 36. 1780.)

+ $2\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ruff, B. 1903, 36. 1780.)

**Titanium hydrogen fluoride,  $2\text{HF}$ ,  $\text{TiF}_4 = \text{H}_2\text{TiF}_6$ .**

Sol. in  $\text{H}_2\text{O}$  with decomposition and separation of a basic salt. Corresponds to fluosilicic acid, and may be considered as fluotitanic acid  $\text{H}_2\text{TiF}_6$ .

**Titanium fluoride with MF.**

See Fluotitanate, M.

**Titanium tetrafluoride ammonia,  $\text{TiF}_4 \cdot 2\text{NH}_3$ .**

Sol. in  $\text{H}_2\text{O}$ ; decomp. in aq. solution on boiling. (Ruff, B. 1903, 36. 1781.)

**Titanium monohydroxide,  $\text{TiO}_2\text{H}_2$ .**

Ppt. (Wöhler, A. 73. 49.)

$\text{Ti}_2\text{O}_3\text{H}_2$ . Not attacked by cold conc. acids; sl. attacked on warming. Insol. in cold or hot  $\text{KOH} + \text{Aq}$ . (Winkler, B. 1890, 23. 2659.)

**Titanium sesquihydroxide,  $\text{Ti}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ .**

Decomposes very quickly with  $\text{H}_2\text{O}$ , forming titanium dihydroxide.

$\text{TiO}_2\text{H}_2$ . (Polidori, Z. anorg. 1899, 19. 306.)

**Titanium dihydroxide.**

See Titanic acid.

**Titanium hydroxychloride,  $\text{TiCl}_3(\text{OH})$ .**

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$  and alcohol. Sol. in ether.

$\text{TiCl}_3(\text{OH})_2 + 1\frac{1}{2}\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether. Aqueous solution decomp. by boiling.

$\text{TiCl}(\text{OH})_2 + \text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . Insol. in alcohol and ether. (König and v. der Pfordten, B. 21. 1708.)

See also Titanium oxychloride.

**Titanium diiodide,  $\text{TiI}_2$ .**

Very hygroscopic; insol. in organic solvents; sol. in conc.  $\text{HF}$  and boiling  $\text{HCl}$ ; decomp. by

H<sub>2</sub>O, alkalies, H<sub>2</sub>SO<sub>4</sub> and HNO<sub>3</sub>. (Defacqz, C. R. 1908, 147. 66.)

**Titanium triiodide, TiI<sub>3</sub>+6H<sub>2</sub>O.**

Very hygroscopic. (Stähler, B. 1904, 37. 4410.)

**Titanium tetraiodide, TiI<sub>4</sub>.**

Fumes on air, and dissolves rapidly in H<sub>2</sub>O with evolution of heat. Solution decomposes on standing. (Weber.)

**Titanium nitride, Ti<sub>3</sub>N<sub>4</sub>.**

Difficultly sol. in warm HNO<sub>3</sub>+Aq. More easily sol. in aqua regia. (Rose.)

Insol. in dil. acids. Decomp. by hot conc. H<sub>2</sub>SO<sub>4</sub> and by conc. HNO<sub>3</sub>, especially when HF is added, and by boiling KOH+Aq. (Ruff and Eisner, B. 1906, 41. 2252.)

Decomp. by H<sub>2</sub>O and dil. acids.

Insol. in all ordinary indifferent organic solvents. (Ruff, B. 1912, 45. 1369.)

TiN<sub>3</sub>. Insol. in H<sub>2</sub>O. (Wöhler.)

Is TiN, according to Guerin (C. R. 82. 972.)

**Titanium monoxide, TiO.**

(Moissan, C. R. 1895, 120. 290.)

**Titanium sesquioxide, Ti<sub>2</sub>O<sub>3</sub>.**

Insol. in HCl or HNO<sub>3</sub>+Aq. Difficultly sol. in H<sub>2</sub>SO<sub>4</sub>. (Ebelmen, A. ch. (3) 20. 392.)

When moist, insol. in H<sub>2</sub>O or NH<sub>4</sub>OH+Aq, but quickly decomp. to TiO<sub>2</sub>. Sol. in oxygen acids, but quickly decomp. (Berzelius.)

**Titanium dioxide, TiO<sub>2</sub>.**

*Amorphous.* Insol. in H<sub>2</sub>O, HCl, or dil. H<sub>2</sub>SO<sub>4</sub>+Aq, even when heated for a long time.

Sol. in conc. H<sub>2</sub>SO<sub>4</sub> by long digestion.

TiO<sub>2</sub>, strongly ignited at 1000°, is practically insol. in conc. H<sub>2</sub>SO<sub>4</sub> and HF.

When less strongly ignited (by heating ortho or metatitanic acid to 700°) it is easily sol. therein. (Bornemann and Schirrmeyer, C. C. 1910, II. 1870.)

Ignited TiO<sub>2</sub> is very difficultly sol. in HF. (Pennington, J. Am. Chem. Soc. 1896, 18. 56.)

The solubility of ignited TiO<sub>2</sub> in H<sub>2</sub>SO<sub>4</sub> is helped by H<sub>2</sub>O<sub>2</sub>. (Weiss and Landecker, Z. anorg. 1909, 64. 71.)

The solubility in H<sub>2</sub>SO<sub>4</sub> is increased by addition of H<sub>2</sub>O<sub>2</sub>. H<sub>2</sub>O<sub>2</sub> brings TiO<sub>2</sub> quickly and completely into solution in the presence of NH<sub>4</sub>OH, NH<sub>4</sub>Cl, NaOH, Na<sub>2</sub>CO<sub>3</sub> and Na<sub>2</sub>HPO<sub>4</sub>. (Weiss and Landecker, Z. anorg. 1909, 64. 71.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 830.)

*Crystalline.* Min. Rutile, Brookite, and Anatase. Solubility as above.

See also Titanic acid.

**Titanium oxide, Ti<sub>2</sub>O<sub>3</sub>.**

(Deville, C. R. 53. 163.)

True formula is TiO<sub>1.5</sub>. (v. der Pfordten, A. 237. 201.)

**Titanium peroxide, TiO<sub>2</sub>.**

Sol. in acids. Solution in H<sub>2</sub>SO<sub>4</sub> is very stable, but the HCl solution decomposes very easily. (Weber, B. 18. 2599; Piccini, B. 15. 2221; Classen, B. 21. 370.)

**Titanium oxychloride, TiO<sub>2</sub>, TiOCl<sub>2</sub>+8H<sub>2</sub>O.**

Sol. in much H<sub>2</sub>O. (Merz, Bull. Soc. 1867. 401.)

Ti<sub>2</sub>O<sub>3</sub>Cl<sub>2</sub>. Insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>OH+Aq with separation of TiO<sub>2</sub>.

See also Titanium hydroxychloride.

**Titanium oxyfluoride.**

Insol. in H<sub>2</sub>O. (Berzelius.)

**Titanium oxyfluoride with MF.**

See Fluoxyperitanate, M.

**Titanium phosphide, TiP.**

Sl. sol. in boiling aqua regia.

Insol. in dil. or conc. acids and alkalies.

Sl. attacked by fuming HNO<sub>3</sub> in sealed tube at 250°-300°. (Gewecke, A. 1908, 361. 84.)

**Titanium phosphochloride.**

See Phosphorus titanium chloride.

**Titanium silicide, TiSi<sub>2</sub>.**

Sol. in HF; insol. in other min. acids.

Slowly sol. in 10% KOH+Aq. (Hönigschmid, C. R. 1906, 143. 226.)

**Titanium monosulphide, TiS.**

Insol. in alkalies. Difficultly sol. in nitric acid and aqua regia.

Insol. in HF. (v. der Pfordten, A. 234. 257.)

**Titanium disulphide, TiS<sub>2</sub>.**

Decomp. slowly on moist air. Insol. in HCl or dil. H<sub>2</sub>SO<sub>4</sub>+Aq. (Ebelmen.)

Sol. in aqua regia or HNO<sub>3</sub>+Aq. Decomp. by KOH+Aq or NaOH+Aq. Insol. in KSH+Aq. (Rose.)

Sol. in HF at 100°. (v. der Pfordten, A. 234. 257.)

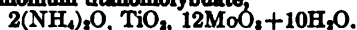
**Titanium sesquisulphide, Ti<sub>2</sub>S<sub>3</sub>.**

Insol. in caustic alkalies+Aq. Sol. in HF at a high temp. Insol. in aqua regia. (v. der Pfordten, A. 234. 257.)

**Titanomolybdic acid, TiO<sub>2</sub>, 12MoO<sub>3</sub>+22H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O.

Sol. in ether. (Pécharde, C. R. 1893, 117. 790.)

**Ammonium titanomolybdate,**

Sol. in  $\text{H}_2\text{O}$  and acids; completely insol. in solutions of ammonium salts. (Péchar'd.)

**Potassium titanomolybdate,**

Efflorescent.

Sol. in  $\text{H}_2\text{O}$ . (Péchar'd.)

**Titanodecitungstic acid,  $\text{H}_2\text{TiW}_{10}\text{O}_{48} + x\text{H}_2\text{O}$ .**

(Lecarme, Bull. Soc. (2) 36. 17.)

**Titanotungstic acid or Titanoduodecitungstic acid,  $\text{H}_2\text{TiW}_{12}\text{O}_{48} + x\text{H}_2\text{O}$** 

(Lecarme, Bull. Soc. (2) 36. 17.)

**Titanous acid.****Sodium titanite,  $\text{Na}_2\text{TiO}_3 = 3\text{Na}_2\text{O}, \text{Ti}_2\text{O}_3$ .**

Sol. in dil. acids. (Koenig and v. der Pfordten, B. 22. 2075.)

**Titanyl compounds.**

See Titanium oxy-compounds.

**Triamine cobaltic compounds.**

See Dichrocobaltic compounds.

**Trithionic acid,  $\text{H}_2\text{S}_3\text{O}_4$ .**

Known only in aqueous solution.

Solution in  $\text{H}_2\text{O}$  gradually decomposes in the cold, rapidly at  $80^\circ$ . Not decomp. if very dilute or in presence of acids, except  $\text{HNO}_3$ ,  $\text{HClO}_4$ , and  $\text{HIO}_4$ . (Fordos and Gélis, A. ch. (3) 23. 451.)

**Trithionates.**

The trithionates are all sol. in  $\text{H}_2\text{O}$ , and very easily decomposed.

**Ammonium trithionate,  $(\text{NH}_4)_2\text{S}_3\text{O}_4$ .**

Very deliquescent and unstable.

Very sol. in  $\text{H}_2\text{O}$ .

Insol. in abs. alcohol. (Divers and Ogawa, Chem. Soc. 1900, 77. 337.)

**Barium trithionate,  $\text{BaS}_3\text{O}_4 + 2\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . Precipitated from aqueous solution by large excess of alcohol. Aqueous solution is very unstable. (Kessler, Pogg. 74. 250.)

**Lead trithionate,  $\text{PbS}_3\text{O}_4$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{Na}_2\text{S}_2\text{O}_3 + \text{Aq.}$  (Fogh, C. R. 110. 524.)

**Potassium trithionate,  $\text{K}_2\text{S}_3\text{O}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. (Kessler, Pogg. 74. 270.)

Sol. in  $\text{H}_2\text{O}$  with decomp.

Insol. in alcohol. (Langlois, A. 1841, 40. 102.)

**Sodium trithionate,  $\text{Na}_2\text{S}_3\text{O}_4$ .**

Very sol. in  $\text{H}_2\text{O}$ .

+  $3\text{H}_2\text{O}$ . (Villiers, C. R. 106. 1356.)

**Thalious trithionate,  $\text{Tl}_2\text{S}_3\text{O}_4$ .**

Sol. in  $\text{H}_2\text{O}$ . (Bevan, C. N. 33. 294.)

**Zinc trithionate.**

Sol. in  $\text{H}_2\text{O}$ , but decomposes upon warming the solution. (Fordos and Gélis, C. R. 16. 1070.)

**Tungsten, W.**

*Metallic.* Not attacked by heating with fuming  $\text{HNO}_3$ , aqua regia, or other acids, or by boiling  $\text{KOH} + \text{Aq.}$  Sol. in  $\text{KOH} + \text{Aq.}$  and  $\text{NaClO} + \text{Aq.}$  (v. Ular, A. 94. 255.)

Not easily acted upon by moist air, if no  $\text{CO}_2$  present. Sol. in a mixture of  $\text{HF}$  and  $\text{HNO}_3$ . Very slowly sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and  $\text{HF}$ . (Moissan, C. R. 1896, 123. 15.)

Very slowly attacked by  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and even  $\text{CrO}_3$ . A mixture of  $\text{CrO}_3$  and  $\text{H}_2\text{SO}_4$  dissolved 1.67 g. in 16 hrs. from a fine wire and 1.36 g. in 14 hours. (Fink, Met. Chem. Eng. 1910, 8. 341.)

Compact tungsten is not attacked by dil., and only sl. dissolved by conc.  $\text{H}_2\text{SO}_4$ . Not attacked by dil. or conc.  $\text{HCl}$ ,  $\text{HNO}_3$ , and  $\text{HNO}_3 + \text{HCl}$  attack slowly by long heating, forming thin layer of  $\text{WO}_3$ . Slowly sol. in  $\text{HNO}_3 + \text{HF}$ . (Weiss, Z. anorg. 1910, 65. 339.)

Aluminothermic tungsten is insol. in acids and in aqua regia. Sol. in fused  $\text{KOH}$ . (Stavenhagen, B. 1899, 32. 1515.)

Insol. in  $\text{HCl}$  of any concentration at room temp. and only very sl. sol. at  $110^\circ$ . After being in contact with hot conc.  $\text{HCl}$  (sp. gr. 1.15) for 175 hrs. the metal lost 0.5% of its weight. Sl. sol. in dil.  $\text{HCl}$  at  $110^\circ$ .

Insol. in conc.  $\text{H}_2\text{SO}_4$  at room temp. and in dil.  $\text{H}_2\text{SO}_4$  at  $110^\circ$ . Somewhat sol. in conc.  $\text{H}_2\text{SO}_4$  at high temp.

Insol. in conc.  $\text{HNO}_3$ , and hot or cold  $\text{HF}$ . Sl. sol. in aqua regia.

Very sol. in  $\text{HF} + \text{HNO}_3$ . (Ruder, J. Am. Chem. Soc. 1912, 34. 387.)

Insol. in aqua regia and acids; sol. in fused  $\text{KOH}$ . (Stavenhagen, B. 1899, 32. 1514.)

Insol. in  $\text{KOH} + \text{Aq.}$

Sol. in fused  $\text{KOH}$ .

Slowly sol. in fused  $\text{Na}_2\text{CO}_3$ ,  $\text{K}_2\text{CO}_3$ , or mixture of the two.

Somewhat sol. in  $\text{NaOCl} + \text{Aq.}$  (Ruder, J. Am. Chem. Soc. 1912, 34. 388.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

*Crystalline.* Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , or  $\text{H}_2\text{SO}_4$ . Oxidised by  $\text{HNO}_3$  or aqua regia. (D'Elhujar, J.)

Sol. in boiling  $\text{KOH} + \text{Aq.}$  (Riche, A. ch. (3) 50. 5.)

*Amorphous.* Easily oxidised by  $\text{HNO}_3 + \text{Aq.}$  (Zettnow.)

**Tungsten amide.**

See Tungsten nitride.

**Tungsten arsenide,  $WAs_2$ .**

Insol. in  $H_2O$  and other solvents. Not attacked by boiling HF or  $HNO_3$ . Sol. in cold HF +  $HNO_3$  and in hot aqua regia. Not attacked by hot KOH + Aq or NaOH + Aq. Decomp. by fused KOH or NaOH. (Defacqz, C. R. 1901, 132. 139.)

**Tungsten boride,  $WB_2$ .**

Slowly attacked by conc. acids; vigorously attacked by aqua regia. (Tucker and Moody, Chem. Soc. 1902, 81. 16.)

**Tungsten dibromide,  $WBr_2$ .**

Partly sol. in  $H_2O$ , the rest decomposing to  $WO_2$  and HBr.

**Tungsten pentabromide,  $WBr_5$ .**

Decomp. by moist air or  $H_2O$ . Sol. in caustic alkalis + Aq.

Very hygroscopic. Fumes in the air.

Decomp. by  $H_2O$ .

Sol. in HF, or conc. HCl. Sl. sol. in fuming HBr. Decomp. by dil. HCl, conc.  $HNO_3$ , or dil.  $H_2SO_4$ . Readily attacked by fused alkalis or alkalis + Aq. Sol. in  $CCl_4$ ,  $CHCl_3$ ,  $CHBr_3$ , abs. alcohol, ether, essence of terebenthine and benzene. (Defacqz, C. R. 1899, 123. 1232.)

**Tungsten hexabromide,  $WBr_6$ .**

Decomp. by  $H_2O$  and in the air.

Sol. in  $NH_4OH$  + Aq. (Smith, J. Am. Chem. Soc. 1897, 18. 1100.)

**Tungsten bromochloride,  $WCl_2$ ,  $WBr_2$ .**

Decomp. by  $H_2O$ . Sol. in HF. Decomp. by  $HNO_3$  or  $H_2SO_4$ . Violently attacked by fused alkali or alkali + Aq. Sol. in most organic solvents.

$WCl_2$ ,  $3WBr_2$ . Properties like those of  $WCl_4$ ,  $WBr_4$ . (Defacqz, C. R. 1899, 129. 516.)

Decomp. by  $H_2O$ . Sol. in 40% HF + Aq.  $22^\circ$  B. HCl + Aq gives a sl. ppt. of  $WO_3$ . Decomp. by  $HNO_3$  and by  $H_2SO_4$ . Sol. in abs. alcohol, ether,  $CS_2$ ,  $C_6H_6$  and glycerine. Sol. in  $CCl_4$  only on warming. Nearly insol. in oil of turpentine. (Defacqz.)

**Tungsten bronze.**

See—

Tungstate tungsten oxide, barium.

Tungstate tungsten oxide, barium potassium.

Tungstate tungsten oxide, barium sodium.

Tungstate tungsten oxide, calcium potassium.

Tungstate tungsten oxide, calcium sodium.

Tungstate tungsten oxide, lithium.

Tungstate tungsten oxide, lithium potassium.

Tungstate tungsten oxide, potassium.

Tungstate tungsten oxide, potassium sodium.

Tungstate tungsten oxide, potassium strontium.

Tungstate tungsten oxide, sodium.

Tungstate tungsten oxide, sodium strontium.

**Tungsten carbide,  $W_2C$ .**

Sol. in boiling  $HNO_3$ ; very slowly acted upon by other acids. (Moissan, C. R. 1890, 123. 16.)

$WC$ . Insol. in dil. acids; only sl. sol. in  $H_2SO_4$  and conc.  $HNO_3$ ; sol. in fused  $KClO_3$  and  $KNO_3$ . (Williams, C. R. 198. 1724.)

**Tungsten dichloride,  $WCl_2$ .**

Decomp. on the air or with  $H_2O$ . (Roscoe.)

**Tungsten tetrachloride,  $WCl_4$ .**

Deliquescent. Partly sol. in  $H_2O$ , with subsequent decomposition. (Roscoe.)

**Tungsten pentachloride,  $WCl_5$ .**

Very deliquescent. Decomp. with  $H_2O$  with hissing and evolution of heat and separation of  $W_2O_5$ .

Very sl. sol. in  $CS_2$ . (Roscoe.)

**Tungsten hexachloride,  $WCl_6$ .**

Not decomp. by moist air or  $H_2O$ . Decomp. by alcohol. Very sol. in  $CS_2$ . (Roscoe.)

Easily sol. in  $POCl_3$ . (Teclu, A. 187. 255.)

**Tungsten chloride nitrogen sulphide,  $WCl_4$ ,  $N_2S_4$ .**

(Davis, Chem. Soc. 1906, 89. (2) 1575.)

**Tungsten chloroarsenide,  $W_2AsCl_3$ .**

Hygroscopic; decomp. by  $H_2O$  and acids; sol. in aq. solution of alkalis; insol. in anhydrous organic solvents. (Defacqz, C. R. 1901, 132. 139.)

**Tungsten chlorosulphide,  $W_2S_2Cl_3$ .**

Decomp. by  $H_2O$ .

Sol. in  $S_2Cl_2$ . (Smith and Oberholtzer, Z. anorg. 1894, 5. 68.)

$WCl_4$ ,  $3WS_2$ . Decomp. by  $H_2O$ . Insol. in  $CS_2$ , alcohol and  $C_6H_6$ . (Defacqz, A. ch. 1901, (7) 22. 266.)

**Tungsten hexafluoride,  $WF_6$ .**

Fumes in the air.

Decomp. by  $H_2O$ . Easily sol. in aq. alkalis. (Ruff, B. 1905, 33. 747.)

**Tungsten diiodide,  $WI_2$ .**

Not decomp. by  $H_2O$ . (Roscoe, A. 162. 366.)

Insol. in  $H_2O$ ,  $CS_2$  and alcohol. Decomp. by boiling  $H_2O$ ,  $HNO_3$ ,  $H_2SO_4$  and aqua regia; sol. in fused KOH, and alkali carbonates. (Defacqz, C. R. 1898, 126. 936.)

**Tungsten tetraiodide,  $WI_4$ .**

Insol. in  $H_2O$ , ether, chloroform and turpentine; sol. in abs. alcohol; decomp. when boiled with  $H_2O$ ; sol. with decomp. in dil.  $HCl$  and  $H_2SO_4$ , in  $HNO_3$  and aqua regia, and in alkali hydroxides and carbonates fused or in aq. solution. (Defacqz, C. R. 1898, 127. 511.)

**Tritungsten nitride,  $W_3N_2$ .**

(Uhrlaub.)

$W_3N_2$ . Insol. in  $HNO_3$ , dil.  $H_2SO_4$  and  $NaOH$ +Aq. (Rideal, Chem. Soc. 1889, 55. 44.)

**Tungsten nitride amide,  $W_3N_2H_4=2WN_2, W(NH_2)_2$ .**

Not attacked by acids or caustic alkalis + Aq. (Wöhler, A. 73. 191.)

**Tungsten nitride amide oxide,  $W_7N_2H_4O_4=3WN_2, W_2(NH_2)_2, 2WO_3$ .**

Not attacked by acids or alkalis. (Wöhler.)

**Tungsten monoxide,  $WO$ .**

Insol. in  $H_2O$ . Not attacked by  $HCl$ ,  $HF$ ,  $H_2SO_4$ , or  $KOH$ +Aq.  $HNO_3$ +Aq or aqua regia convert it into  $WO_3$ . (Headden, Sil. Am. J. 145. 280.)

**Tungsten dioxide,  $WO_2$ .**

(a) When prepared in the dry way, is attacked only by aqua regia, which oxidises to  $WO_3$ .

(b) When moist, is sol. in  $HCl$  or  $H_2SO_4$ +Aq, also in  $KOH$ +Aq. Insol. in  $NH_4OH$ +Aq. (Riche, A. ch. (3) 50. 5.)

*Cryst.* Insol. in  $HCl$ ,  $H_2SO_4$  and conc. aq. alkalis; sol. in  $HNO_3$ . (Hallepeau, C. R. 1898, 127. 135.)

**Tungsten oxide, blue.**

$W_2O_5$  (Riche, A. ch. (3) 50. 33);  $W_3O_5$  (v. Uslar);  $W_4O_{11}$  (Gmelin).

All are probably the same substance. Not attacked by boiling  $HNO_3$  or aqua regia. Slowly sol. in boiling  $KOH$ +Aq.

**Tungsten trioxide,  $WO_3$ .**

Insol. in  $H_2O$  or acids. Sl. sol. in dil.  $KOH$ +Aq,  $NaOH$ +Aq,  $Na_2CO_3$ +Aq, or  $H_2CO_3$ +Aq, but easily sol. in conc. boiling solutions of same.  $NH_4OH$ +Aq when boiling has a solvent action.

Insol. in conc. and dil.  $H_2SO_4$ . (Desi, J. Am. Chem. Soc. 1897, 19. 214.)

*Min. Tungstite.* Insol. in acids. Sol. in  $NH_4OH$ +Aq.

**Tungsten oxide,  $W_2O_5$ .**

Sol. in alkalis. (Desi, J. Am. Chem. Soc. 1897, 19. 214.)

$W_2O_5$ . Insol. in acids and alkalis. (Desi, J. Am. Chem. Soc. 1897, 19. 228.)

+ $H_2O$ . Like  $W_2O_5$ + $H_2O$ . (Allen and Gottschalk, Am. Ch. J. 1902, 27. 336.)

$W_2O_5$ . (Desi, J. Am. Chem. Soc. 1897, 19. 219.)

$W_2O_5$ . (Desi.)

$W_2O_5$ + $H_2O$ . Insol. in  $H_2O$  containing a little  $HCl$ .

Slowly attacked by cold, conc.  $MOH$ +Aq. (Allen and Gottschalk, Am. Ch. J. 1902, 27. 333.)

**Tungsten trioxide ammonia,  $WO_3, 3NH_3$ .**

(Rosenheim and Jacobsohn, Z. anorg. 1906, 50. 306.)

**Tungsten oxybromide, etc.**

See Tungstyl bromide, etc.

**Tungsten monophosphide,  $WP$ .**

Not attacked by  $HF$  or  $HCl$ .

Sol. in warm  $HNO_3$ + $HF$ . Slowly attacked by hot  $HNO_3$ .

Not attacked by  $KOH$ +Aq or  $NaOH$ +Aq. (Defacqz, C. R. 1901, 132. 34.)

**Tungsten diphosphide,  $WP_2$ .**

Insol. in  $H_2O$  and in most organic solvents; insol. in  $HCl$  and  $HF$ ; sol. in a mixture of  $HF$  and  $HNO_3$  in the cold, and in aqua regia on warming. (Defacqz, C. R. 1900, 120. 916.)

**Tungsten phosphide,  $W_4P_3$ .**

Not attacked by any acid, not even by aqua regia. (Wöhler and Wright, A. 79. 244.)

$W_4P_4$ . (Wöhler and Wright.)

**Tungsten diselenide,  $WSe_2$ .**

(Uelsmann.)

**Tungsten triselenide,  $WSe_3$ .**

Easily sol. in alkali sulphides or selenides +Aq. (Uelsmann, Jahrb. f. Ch. 1890. 92.)

**Tungsten silicide.**

Sol. in  $HF$ .

Only very sl. sol. in other acids. (Warren, C. N. 1898, 73. 319.)

$WSi_2$ . Not attacked by ordinary acids and scarcely by warm aqua regia, but violently attacked by  $HNO_3$ + $HF$ . Sl. attacked by 10% alkalis+Aq. (Hönigschmid, M. 1907, 23. 1017.)

Not attacked by dil. or conc.  $HCl$ ,  $HF$ ,  $HNO_3$  or  $H_2SO_4$ , nor by hot aqua regia.

Attacked by  $HNO_3$ + $HF$  or by fused alkalis. (Defacqz, C. R. 1907, 144. 850.)

$WSi_3$ . Violently attacked by  $HNO_3$ + $HF$ . Not attacked by  $HNO_3$ ,  $H_2SO_4$ ,  $HCl$  or  $HF$ . (Friley, Rev. Mét. 1911, 8. 509.)

$W_2Si_3$ . Insol. in acids including  $HF$ ; sol. in a mixture of  $HF$  and  $HNO_3$ ; sol. in fused alkali hydroxides and carbonates. (Vigouroux, C. R. 1898, 127. 394.)

**Tungsten disulphide, WS<sub>2</sub>.**

Oxidised by HNO<sub>3</sub>+Aq. (Berzelius.)

Insol. in min. acids.

Sol. in a mixture of HF and HNO<sub>3</sub> and in fused alkalis and alkali carbonates. (De-faocq, C. R. 1899, 128. 611.)

**Tungsten trisulphide, WS<sub>3</sub>.**

Somewhat sol. in cold, abundantly in hot H<sub>2</sub>O, but separated out by the addition of salts, especially NH<sub>4</sub>Cl, or acids. Sol. in alkali sulphides, and hydrosulphides+Aq. Sol. in caustic alkalies, and alkali carbonates +Aq. Slowly sol. in NH<sub>4</sub>OH+Aq in the cold.

**Tungstic acid, H<sub>2</sub>WO<sub>4</sub>.**

Insol. in H<sub>2</sub>O. Sol. in HF. Insol. in tungstates+Aq.

44.7% H<sub>2</sub>WO<sub>4</sub> is sol. in 50% HF+Aq at 25°.

55.3% H<sub>2</sub>WO<sub>4</sub> is sol. in 50% HF+Aq at 50°.

100 g. sat. H<sub>2</sub>WO<sub>4</sub>+HCl+Aq contain 0.68 g. H<sub>2</sub>WO<sub>4</sub> at 80°.

9.8 % H<sub>2</sub>WO<sub>4</sub> is sol. in sat. alcoholic HCl at 75°.

Insol. in alcoholic solutions of HBr and HI. (Rosenheim, Chem. Soc. 1911, 100. (2) 402.)

Freshly pptd. tungstic acid dissolves in H<sub>2</sub>O<sub>2</sub>. (Kellner, Dissert. 1909.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 830.)

H<sub>2</sub>WO<sub>4</sub>. Precipitate. Sl. sol. in H<sub>2</sub>O and aqueous solutions of the tungstates. Sol. in 250-300 pts. H<sub>2</sub>O. When freshly pptd., sol. in alkali hydrates or carbonates+Aq. (Anthon, J. pr. 9. 6.)

**Metatungstic acid, H<sub>2</sub>W<sub>2</sub>O<sub>11</sub>+9H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. Solution may be boiled and evaporated to a syrupy consistency, when it suddenly gelatinises and ordinary tungstic acid is precipitated.

Sol. in H<sub>2</sub>O. When heated to 50°, it becomes insol. in H<sub>2</sub>O. (Soboleff, Z. anorg. 1896, 12. 28.)

Solubility in H<sub>2</sub>O at t°.

t°	100 ccm. H <sub>2</sub> O dissolve g. of the cryst. acid	Sp. gr. of the solution
0	41.46	1.6025
22	88.57	2.5289
43.5	111.87	3.6503

(Soboleff.)

Sp. gr. of solution of metatungstic acid at 17.5° containing:

2.79 12.68 27.61 43.75% WO<sub>3</sub>.  
1.0257 1.1275 1.3274 1.6343

(Scheibler, J. pr. 83. 273.)

Sp. gr. of aqueous solution calculated by M=Mendeleeff, and G=(Gerlach (Z. anal. 27. 300), containing:

5 10 15 20 25% WO<sub>3</sub>,  
M 1.047 1.098 1.153 1.214 1.285  
G 1.0469 1.0980 1.1544 1.2172 1.2873

30 35 40 45 50% WO<sub>3</sub>.  
M 1.366 1.458 1.555 1.581 (?)  
G 1.3660 1.4540 1.5527 1.6630 1.7860

Solubility in ether at t°.

t°	100 ccm. ether dissolve g. of the cryst. acid
0	83.456
7.8	88.389
18.2	99.66
24.3	110.76

(Soboleff, Z. anorg. 1896, 12. 32.)

*Colloidal.* Sol. in H<sub>2</sub>O. Not precipitated by acids or alcohol. Can be evaporated to dryness and heated to 200°, and still remains sol. in H<sub>2</sub>O. Sol. in ¼pt. of H<sub>2</sub>O.

Sp. gr. of aqueous solution containing:

5 20 50 66.5 79.8% WO<sub>3</sub>.  
1.0475 1.2168 1.8001 2.596 3.243

(Graham, Chem. Soc. 17. 318.)

Perhaps *paratungstic acid*, H<sub>10</sub>W<sub>17</sub>O<sub>41</sub>. (Klein, Bull. Soc. (2) 36. 547.)

**Tungstates.**

Few normal tungstates are sol. in H<sub>2</sub>O, even some of the K and NH<sub>4</sub> salts are very sl. sol. Most of the metatungstates, however, are easily sol. in H<sub>2</sub>O.

Tungstates insol. in H<sub>2</sub>O are usually insol. in dil. acids.

**Aluminum tungstate, Al<sub>2</sub>(WO<sub>4</sub>)<sub>3</sub>+8H<sub>2</sub>O.**

Precipitate. Insol. in H<sub>2</sub>O and Na<sub>2</sub>WO<sub>4</sub>+Aq. Sol. in (NH<sub>4</sub>)<sub>2</sub>Al<sub>2</sub>(SO<sub>4</sub>)<sub>4</sub>+Aq, NaOH+Aq, NH<sub>4</sub>OH+Aq.

Easily sol. in H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>, and H<sub>2</sub>C<sub>4</sub>H<sub>4</sub>O<sub>6</sub>+Aq. (Lotz, A. 83. 65.)

Sol. in 1500 pts. H<sub>2</sub>O at 15°. (Lefort, C. R. 87. 748.)

Al<sub>2</sub>O<sub>3</sub>. 4WO<sub>3</sub>+9H<sub>2</sub>O. Sol. in 400 pts. H<sub>2</sub>O at 15°. (Lefort, C. R. 87. 748.)

Al<sub>2</sub>O<sub>3</sub>. 5WO<sub>3</sub>+6H<sub>2</sub>O. Sol. in H<sub>2</sub>O, from which it is pptd. by alcohol. (Lefort.)

Formula according to Lefort is Al<sub>2</sub>O<sub>3</sub>. 3WO<sub>3</sub>+3H<sub>2</sub>O, 2WO<sub>3</sub>.

See also *Aluminicotungstic acid*.

**Aluminum paratungstate, 5Al<sub>2</sub>O<sub>3</sub>. 36WO<sub>3</sub>+46H<sub>2</sub>O=Al<sub>2</sub>O<sub>3</sub>. 7WO<sub>3</sub>+9H<sub>2</sub>O (?).**

Easily sol. in an alum solution. (Lotz, A. 83. 65.)

**Aluminum ammonium tungstate, 3(NH<sub>4</sub>)<sub>2</sub>O. Al<sub>2</sub>O<sub>3</sub>. 9WO<sub>3</sub>+4H<sub>2</sub>O.**

Sol. in conc. HNO<sub>3</sub> and in conc. HCl. (Balke and Smith, J. Am. Chem. Soc. 1903, 25. 1230.)

**Aluminum ammonium antimony tungstate.**

See *Aluminicoantimoniotungstate, ammonium*.

**Aluminum antimony tungstate.**

See *Aluminicoantimoniotungstic acid*.

**Aluminum zinc tungstate,  $Al_2O_3$ ,  $ZnO$ ,  $9WO_3$ ,  $+20H_2O$ .**

Very sol. in  $H_2O$ . (Daniels, J. Am. Chem. Soc. 1908, 30. 1850.)

$2Al_2O_3$ ,  $3ZnO$ ,  $18WO_3$ ,  $+16H_2O$ . Sol. in much  $H_2O$ .

Sol. in very dil. mineral acids or in acetic acid. (Daniels.)

**Ammonium tungstate,  $(NH_4)_2WO_4$ .**

Known only in solution.

$(NH_4)_2W_2O_{11} + 3H_2O = 2(NH_4)_2O$ ,  $3WO_3$ ,  $+3H_2O$ . Sol. in  $H_2O$  with decomp. Decomp. on air with evolution of  $NH_3$ , and formation of *paratungstate*. Sol. in  $NH_4OH$  + Aq. (Marignac, A. ch. (3) 69. 23.)

$(NH_4)_2W_2O_{17} + 5H_2O = 2(NH_4)_2O$ ,  $5WO_3$ ,  $+5H_2O$ . Sol. at ordinary temp. in 26-29 pts.  $H_2O$  with partial decomposition. (Marignac.)  $+2\frac{1}{2}H_2O$ ,  $+3H_2O$ ,  $+4H_2O$ ,  $+4\frac{1}{2}H_2O$ , and  $+5H_2O$ . (Pinagel, Dissert, 1904.)

$(NH_4)_2W_2O_{27} + 8H_2O = 3(NH_4)_2O$ ,  $8WO_3$ ,  $+8H_2O$ . Sol. in  $H_2O$ . (Marignac.)

*Colloidal*.  $(NH_4)_2O$ ,  $6WO_3$ ,  $+4$  or  $6H_2O$ . Miscible with water in nearly all proportions. (Taylor, J. Am. Chem. Soc. 1902, 24. 632.)

**Ammonium metatungstate,  $(NH_4)_4W_7O_{19}$ .**

$+6H_2O$ . (Marignac, A. ch. (4) 3. 74.)

$+8H_2O$ . Efflorescent. Very sol. in  $H_2O$ .

1 pt. dissolves at  $15^\circ$  in 0.84 pt.  $H_2O$ . (Lots.)

1 pt. dissolves at ordinary temp. in 0.35 pt.  $H_2O$ . (Riche.)

Solubility increases rapidly with the temperature.

Saturated solution at  $40^\circ$  is solid on cooling.

Sl. sol. in ordinary, insol. in absolute alcohol. (Lots.) Insol. in ether. (Riche.)

$[(NH_4)_2W_2O_{10} + 5H_2O$  of Margueritte.]

$(NH_4)_4W_{10}O_{31} + 17H_2O = 3(NH_4)_2O$ ,  $16WO_3$ ,  $+17H_2O$ . Very efflorescent. Decomp. by dissolving in pure  $H_2O$ . (Marignac, A. ch. (4) 3. 75.)

**Ammonium paratungstate,  $(NH_4)_{10}W_{12}O_{41} = 5(NH_4)_2O$ ,  $12WO_3$ .**

(Marignac, A. ch. (3) 69. 25.)

According to Lots (A. 91. 49) and Scheibler (J. pr. 80. 208), formula is  $(NH_4)_8W_7O_{34} = 3(NH_4)_2O$ ,  $7WO_3$ .

$+5H_2O$ . (Scheibler, J. pr. 48. 232.)

$+11H_2O$ . Sol. in 25-28 pts. cold  $H_2O$ . (Anthon.)

Sol. in 26.1 pts.  $H_2O$  at  $10.7^\circ$ , and 5.8 pts. at  $100^\circ$ . (Lots.)

Sol. in 33.3 pts. cold  $H_2O$ , and 9.6 pts. at  $100^\circ$ . (Riche.)

Sol. in 22-38 pts.  $H_2O$  at  $15-18^\circ$ . The solution gradually decomposes, with the formation of a more soluble salt. (Marignac.)

Not much more sol. in  $NH_4OH$  + Aq than in  $H_2O$ . Insol. in alcohol. (Anthon.)

Sol. in  $H_2O_2$ . (Kellner, Dissert, 1900.)

**Ammonium bismuth tungstate.**

See *Bismuthicotungstate, ammonium*.

**Ammonium cadmium paratungstate,**

$3(NH_4)_2O$ ,  $12CdO$ ,  $35WO_3$ ,  $+35H_2O$ .

Ppt. Sol. in  $H_2O$  acidulated with  $HNO_3$ . (Lots, A. 91. 49.)

**Ammonium cerium tungstate.**

See *Cericotungstate, ammonium*.

**Ammonium cobaltous tungstate,  $8(NH_4)_2O$ ,**

$2CoO$ ,  $15WO_3$ ,  $+3H_2O$ .

(Carnot, C. R. 109. 147.)

**Ammonium hydroxylamine tungstate,**

$NH_4OWO_2NH_4$ .

Sol. in  $H_2O$ . (Hofmann, Z. anorg. 1898, 16. 465.)

**Ammonium iron (ferric) tungstate,  $5(NH_4)_2O$ ,**

$Fe_2O_3$ ,  $5WO_3$ ,  $+5H_2O$ .

Sol. in  $H_2O$ . (Borek.)

**Ammonium lanthanum tungstate.**

See *Lanthanicotungstate, ammonium*.

**Ammonium magnesium paratungstate,**

$2(NH_4)_2O$ ,  $3MgO$ ,  $12WO_3$ ,  $+24H_2O$ .

Very slightly sol. in  $H_2O$ . (Marignac, A. ch. (3) 69. 58.)

$(NH_4)_2O$ ,  $2MgO$ ,  $7WO_3$ ,  $+10H_2O$ . Very sl. sol. in  $H_2O$ ; sol. in  $H_2O$  acidulated with  $HNO_3$ . (Lots.)

**Ammonium mercuric tungstate,  $(NH_4)_2WO_4$ ,**

$HgWO_4$ ,  $+H_2O$ .

Insol. in  $H_2O$ . Decomp. by acids or alkalis. (Anthon.)

**Ammonium neodymium tungstate.**

See *Neodymicotungstate, ammonium*.

**Ammonium nickel tungstate.**

See *Nickelicotungstate, ammonium*.

**Ammonium potassium paratungstate,**

$5K(NH_4)_2O$ ,  $12WO_3$ ,  $+11H_2O$ .

Sol. in boiling  $H_2O$ ; sl. sol. in cold  $H_2O$ . (Hallopeau, C. R. 1896, 123. 180.)

**Ammonium potassium sodium paratungstate,**

$5(K, Na, NH_4)_2O$ ,  $12WO_3$ ,  $+13H_2O$ , where  $K : Na : NH_4 = 3 : 3 : 4$ .

$10(K, Na, NH_4)_2O$ ,  $24WO_3$ ,  $+26H_2O$ , where  $K : Na : NH_4 = 3 : 3 : 14$ . (Laurent.)

**Ammonium sodium paratungstate**,  $4(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 5\text{H}_2\text{O}$ .

Can be crystallised from  $\text{H}_2\text{O}$  without decomp. (Lotz, A. 91. 57.)

+  $14\text{H}_2\text{O}$ . Sol. in warm  $\text{H}_2\text{O}$ . (Hallopeau, C. R. 1896, 123. 181.)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 25\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ . (Hallopeau, C. R. 1895, 120. 1344.)

$5\text{Na}_2\text{O}$ ,  $15(\text{NH}_4)_2\text{O}$ ,  $48\text{WO}_3 + 48\text{H}_2\text{O}$ . (Marignac, A. ch. (3) 69. 53.)

$2\text{Na}_2\text{O}$ ,  $3(\text{NH}_4)_2\text{O}$ ,  $12\text{WO}_3 + 15\text{H}_2\text{O}$ . (Marignac.)

$3(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 15\text{H}_2\text{O}$ .  $3(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $16\text{WO}_3 + 22\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  without decomp. (Hallopeau, C. R. 1896, 123. 181.)

$3\text{Na}_2\text{O}$ ,  $4(\text{NH}_4)_2\text{O}$ ,  $16\text{WO}_3 + 18\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 236.)

Is  $2\text{Na}_2\text{O}$ ,  $3(\text{NH}_4)_2\text{O}$ ,  $12\text{WO}_3 + 13\text{H}_2\text{O}$ , according to Knorre (B. 19. 823).

Very sol. in hot  $\text{H}_2\text{O}$ . (Knorre, B. 1886, 19. 823.)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{Na}_2\text{O}$ ,  $16\text{WO}_3 + 38\text{H}_2\text{O}$ . (Wyrouboff, Bull. Soc. Min. 1892, 15. 85.)

$6(\text{NH}_4)_2\text{O}$ ,  $2\text{Na}_2\text{O}$ ,  $20\text{WO}_3 + 24\text{H}_2\text{O}$ . Can be cryst. from boiling  $\text{H}_2\text{O}$ . (Baragiola, Dissert, 1902.)

$4\text{Na}_2\text{O}$ ,  $16(\text{NH}_4)_2\text{O}$ ,  $50\text{WO}_3 + 50\text{H}_2\text{O}$ . Sl. sol. in cold  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. 15. 12.)

**Ammonium zinc paratungstate**,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{ZnO}$ ,  $7\text{WO}_3 + 13\text{H}_2\text{O}$ .

Sl. sol. in boiling  $\text{H}_2\text{O}$ , but more easily on addition of oxalic, tartaric, phosphoric, or dil. nitric acids, or of ammonium tungstate. (Lotz, A. 91. 49.)

**Ammonium zirconium tungstate.**

See Zirconotungstate, ammonium.

**Ammonium metatungstate nitrate.**

See Nitrate metatungstate, ammonium.

**Ammonium tungstate vanadate.**

See Vanadiotungstate, ammonium.

**Antimony tungstate**,  $\text{Sb}_2\text{O}_3$ ,  $5\text{WO}_3 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$  without decomp. (Lefort.)

$\text{Sb}_2\text{O}_3$ ,  $6\text{WO}_3 + 8\text{H}_2\text{O}$ . Ppt.

See also Antimoniotungstic acid.

**Barium tungstate**,  $\text{BaWO}_4$ .

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{HNO}_3 + \text{Aq.}$  (Geuther and Forsberg, A. 120. 270.)

+  $\frac{1}{2}\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or boiling  $\text{H}_3\text{PO}_4 + \text{Aq.}$  Sol. in boiling, less sol. in cold  $\text{H}_3\text{C}_2\text{O}_4 + \text{Aq.}$  (Anthon.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . Insol. precipitate. (Scheibler.) Pptd.  $\text{BaWO}_4$  is attacked by dil. acids.

More sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$  than in  $\text{H}_2\text{O}$ . (Smith and Bradbury, B. 24. 2930.)

**Barium ditungstate**,  $\text{BaW}_2\text{O}_7 + \text{H}_2\text{O}$  (?).

Nearly insol. in  $\text{H}_2\text{O}$ . 100 ccm.  $\text{H}_2\text{O}$  dissolve about 0.05 g. at  $15^\circ$ . (Lefort, A. ch. (5) 15. 325.)

**Barium tritungstate**,  $\text{BaW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).

Sol. in about 300 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . Decomp. by boiling  $\text{H}_2\text{O}$  into an insol. salt. (Lefort, C. R. 88. 798.)

+  $6\text{H}_2\text{O}$ . (Scheibler.)

**Barium metatungstate**,  $\text{BaW}_6\text{O}_{18} + 9\text{H}_2\text{O}$ .

Efflorescent. Quite sol. in hot  $\text{H}_2\text{O}$ . Partly decomp. by cold  $\text{H}_2\text{O}$  into  $\text{BaW}_2\text{O}_7$  and  $\text{WO}_3$ , which recombine on heating. (Scheibler, J. pr. 80. 204.)

**Barium tungstate**,  $\text{BaW}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq.}$  (Zettnow.)  $\text{BaW}_2\text{O}_{11}$ . *Barium bronze.* (Hallopeau, A. ch. 1900, (7) 19. 121.)

**Barium paratungstate**,  $\text{Ba}_5\text{W}_{12}\text{O}_{41} + 14\text{H}_2\text{O}$ , or  $\text{Ba}_5\text{W}_7\text{O}_{34} + 8\text{H}_2\text{O}$ .

Insol. in cold  $\text{H}_2\text{O}$ ; when freshly pptd. is sl. sol. in  $\text{HNO}_3 + \text{Aq.}$  (Lotz, A. 91. 60.) Sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder.)

+  $27\text{H}_2\text{O} = \text{Ba}_5\text{W}_7\text{O}_{34} + 16\text{H}_2\text{O}$ . Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Knorre, B. 18. 327.)

**Barium potassium tungstate tungsten oxide**,  $\text{BaW}_6\text{O}_{18}$ ,  $5\text{K}_2\text{W}_6\text{O}_{18}$ .

(Engels, Z. anorg. 1903, 37. 136.)

**Barium silver metatungstate.**

(Scheibler.)

**Barium sodium paratungstate**,  $2\text{BaO}$ ,  $3\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 24\text{H}_2\text{O}$ . (Marignac), or  $\text{BaO}$ ,  $2\text{Na}_2\text{O}$ ,  $7\text{WO}_3 + 14\text{H}_2\text{O}$  (Scheibler).

Insol. in  $\text{H}_2\text{O}$ .

**Barium sodium tungstate tungsten oxide**,  $2\text{BaW}_6\text{O}_{18}$ ,  $3\text{Na}_2\text{W}_6\text{O}_{18}$ .

$\text{BaW}_6\text{O}_{18}$ ,  $5\text{Na}_2\text{W}_6\text{O}_{18}$ . (Engels, Z. anorg. 1903, 37. 131.)

**Bismuth tungstate**,  $\text{Bi}_2\text{O}_3$ ,  $6\text{WO}_3 + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$  with decomp. Pptd. by alcohol from aqueous solution. (Lefort, C. R. 87. 748.)

**Cadmium tungstate**,  $\text{CdWO}_4$ .

*Anhydrous.*

+  $\text{H}_2\text{O}$ . Sol. in about 2000 pts.  $\text{H}_2\text{O}$ . (Lefort.)

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in hot phosphoric or oxalic acids, or in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Anthon, J. pr. 9. 341.)

Sol. in  $\text{KCN} + \text{Aq.}$  (Smith and Bradbury, B. 24. 2390.)



**Cadmium ditungstate,  $\text{CdW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?).**

Sol. in about 500 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, A. ch. (5) 15. 346.)

**Cadmium tritungstate,  $\text{CdW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).**  
(Lefort.)**Cadmium metatungstate,  $\text{CdO}$ ,  $4\text{WO}_3 + 10\text{H}_2\text{O}$ .**

Not efflorescent. (Scheibler, J. pr. 83. 273.)  
Somewhat less sol. in  $\text{H}_2\text{O}$  than the Mn salt.  
(Wyruboff, Bull. Soc. Min. 1892, 15. 84.)

**Cadmium paratungstate,  $\text{Cd}_2\text{W}_7\text{O}_{24} + 16\text{H}_2\text{O}$ .**

Ppt. (Gonzalez.)  
Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  and hot  $\text{H}_3\text{PO}_4$ ,  $\text{H}_2\text{C}_2\text{O}_4$ , or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq.}$

**Cadmium sodium paratungstate,  $2\text{CdO}$ ,  $\text{Na}_2\text{O}$ ,  $7\text{WO}_3 + 18\text{H}_2\text{O}$ .**

Difficultly sol. in cold  $\text{H}_2\text{O}$ . (Knorre, B. 19. 824.)

**Calcium tungstate,  $\text{CaWO}_4$ .**

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Sol. in about 500 pts.  $\text{H}_2\text{O}$ . (Lefort.)

Decomp. by  $\text{KOH} + \text{Aq.}$  (Anthon.)  
When freshly pptd., sol. in  $\text{NH}_4\text{Cl} + \text{Aq.}$  (Wackenroder.)

Sol. in Mg, and  $\text{NH}_4$  salts, also  $\text{Na}_2\text{WO}_4 + \text{Aq.}$  (Sonstadt, C. N. 11. 97.)

Min. *Scheelite*. Decomp. by  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq.}$  with separation of  $\text{WO}_3$ .

**Calcium ditungstate,  $\text{CaW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?).**

Sol. in 30 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, A. ch. (5) 15. 328.)

**Calcium tritungstate,  $\text{CaW}_3\text{O}_{10} + 6\text{H}_2\text{O}$  (?).**

Sol. in cold  $\text{H}_2\text{O}$ . (Lefort.)

**Calcium metatungstate,  $\text{CaW}_2\text{O}_9 + 10\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Scheibler.)

**Calcium paratungstate,  $\text{Ca}_2\text{W}_7\text{O}_{24} + 18\text{H}_2\text{O}$  (or  $\text{Ca}_5\text{W}_{12}\text{O}_{41} + 30\text{H}_2\text{O}$ ).**

Much more sol. than Sr or Ba salt. (Knorre B. 18. 328.)

Easily sol. in  $\text{H}_2\text{O}_2$ . (Knorre, B. 1885, 18. 326.)

**Calcium potassium tungstate tungsten oxide,  $\text{CaW}_4\text{O}_{12}$ ,  $5\text{K}_2\text{W}_2\text{O}_{11}$ .**

(Engels, Z. anorg. 1903, 37. 149.)

**Calcium sodium paratungstate,  $2\text{CaO}$ ,  $3\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 3\text{H}_2\text{O}$ .**

(Gonzalez, J. pr. (2) 36. 44.)

**Calcium sodium tungstate tungsten oxide,  $\text{CaW}_4\text{O}_{12}$ ,  $5\text{Na}_2\text{W}_2\text{O}_{11}$ .**

Engels, Z. anorg. 1903, 37. 145.)

**Cerium tungstate,  $\text{Ce}_2(\text{WO}_4)_3 + \text{H}_2\text{O}$ .**

Precipitate. (Cossa and Zecchino, Gazz. ch. it. 10. 225.)

**Cerium metatungstate,  $\text{Ce}_2\text{O}_3$ ,  $12\text{WO}_3 + 30\text{H}_2\text{O}$ .**

Permanent. Sol. in  $\text{H}_2\text{O}$ . (Scheibler.)

**Cerium sodium tungstate,  $\text{Ce}_2\text{Na}_4(\text{WO}_4)_7$ .**

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in dil. acids, easily in  $\text{HCl} + \text{Aq.}$  (Högbom, Bull. Soc. (2) 42. 2.)

$\text{Ce}_2(\text{WO}_4)_3$ ,  $3\text{Na}_2\text{WO}_4$ . (Didier, C. R. 102. 823.)

**Cerium tungstate chloride,  $3\text{Ce}_2(\text{WO}_4)_3$ ,  $2\text{CeCl}_3$ .**

(Didier, C. R. 102. 823.)

**Chromic tungstate, basic,  $\text{Cr}_2\text{O}_3$ ,  $2\text{WO}_3 + 5\text{H}_2\text{O}$ .**

Sol. in 400 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, C. R. 87. 748.)

**Chromic tungstate,  $\text{Cr}_2(\text{WO}_4)_3 + 7$ , and  $13\text{H}_2\text{O}$ .**

Sol. in  $\text{CrCl}_3 + \text{Aq.}$  and in phosphoric, oxalic, or tartaric acids +  $\text{Aq.}$  (Lotz.)

$+ 3\text{H}_2\text{O}$ . (Lefort, C. R. 87. 748.)  
 $\text{Cr}_2\text{O}_3$ ,  $4\text{WO}_3 + 6\text{H}_2\text{O}$ . Sol. in about 50 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort.)

$\text{Cr}_2\text{O}_3$ ,  $5\text{WO}_3$ . Not attacked by aqua regia. (Smith and Oberholtzer, Z. anorg. 5. 63.)

**Chromic paratungstate,  $\text{Cr}_2\text{W}_7\text{O}_{24} + 9\text{H}_2\text{O}$ .**

Insol. in  $\text{H}_2\text{O}$  or  $\text{NH}_4$  paratungstate +  $\text{Aq.}$  sol. in  $\text{CrCl}_3 + \text{Aq.}$  (Lotz.)

**Cobaltous tungstate,  $\text{CoWO}_4$ .**

Anhydrous. Insol. in  $\text{H}_2\text{O}$  and acids.  
 $+ 2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and cold  $\text{HNO}_3 + \text{Aq.}$  Sl. sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq.}$  Completely sol. in warm  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Anthon, J. pr. 9. 344.)

Sol. in about 500 pts.  $\text{H}_2\text{O}$ . (Lefort.)

**Cobaltous ditungstate,  $\text{CoW}_2\text{O}_7$  (?).**

$+ 3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq.}$  Completely sol. in  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq.}$  (Anthon.)  
 $+ 5\text{H}_2\text{O}$ . Sol. in about 100 pts.  $\text{H}_2\text{O}$ . (Lefort.)  
 $+ 8\text{H}_2\text{O}$  (?). (Lefort.)

**Cobaltous tritungstate,  $\text{CoW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).**

Sol. in  $\text{H}_2\text{O}$ . (Lefort, C. R. 88. 798.)

**Cobaltous metatungstate,  $\text{CoW}_2\text{O}_9 + 9\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 83. 317.)

**Cobaltous paratungstate,  $\text{Co}_2\text{W}_7\text{O}_{24} + 25\text{H}_2\text{O}$ .**

(Gonzalez, J. pr. (2) 36. 44.)

**Cobaltous sodium paratungstate**,  $2\text{CoO}$ ,  $3\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 30\text{H}_2\text{O}$ .  
(Gonzalez.)

**Cupric tungstate**,  $\text{CuWO}_4$ .

+  $2\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{H}_3\text{PO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . (Anthon.)  
100 ccm.  $\text{H}_2\text{O}$  at  $15^\circ$  dissolve 0.1 g. (Lefort.)

**Cupric ditungstate**,  $\text{CuW}_2\text{O}_7$  (?).

+  $4\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  and  $\text{HNO}_3$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Anthon, J. pr. 9. 346.)  
+  $5\text{H}_2\text{O}$ . Sol. in about 300 pts.  $\text{H}_2\text{O}$ . (Lefort.)

**Cupric metatungstate**,  $\text{CuW}_4\text{O}_{11} + 11\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Scheibler.)

**Cupric paratungstate**,  $\text{Cu}_2\text{W}_7\text{O}_{24} + 19\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Knorre, B. 19. 826.)

**Cuprocupric tungstate**,  $\text{Cu}_2\text{WO}_4$ ,  $2\text{CuWO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Zettnow, Pogg. 130. 255.)

**Cupric sodium paratungstate**,

$\text{Cu}_2\text{Na}_6(\text{W}_7\text{O}_{24})_2 + 32\text{H}_2\text{O}$ .

Ppt. (Knorre, B. 19. 826.)

$\text{CuO}$ ,  $4\text{Na}_2\text{O}$ ,  $12\text{WO}_3 + 32\text{H}_2\text{O}$ . Ppt. (Gonzalez, J. pr. (2) 38. 52.)

**Cupric tungstate ammonia**,  $\text{CuWO}_4$ ,  $2\text{NH}_3 + \text{H}_2\text{O}$ .

(Schiff, A. 123. 39.)

$\text{CuWO}_4$ ,  $4\text{NH}_3$ . Gives off  $\text{NH}_3$  at ord. temp. Sol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Briggs, Chem. Soc. 1904. 85. 676.)

$\text{CuO}$ ,  $4\text{WO}_3$ ,  $6\text{NH}_3 + 8\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Nearly insol. in dil.  $\text{NH}_4\text{OH} + \text{Aq}$ . (Briggs, Chem. Soc. 1904. 85. 676.)

**Didymium tungstate**,  $\text{Di}_2(\text{WO}_4)_3$ .

Precipitate. (Frerichs and Smith, A. 191. 355.)

**Didymium metatungstate**.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler.)

**Didymium sodium tungstate**,  $\text{DiNa}_3(\text{WO}_4)_3$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in dil. acids. Sol. in conc.  $\text{HCl} + \text{Aq}$ .

$\text{DiNa}(\text{WO}_4)_3$ . As above. (Högbom, Bull. Soc. (2) 42. 2.)

**Erbium sodium tungstate**,  $\text{Na}_3\text{Er}_2(\text{WO}_4)_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Högbom.)

**Glucinum metatungstate**.

Very sol. in  $\text{H}_2\text{O}$ .

**Indium tungstate**,  $\text{In}_2(\text{WO}_4)_3 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Decomp. by acids. (Renz, Dissert. 1902.)

**Iron (ferrous) tungstate**,  $\text{FeWO}_4$ .

Min. *Ferberite*, *Reinile*.

+  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in cold  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , or  $\text{HNO}_3 + \text{Aq}$ . Decomp. by boiling acids with separation of  $\text{WO}_3$ . Sol. in boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$  or warm  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . (Anthon, J. pr. 9. 343.)

+  $z\text{H}_2\text{O}$ . Very unstable. (Lefort, A. ch. (5) 15. 314.)

**Iron (ferrous) ditungstate**,  $\text{FeW}_2\text{O}_7$  (?).

Insol. in  $\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_3\text{PO}_4 + \text{Aq}$  or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Decomp. by dil.  $\text{HCl} + \text{Aq}$  or by  $\text{KOH} + \text{Aq}$ . (Ebelmen, C. R. 17. 1198.)

+  $z\text{H}_2\text{O}$ . Very unstable. (Lefort.)

**Iron (ferrous) tritungstate**,  $\text{FeW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).

Ppt. Decomp. by cold, more rapidly by hot  $\text{H}_2\text{O}$ . (Lefort.)

**Iron (ferrous) metatungstate**.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 83. 315.)

**Iron (ferric) tungstate, basic**,  $\text{Fe}_2\text{O}_3$ ,  $2\text{WO}_3 + 4\text{H}_2\text{O}$ .

Sol. in about 50 pts.  $\text{H}_2\text{O}$ . (Lefort.)

$2\text{Fe}_2\text{O}_3$ ,  $3\text{WO}_3 + 6\text{H}_2\text{O}$ . Sol. in about 300 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort.)

**Iron (ferric) tritungstate** (?),  $\text{Fe}_3\text{O}_3$ ,  $4\text{WO}_3 + 4\text{H}_2\text{O} = \text{Fe}_2\text{O}_3$ ,  $3\text{WO}_3 + \text{WO}_3$ ,  $4\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$  without decomp. (Lefort.)

**Iron (ferric) metatungstate**.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 83. 273.)

**Iron (ferrous) manganous tungstate**,  $7\text{FeWO}_4$ ,  $\text{MnWO}_4$ .

(Geuther and Forsberg, A. 120. 277.)

$4\text{FeWO}_4$ ,  $\text{MnWO}_4$ . (G. and F.)

$3\text{FeWO}_4$ ,  $\text{MnWO}_4$ . Partially sol. in conc.

$\text{HCl} + \text{Aq}$ . (G. and F.)

$3\text{FeWO}_4$ ,  $2\text{MnWO}_4$ . (G. and F.)

$\text{FeWO}_4$ ,  $\text{MnWO}_4$ . (Zettnow, Pogg. 130. 250.)

$\text{FeWO}_4$ ,  $2\text{MnWO}_4$ . (G. and F.)

$\text{FeWO}_4$ ,  $7\text{MnWO}_4$ . (G. and F.)

$z\text{FeWO}_4$ ,  $y\text{MnWO}_4$ . Min. *Wolframite*. Sol. in  $\text{HCl} + \text{Aq}$ , and boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$ .

**Lanthanum tungstate**,  $\text{La}_2(\text{WO}_4)_3$ .

Precipitate.

**Lanthanum metatungstate**.

Sol. in  $\text{H}_2\text{O}$ . (Scheibler.)

**Lanthanum silver tungstate**.

See *Lanthanicotungstate*, silver.

**Lanthanum sodium tungstate**,  $\text{Na}_3\text{La}_2(\text{WO}_4)_7$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in dil. acids.

Sol. in  $\text{HCl} + \text{Aq}$ .

$\text{La}_2\text{Na}_3(\text{WO}_4)_7$ . As above. (Högbom, Bull. Soc. (2) 42. 2.)

**Lead tungstate,  $PbWO_4$ .**

Insol. in  $H_2O$  or cold  $HNO_3$  + Aq. Sol. in  $KOH$  + Aq. Decomp. by hot  $HNO_3$  + Aq. (Anthon, J. pr. 9. 342.)

Sol. in about 4000 pts.  $H_2O$ . (Lefort.)

Min. *Scheelenite*, *Stolzite*. Sol. in  $KOH$  + Aq; decomp. by  $HNO_3$ .

Absolutely insol. in  $NH_4NO_3$  + Aq. (Smith and Bradbury, B. 24. 2930.)

**Lead ditungstate,  $PbW_2O_7 + 2H_2O$  (?).**

Sol. in about 80 pts.  $H_2O$  at  $15^\circ$ . (Lefort.)

**Lead tritungstate,  $PbW_3O_{10} + 2H_2O$  (?).**

Ppt. (Lefort.)

**Lead metatungstate,  $PbW_4O_{13} + 5H_2O$ .**

Sl. sol. in cold, more in hot  $H_2O$ . Sol. in hot  $HNO_3$  + Aq. (Scheibler, J. pr. 83. 318.)

**Lead paratungstate,  $Pb_3W_7O_{34}$ .**

Insol. in  $H_2O$ , dil.  $HNO_3$  + Aq,  $(NH_4)_2WO_4$  + Aq, or  $Pb(NO_3)_2$  + Aq. Sol. in  $NaOH$  + Aq or boiling  $H_3PO_4$  + Aq. (Lotz, A. 91. 49.)

**Lead sodium paratungstate,  $PbO$ ,  $4Na_2O$ ,  $12WO_3 + 28H_2O$ .**

(Gonzalez.)

**Lithium tungstate,  $Li_2WO_4$ .**

Rather easily sol. in  $H_2O$ . (Gmelin.)

**Lithium metatungstate,  $Li_2W_4O_{13}$ .**

Insol. in  $H_2O$ . (Knorre, J. pr. (2) 27. 94.)

+  $xH_2O$ . Syrup. (Scheibler.)

**Lithium paratungstate,  $Li_{10}W_{12}O_{41} + 33H_2O$  (or  $Li_4W_3O_{14} + 19H_2O$ ).**

According to Scheibler, more sol. than the paratungstates of the other alkali metals.

**Lithium tungstate tungsten oxide,  $Li_2W_6O_{18}$ .**

*Lithium bronze*. Insol. in  $H_2O$ .

**Lithium potassium tungstate tungsten oxide,  $Li_3W_5O_{18}$ ,  $3K_2W_6O_{18}$ .**

*Lithium potassium bronze*. Insol. in  $H_2O$ . (Feit, B. 21. 135.)

**Lithium sodium tungstate,  $Li_2WO_4 + 3H_2O$ ,  $3(Na_2WO_4 + 3H_2O)$ .**

(Traube, N. Jahrb. Miner, 1894, I. 190.)

**Magnesium tungstate,  $MgWO_4$ .**

*Anhydrous*. Insol. in  $H_2O$ . Gradually decomp. by boiling conc.  $HNO_3$  + Aq. (Geuther and Forsberg, A. 120. 272.)

+  $3H_2O$ . Very sol. in  $H_2O$ ; nearly insol. in alcohol. (Lefort, A. ch. (5) 15. 329.)

+  $7H_2O$ . Slowly sol. in cold, very easily in hot  $H_2O$ . (Ullik, W. A. B. 56. 2. 152.)

**Magnesium ditungstate,  $MgW_2O_7 + 8H_2O$  (?).**

Sol. in about 100 pts.  $H_2O$ . (Lefort.)

**Magnesium tritungstate,  $MgW_3O_{10} + 4H_2O$  (?).**

Easily sol. in  $H_2O$  with gradual decomp. (Lefort.)

**Magnesium metatungstate,  $MgW_4O_{13} + 8H_2O$ .**

Sol. in  $H_2O$ . (Scheibler.)

**Magnesium paratungstate,  $Mg_3W_7O_{34} + 24H_2O$ .**

Very difficultly sol. in cold, somewhat sol. in hot  $H_2O$ . (Knorre, B. 19. 825.)

**Magnesium potassium tungstate,  $MgWO_4$ ,  $K_2WO_4$ .**

+  $2H_2O$ . Very sl. sol. in  $H_2O$ . (Ullik.)

+  $6H_2O$ . Precipitate.

**Magnesium potassium paratungstate,  $5(2/3K_2O, 1/3MgO)$ ,  $12WO_3 + 24H_2O$ .**

Insol. in cold, sol. in hot  $H_2O$ . (Hallopeau, C. R. 1898, 127. 621.)

**Magnesium sodium paratungstate,  $3MgO$ ,  $3Na_2O$ ,  $14WO_3 + 33H_2O$ .**

Nearly insol. in  $H_2O$ . (Knorre, B. 19. 825.)

**Manganous tungstate,  $MnWO_4$ .**

Min. *Hubnerite*. Partially sol. in  $HCl$  + Aq.

+  $2H_2O$ . Insol. in  $H_2O$ ; sol. in warm  $H_3PO_4$  and  $H_2C_2O_4$  + Aq; sl. sol. in  $HC_2H_3O_2$  + Aq. Insol. in cold  $HCl$  + Aq. (Anthon.)

+  $H_2O$ . Sol. in about 2500 pts.  $H_2O$  at  $15^\circ$ . (Lefort.)

**Manganous ditungstate,  $MnW_2O_7 + 3H_2O$  (?).**

Sol. in about 450 pts.  $H_2O$  at  $15^\circ$ . (Lefort, A. ch. (5) 15. 333.)

**Manganous tritungstate,  $MnW_3O_{10} + 5H_2O$  (?).**

Decomp. by  $H_2O$  into  $MnW_2O_7$  and  $MnW_4O_{13}$ . (Lefort, A. ch. (5) 17. 480.)

**Manganous metatungstate,  $MnW_4O_{13} + 10H_2O$ .**

Very sol. in  $H_2O$ . (Wyrouboff, Bull. Soc. Min. 1892, 15. 82.)

**Manganous paratungstate,  $5MnO$ ,  $12WO_3 + 34H_2O$ .**

(Gonzalez, J. pr. (2) 36. 44.)

$Mn_2W_7O_{34} + 11H_2O$ . When recently pptd., sol. in a small amt. of  $H_2O$  acidulated with  $HNO_3$ . (Lotz.)

**Manganous potassium tungstate,  $2MnO$ ,  $3K_2O$ ,  $12WO_3 + 16H_2O$ .**

Completely insol. in  $H_2O$ . (Hallopeau, Bull. Soc. 1898, (3) 19. 955.)

**Manganous sodium paratungstate,  $3\text{Na}_2\text{O}, 3\text{MnO}, 14\text{WO}_3 + 36\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Knorre, B. 19. 826.)**Manganic sodium tungstate.**

See Permanganotungstate, sodium.

**Mercurous tungstate,  $\text{Hg}_2\text{WO}_4$ .**Insol. in  $\text{H}_2\text{O}$ . (Anthon.)

Impossible to obtain pure, as it is decomp. into—

 $2\text{Hg}_2\text{O}, 3\text{WO}_3 + 8\text{H}_2\text{O}$ . Sol. in 100 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort.)**Mercurous metatungstate,  $\text{Hg}_2\text{W}_2\text{O}_{11} + 25\text{H}_2\text{O}$ .**

Ppt. (Scheibler, J. pr. 83. 319.)

**Mercuric tungstate,  $\text{HgWO}_4$ .**Sl. sol. in  $\text{H}_2\text{O}$  and very unstable. (Lefort, A. ch. (5) 15. 356.) $3\text{HgO}, 2\text{WO}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Anthon.) $2\text{HgO}, 3\text{WO}_3$ . Insol. in  $\text{H}_2\text{O}$ . (Anthon.) $3\text{HgO}, 5\text{WO}_3 + 5\text{H}_2\text{O}$ . Sol. in about 250 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort.) $2\text{HgO}, 5\text{WO}_3 + 7\text{H}_2\text{O}$ . Decomp. by hot or cold  $\text{H}_2\text{O}$ . (Lefort, C. R. 88. 798.)**Mercuric tritungstate,  $\text{HgW}_3\text{O}_{10} + 7\text{H}_2\text{O}$  (?).**Sol. in about 120 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort, A. ch. (5) 15. 360.)**Molybdenum tungstate.**Easily sol. in  $\text{H}_2\text{O}$ . Insol. in  $\text{NH}_4\text{Cl} + \text{Aq}$  or in alcohol of 0.87 sp. gr. (Berzelius.)**Neodymium tungstate,  $\text{Nd}_2(\text{WO}_4)_3$ .**Very sl. sol. in  $\text{H}_2\text{O}$ . 1 pt. is sol. in 52630 pts.  $\text{H}_2\text{O}$  at  $22^\circ$ ; 59580 pts. at  $65^\circ$ ; 66040 pts. at  $98^\circ$ . (Hitchcock, J. Am. Chem. Soc. 1895, 17. 532.)**Nickel tungstate,  $\text{NiWO}_4$ .** $+3\text{H}_2\text{O}$ . Sol. in about 1000 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . (Lefort.) $+6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$  or  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Sol. in boiling  $\text{H}_3\text{PO}_4 + \text{Aq}$ ,  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Anthon.)**Nickel ditungstate,  $\text{NiW}_2\text{O}_7 + 5\text{H}_2\text{O}$  (?).**Sol. in about 250 pts.  $\text{H}_2\text{O}$ . (Lefort.)**Nickel tritungstate,  $\text{NiW}_3\text{O}_{10} + 4\text{H}_2\text{O}$  (?).**Sol. in  $\text{H}_2\text{O}$ . Pptd. by alcohol. Decomp. by cold or warm  $\text{H}_2\text{O}$  after above pptn. (Lefort.)**Nickel metatungstate,  $\text{NiW}_2\text{O}_{11} + 8\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 83. 273.)**Nickel paratungstate,  $\text{Ni}_3\text{W}_7\text{O}_{24} + 14\text{H}_2\text{O}$ .**Insol. in  $\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{C}_2\text{O}_4 + \text{Aq}$ . Completely sol. in warm  $\text{H}_3\text{PO}_4$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Anthon.)**Potassium tungstate,  $\text{K}_2\text{WO}_4$ .***Anhydrous*. Rather deliquescent. Easily sol. in  $\text{H}_2\text{O}$ . $+ \text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in alcohol. $+ 2\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  with absorption of heat.1 pt. dissolves in 1.94 pts. cold, and 0.66 pt. boiling  $\text{H}_2\text{O}$ . Alcohol does not mix with conc. aq. solution, but slowly separates out the salt from it. Acids, even  $\text{H}_2\text{SO}_4$ ,  $\text{HC}_2\text{H}_3\text{O}_2$  or  $\text{H}_2\text{C}_2\text{O}_4$ , separate out  $\text{WO}_3$  from solution. (Riche, A. ch. (3) 50. 45.)**Potassium ditungstate,  $\text{K}_2\text{W}_2\text{O}_7 + 2\text{H}_2\text{O}$ .**Sol. in about 8 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , but on heating is converted into— $+ 3\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve only 2-3 pts. at  $15^\circ$ . (Lefort, A. ch. (5) 9. 102.)**Potassium tritungstate,  $\text{K}_2\text{W}_3\text{O}_{10} + 2\text{H}_2\text{O}$ .**Sol. in 5-6 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ . Can be recryst. from hot  $\text{H}_2\text{O}$ . (Lefort, A. ch. (5) 9. 105.)**Potassium metatungstate,  $\text{K}_2\text{W}_2\text{O}_{11} + 5\text{H}_2\text{O}$ .**Not efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Marignac.) $(\text{K}_2\text{W}_2\text{O}_{11} + 8\text{H}_2\text{O}$  of Margueritte.) $+ 8\text{H}_2\text{O}$ . Extremely efflorescent. (Scheibler.)**Potassium octatungstate,  $\text{K}_2\text{W}_8\text{O}_{28}$ .**Insol. in  $\text{H}_2\text{O}$ . (Knorre, J. pr. (2) 27. 49.)**Potassium tungstate,  $\text{K}_2\text{W}_{10}\text{O}_{34} + 9\text{H}_2\text{O} = 4\text{K}_2\text{O}, 10\text{WO}_3 + 9\text{H}_2\text{O}$ .**

Properties resemble the paratungstate. (Gibbs, Proc. Am. Acad. 18. 11.)

 $+ 8\text{H}_2\text{O} = \text{K}_2\text{W}_4\text{O}_{17} + 4\text{H}_2\text{O}$ . Sol. in 15 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , but decomposed by heating into  $\text{K}_2\text{W}_2\text{O}_7$  and  $\text{K}_2\text{W}_3\text{O}_{10}$ . (Lefort, A. ch. (5) 9. 104.) $\text{K}_{10}\text{W}_4\text{O}_{27}$ . Very difficulty sol. in cold, appreciably sol. in hot  $\text{H}_2\text{O}$ , probably with decomposition. (Knorre.)**Potassium paratungstate,  $\text{K}_{10}\text{W}_{11}\text{O}_{41} + 11\text{H}_2\text{O}$  (or  $\text{K}_4\text{W}_7\text{O}_{34} + 6\text{H}_2\text{O}$ , according to Lots and Scheibler.)**Much more sol. in hot than cold  $\text{H}_2\text{O}$ . (Anthon.)Sol. in 100 pts.  $\text{H}_2\text{O}$  at  $16^\circ$ , in 8.5 pts. at  $100^\circ$ . (Anthon.)Sol. in 46.5 pts. cold, and 15.15 pts. boiling  $\text{H}_2\text{O}$ . (Riche.)By shaking the crystals several days at  $20^\circ$ , 1 pt. dissolves in 71 pts.  $\text{H}_2\text{O}$ . If the salt is treated with boiling water, more goes into solution the longer it is boiled, until after several days' boiling 1 pt. of the salt dissolved in 5.52 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . Kept in a closed flask, this solution contained after 26 days 1 pt. of salt to 11.9 pts.  $\text{H}_2\text{O}$ ; after 153 days, 1 pt. of salt to 15.6 pts.  $\text{H}_2\text{O}$ ; after 334 days, 1 pt. of salt to 15.6 pts.  $\text{H}_2\text{O}$ . Insol. in alcohol. (Marignac.) $+ 8\text{H}_2\text{O}$ .

**Potassium sodium tungstate**,  $K_2WO_4$ ,  $2Na_2WO_4 + 14H_2O$ .

Easily sol. in hot and cold  $H_2O$ . (Ullik, W. A. B. 56, 2. 150.)

Deliquescent. Sol. in 1 pt. cold, and  $\frac{1}{2}$  pt. hot  $H_2O$ . (Anthon.)

**Potassium sodium paratungstate**,  $Na_2O$ ,  $4K_2O$ ,  $12WO_3 + 15H_2O$ .

Sol. in  $H_2O$ . (Marignac.)

$\frac{1}{11}Na_2O$ ,  $\frac{1}{11}K_2O$ ,  $12WO_3 + 25H_2O$ . Sol. in  $H_2O$ . (Marignac.)

**Potassium strontium tungstate tungsten oxide**,  $5K_2W_6O_{13}$ ,  $SrW_6O_{13}$ .

(Engels, Z. anorg. 1903, 37. 143.)

**Potassium uranous tungstate.**

See Uranosettingstate, potassium.

**Potassium zirconium tungstate.**

See Zirconotungstate, potassium.

**Potassium tungstate tungsten oxide**,  $K_2WO_4$ ,  $W_2O_5$ .

*Potassium tungsten bronze.* (Scheibler, J. pr. 83. 321.)

Formula is  $K_3W_4O_{12}$ . Not attacked by acids, and only very sl. by alkalis. (Knorre, J. pr. (2) 27. 49.)

$K_2WO_4$ ,  $4WO_3$ . Not attacked by acids, even HF, or by alkalis + Aq. Insol. in alcohol. (Zettnow, Pogg. 130. 262.)

Does not exist. (Knorre.)

**Potassium sodium tungstate tungsten oxide**,  $5K_2W_6O_{13} + 2Na_4W_6O_{13}$ .

*Potassium sodium tungsten bronze.* Properties as potassium bronze.

$3K_2W_6O_{13}$ ,  $2Na_4W_6O_{13}$ . As above. (Knorre, J. pr. (2) 27. 49.)

**Praseodymium tungstate**,  $Pr_2(WO_4)_3$ .

Very sl. sol. in  $H_2O$ .

Insol. in  $H_2O$  at  $20^\circ$ ; at  $75^\circ$ , 1 pt. is sol. in 23,300 pts.  $H_2O$ . (Hitchcock, J. Am. Chem. Soc. 1895, 17. 529.)

**Rubidium metatungstate**,  $Rb_2O$ ,  $4WO_3 + 8H_2O$ .

Sol. in about 10 pts. cold  $H_2O$ .

Moderately sol. in warm  $H_2O$ . (Wyruboff, Bull. Soc. Min. 1892, 15. 69.)

**Rubidium pentatungstate**,  $Rb_2W_5O_{16}$ .

Almost insol. in hot  $H_2O$ . When finely powdered, it is sol. in alkali carbonates + Aq. (Schaeffer, Z. anorg. 1904, 33. 163.)

**Rubidium octotungstate**,  $Rb_2W_8O_{24}$ .

Insol. in  $H_2O$ , acids, and alkalis. (Schaeffer, Z. anorg. 1904, 33. 103.)

**Rubidium paratungstate**,  $5Rb_2O$ ,  $12WO_3 + 18H_2O$ .

Very sl. sol. in  $H_2O$ . (Schaeffer, Z. anorg. 1904, 33. 173.)

**Samarium metatungstate**,  $Sm_2O_3$ ,  $12WO_3 + 35H_2O$ .

Easily sol. in  $H_2O$ . (Cleve.)

**Samarium sodium tungstate**,  $Na_2Sm_4(WO_4)_4$ .

Insol. in  $H_2O$ . Slowly sol. in dil. acids, easily in conc. HCl + Aq. (Högbom, Bull. Soc. (2) 42. 2.)

**Silver (argentous) tungstate**,  $Ag_2O$ ,  $2WO_3$ .

$HNO_3$  + Aq separates  $WO_3$ . KOH + Aq dissolves out  $WO_3$  and separates  $Ag_2O$ . (Wöhler and Rautenberg, A. 114. 120.)

Does not exist. (Muthmann, B. 20. 983.)

**Silver tungstate**,  $Ag_2WO_4$ .

Sol. in about 2000 pts.  $H_2O$  at  $15^\circ$ . Easily decomp. by NaCl + Aq or  $HNO_3$  + Aq. (Lefort.)

$Ag_2W_2O_7$ . Insol. in  $H_2O$ . Nearly insol. in  $HC_2H_3O_2$  or  $H_3PO_4$  + Aq. More sol. in KOH,  $NH_4OH$  + Aq, or  $H_2C_2O_4$  + Aq. (Anthon, J. pr. 9. 347.)

+  $H_2O$ . Sol. in about 5000 pts.  $H_2O$  at  $15^\circ$ . (Lefort.)

**Silver metatungstate**,  $Ag_2W_6O_{13} + 3H_2O$ .

Sl. sol. in  $H_2O$ . (Scheibler, J. pr. 83. 318.)

Nearly insol. in  $H_2O$ . (Rosenheim, Z. anorg. 1911, 69. 250.)

**Silver paratungstate**,  $Ag_{10}W_{12}O_{41} + 8H_2O$ .

(Gonzalez, J. pr. (2) 36. 44.)

**Silver tungstate ammonia**,  $Ag_2WO_4$ ,  $4NH_3$ .

Sol. in  $H_2O$  with rapid decomp. (Widmann, Bull. Soc. (2) 20. 64.)

**Sodium tungstate**,  $Na_2WO_4 + 2H_2O$ .

Sol. in 4 pts. cold, and 2 pts. boiling  $H_2O$ . (Vauquelin and Hecht.)

Sol. in 1.1 pts. cold, and 0.5 pt. boiling  $H_2O$ . (Anthon.)

Sol. in 2.44 pts.  $H_2O$  at  $0^\circ$ ; 1.81 pts. at  $15^\circ$ ; 0.81 pt. at  $100^\circ$ . (Riche.)

Solubility in  $H_2O$  at  $t^\circ$ .

$t^\circ$	% $Na_2WO_4$	Mols. $H_2O$ to 1 mol. $Na_2WO_4$	Mols. of anhydrous salt to 100 mols. $H_2O$
-3.5	41.67	22.87	4.37
+0.5	41.73	22.80	4.39
21.0	42.27	22.30	4.43
43.5	43.98	20.80	4.31
80.5	47.65	17.95	5.57
100.0	49.31	16.79	5.95

(Funk, B. 1900, 33. 3701.)

See also +10 $H_2O$ .

Sp. gr. of  $\text{Na}_2\text{WO}_4 + \text{Aq}$  at 24.5° containing:

5	10	15	$\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$
1.036	1.075	1.119	
20	25	30	% $\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$
1.166	1.215	1.274	
35	40	44	% $\text{Na}_2\text{WO}_4 + 2\text{H}_2\text{O}$
1.349	1.430	1.492	

(Frans, J. pr. (2) 4. 238.)

Sp. gr. of  $\text{Na}_2\text{WO}_4 + \text{Aq}$  at 25°.

Sp. gr. at 20°	Per cent $\text{Na}_2\text{WO}_4$	Per cent $\text{Na}_2\text{WO}_4 \cdot 2\text{H}_2\text{O}$
1.02016	2.21	2.48
1.03945	4.26	4.78
1.04292	4.59	5.15
1.05831	6.25	7.01
1.07449	7.83	8.79
1.08209	8.61	9.66
1.09687	10.08	11.31
1.12114	12.30	13.81
1.13036	13.16	14.77
1.14392	14.44	16.21
1.16896	16.56	18.62
1.19154	18.52	20.79
1.19938	19.10	21.44
1.20787	19.74	22.16
1.21720	20.59	23.11
1.25041	23.16	25.99
1.25083	23.30	26.15
1.26234	24.05	27.00
1.28143	25.46	28.58
1.33993	29.50	33.11
1.38826	32.68	36.68
1.41072	33.91	38.06
1.47193	37.30	41.87
1.48481	38.20	42.87
1.48595	38.43	43.14

(Pawlewski, B. 1900, 33. 1224.)

$\text{Na}_2\text{WO}_4 + \text{Aq}$  is pptd. by  $\text{HCl}$ ,  $\text{HNO}_3$ , or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , but not by  $\text{H}_2\text{SO}_4$ ,  $\text{HI}$ ,  $\text{HCN}$ , oxalic, or tartaric acids +  $\text{Aq}$ , but pptn. by the former acids is not prevented by presence of the latter, but when heated with  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , or in presence of  $\text{H}_3\text{PO}_4 + \text{Aq}$ , mineral acids cause no ppt. (Zettnow, Pogg, 130. 16.)

Much more sol. in  $\text{H}_2\text{O}_2$  than in  $\text{H}_2\text{O}$ . (Kellner, Dissert, 1909.)

Sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 829.)

Insol. in alcohol. (Riche, A. ch. (3) 50. 52.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+  $10\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$  at t°.

t°	% $\text{Na}_2\text{WO}_4$	Mols. $\text{H}_2\text{O}$ to 1 mol. $\text{Na}_2\text{WO}_4$	Mols. anhydrous salt to 100 mols. $\text{H}_2\text{O}$
-5.	30.60	37.04	2.70
-4.0	31.87	34.92	2.86
-3.5	32.98	33.19	3.01
-2.0	34.52	30.90	3.23
0.0	36.54	28.37	3.52
+3.0	39.20	25.33	3.95
+5.0	41.02	23.48	4.26

(Funk, B. 1900, 33. 3701.)

**Sodium ditungstate,  $\text{Na}_2\text{W}_2\text{O}_7$ .**

Sol. in  $\text{H}_2\text{O}$  by heating several hours to 130°-150°. (Knorre, J. pr. (2) 27. 80.)  
+  $6\text{H}_2\text{O}$ . Sol. in 13 pts.  $\text{H}_2\text{O}$  at 15°. (Lefort, C. R. 88. 798.)

**Sodium tritungstate,  $\text{Na}_2\text{W}_3\text{O}_{10} + 4\text{H}_2\text{O}$ .**

Sol. in 1 pt.  $\text{H}_2\text{O}$ . Decomp. on standing into sol. *tetartungstate* and insol. *ditungstate*. (Lefort, C. R. 88. 798.)

Neither this nor the other *tritungstates* of Lefort exist, according to Knorre (J. pr. (2) 27. 49.)

**Sodium metatungstate,  $\text{Na}_2\text{W}_6\text{O}_{18}$ .**

*Anhydrous*. Insol. in  $\text{H}_2\text{O}$ .  
+  $10\text{H}_2\text{O}$ . Sol. at 13° in 0.935 pt.  $\text{H}_2\text{O}$  to form a solution of 3.02 sp. gr. (Scheibler.)  
Sol. at 19° in 0.195 pt.  $\text{H}_2\text{O}$ . (Forcher.)  
Precipitated by alcohol.

**Sodium pentatungstate,  $\text{Na}_2\text{W}_5\text{O}_{24}$ .**

Sl. sol. in  $\text{H}_2\text{O}$  by heating 3 hours at 150°. (Knorre, J. pr. (2) 27. 49.)

**Sodium octotungstate,  $\text{Na}_2\text{W}_8\text{O}_{32}$ .**

Insol. in  $\text{H}_2\text{O}$ . Very difficultly attacked by acids and alkalis. (Knorre.)  
+  $12\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ , and can be recryst. without decomp. (Ullik, W. A. B. 56, 2. 157.)

$3\text{Na}_2\text{O}, 8\text{WO}_3 + 17\text{H}_2\text{O}$ . Very efflorescent. Very sol. in hot  $\text{H}_2\text{O}$ . (Wells, J. Am. Chem. Soc. 1907, 29. 112.)

**Sodium tungstate,  $\text{Na}_2\text{W}_2\text{O}_7$  (?).**

+  $16\text{H}_2\text{O}$  (?). (Marignac, A. ch. (3) 69. 51.)

+  $21\text{H}_2\text{O}$  (?). Much more sol. and much more rapidly than the *paratungstate*. (Marignac.)

$\text{Na}_4\text{W}_2\text{O}_{11} + 7\text{H}_2\text{O}$  (?). Mixture of  $\text{Na}_2\text{W}_2\text{O}_7$  and  $\text{Na}_2\text{WO}_4$ . (Knorre, J. pr. (2) 27. 49.)

$\text{Na}_4\text{W}_2\text{O}_{11} + 11\text{H}_2\text{O}$ . Efflorescent. Sol. in  $\text{H}_2\text{O}$ . (Marignac.)

100 pts.  $\text{H}_2\text{O}$  dissolve 16 pts. at 15°. (Lefort, A. ch. (5) 9. 97.)

Formula is  $4\text{Na}_2\text{O}, 10\text{WO}_3 + 23\text{H}_2\text{O}$ , according to Gibbs (Proc. Am. Acad. 16. 5.)

**Sodium paratungstate**,  $\text{Na}_{10}\text{W}_{12}\text{O}_{41} + 21\text{H}_2\text{O}$ .  
 +  $25\text{H}_2\text{O}$ .  
 +  $28\text{H}_2\text{O} = 3\text{Na}_2\text{W}_2\text{O}_{14} + 16\text{H}_2\text{O}$ , according to Lots and Scheibler.

Sol. in 8 pts. cold  $\text{H}_2\text{O}$  (Anthon); in 12.6 pts. at  $22^\circ$ . (Forcher).

Sol. in about 12 pts.  $\text{H}_2\text{O}$ . (Marignac.)  
 The aqueous solution saturated at  $35-40^\circ$  contained to 1 pt. of the salt, after:

1	12	77	227	410 days,
at $18^\circ$	$18^\circ$	$18^\circ$	$16^\circ$	$20^\circ$
9.25	11.26	10.92	11.90	11.74 pts. $\text{H}_2\text{O}$ .

The solution saturated by very long boiling, after a part of the salt had crystallised out, contained, after:

1	2	12 days,
0.68	0.91	2.59 pts. $\text{H}_2\text{O}$ to 1 pt. salt,
72	222	405 days,
6.88	9.75	8.80 pts. $\text{H}_2\text{O}$ to 1 pt. salt.

(Marignac.)

Decomp. by boiling with  $\text{H}_2\text{O}$ . (Knorre, B. 18. 2362.)

**Sodium strontium paratungstate**,  $\text{Na}_2\text{O}$ ,  
 $4\text{SrO}$ ,  $12\text{WO}_3 + 29\text{H}_2\text{O}$ .  
 (Gonzalez, J. pr. (2) 36. 44.)

**Sodium strontium tungstate tungsten oxide**,  
 $5\text{Na}_2\text{W}_2\text{O}_{11}$ ,  $\text{SrW}_4\text{O}_{13}$ .  
 $12\text{Na}_2\text{W}_2\text{O}_{11}$ ,  $\text{SrW}_4\text{O}_{13}$ . (Engels, Z. anorg. 1903, 37. 138.)

**Sodium thorium tungstate**,  $\text{Na}_4\text{Th}(\text{WO}_4)_4$ .

Insol. in  $\text{H}_2\text{O}$ . Slowly sol. in dil. acids, easily in conc.  $\text{HCl} + \text{Aq}$ . (Högbom, Bull. Soc. (2) 42. 2.)

**Sodium ytterbium tungstate**,  $\text{Yb}_2\text{O}_3$ ,  $9\text{Na}_2\text{O}$ ,  $12\text{WO}_3$ .

Insol. in  $\text{H}_2\text{O}$ . (Cleve, Z. anorg. 1902, 32. 154.)

$2\text{Yb}_2\text{O}_3$ ,  $4\text{Na}_2\text{O}$ ,  $7\text{WO}_3$ . Ppt. (Cleve.)

**Sodium yttrium tungstate**,  $\text{Na}_3\text{Y}_2(\text{WO}_4)_7$ .

Insol. in  $\text{H}_2\text{O}$ , and very slowly attacked by dil. acids. (Högbom, Bull. Soc. (2) 42. 2.)

**Sodium zinc paratungstate**,  $\text{Na}_2\text{O}$ ,  $2\text{ZnO}$ ,  $7\text{WO}_3 + 15\text{H}_2\text{O}$ .

Difficultly sol. in cold, more sol. in hot  $\text{H}_2\text{O}$ . (Knorre, B. 19. 823.)

+  $21\text{H}_2\text{O}$ . (Knorre.)

**Sodium tungstate tungsten oxide**,  $\text{Na}_2\text{WO}_4$ ,  $\text{W}_2\text{O}_5$ .

*Yellow tungsten bronze*. Gradually deliquesces on air. Not decomp. by any acid, even aqua regia, except  $\text{HF}$ , or by alkalis. (Wöhler, Pogg. 2. 350.)

Correct formula is  $\text{Na}_2\text{W}_2\text{O}_{11}$ , according to Phillip (B. 15. 499).

Sol. in ammoniacal silver solution with separation of Ag. Easily sol. in boiling alkaline potassium ferricyanide + Aq. (Phillip, B. 12. 2234.)

$\text{Na}_2\text{WO}_4$ ,  $2\text{W}_2\text{O}_5$ . *Blue tungsten bronze*. Not attacked by acids or alkalis. (Scheibler.) Correct formula is  $\text{Na}_2\text{W}_2\text{O}_{11}$ , according to Phillip (B. 15. 506).

Sol. in ammoniacal silver solution with separation of Ag.

$\text{Na}_2\text{W}_2\text{O}_{11}$ . Properties as above. (Phillip, B. 15. 499.)

$\text{Na}_2\text{W}_2\text{O}_5$ . Properties as above. (Phillip.)

**Strontium tungstate**,  $\text{SrWO}_4$ .

Precipitate. (Schultze.)

Sol. in about 700 pts.  $\text{H}_2\text{O}$ . (Lefort.)

**Strontium ditungstate**,  $\text{SrW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?).

100 ccm.  $\text{H}_2\text{O}$  dissolve 0.35 g. at  $15^\circ$ . (Lefort, A. ch. (5) 15. 326.)

**Strontium tritungstate**,  $\text{SrW}_3\text{O}_{10} + 5\text{H}_2\text{O}$  (?).

Sol. in  $\text{H}_2\text{O}$  with decomp. into  $\text{SrW}_2\text{O}_7$  and  $\text{SrW}_4\text{O}_{13}$ . (Lefort, A. ch. (5) 17. 477.)

**Strontium metatungstate**,  $\text{SrW}_6\text{O}_{19} + 8\text{H}_2\text{O}$ .

Solubility as calcium metatungstate. (Scheibler.)

Extraordinarily sol. in  $\text{H}_2\text{O}$ . (Wyruboff, Bull. Soc. Min. 1892, 15. 63.)

**Strontium paratungstate**,  $\text{Sr}_2\text{W}_2\text{O}_{14} + 16\text{H}_2\text{O}$ , or  $\text{Sr}_2\text{W}_{12}\text{O}_{41} + 27\text{H}_2\text{O}$ .

Insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ . (Knorre, B. 18. 327.)

**Thallous tungstate**,  $\text{Tl}_2\text{WO}_4$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in hot  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . (Flemming, J. B. 1868. 250.)

**Thallous metatungstate**,  $\text{Tl}_2\text{W}_6\text{O}_{19} + 3\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . (Rosenheim, Z. anorg. 1911, 69. 251.)

**Thallous paratungstate**,  $5\text{Tl}_2\text{O}$ ,  $12\text{WO}_3$ .

Insol. in  $\text{H}_2\text{O}$ .

Sol. in  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . and  $\text{KOH} + \text{Aq}$ . decomposed by mineral acids. (Schaeffer, Z. anorg. 1904, 33. 171.)

**Thallous hydrogen tungstate**,  $\text{TiHWO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Difficultly sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in boiling alkali carbonates or hydrates + Aq. (Oettinger, J. B. 1864. 254.)

**Thorium tungstate**.

Precipitate. (Berzelius.)

Insol. in  $\text{H}_2\text{O}$ .

**Tin (stannous) tungstate**,  $\text{SnWO}_4 + 6\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in oxalic acid and in  $\text{KOH} + \text{Aq}$ . Slowly sol. in hot  $\text{H}_3\text{PO}_4 + \text{Aq}$ . (Anthon, J. pr. 9. 341.)

**Tin (stannic) tungstate**,  $9\text{SnO}_3, 13\text{WO}_3$ .

Insol. in ammonium tungstate + Aq. Sol. in tin salts + Aq, also in phosphoric, oxalic, or tartaric acids + Aq. (Lotz, A. 91. 49.)

**Tungsten tungstate**,  $\text{WO}_3, \text{WO}_3 = \text{W}_2\text{O}_7$ .

See Tungsten oxide,  $\text{W}_2\text{O}_7$ .

**Uranous tungstate**,  $\text{UO}_2, 3\text{WO}_3 + 6\text{H}_2\text{O}$ .

Decomp. by  $\text{NaOH} + \text{Aq}$  or  $\text{HNO}_3 + \text{Aq}$ . Sol. in  $\text{HCl} + \text{Aq}$ , but not in  $\text{H}_2\text{SO}_4$ . (Ramelsberg.)

**Uranyl tungstate**,  $\text{UO}_2, \text{WO}_3 + 2\text{H}_2\text{O}$ .

Sol. in about 100 pts.  $\text{H}_2\text{O}$ . (Lefort, C. R. 87. 748.)

$\text{UO}_2, 3\text{WO}_3 + 5\text{H}_2\text{O}$  (?). Sol. in about 200 pts.  $\text{H}_2\text{O}$ . (Lefort.)

**Vanadium tungstate**.

Sl. sol. in  $\text{H}_2\text{O}$ .

**Ytterbium tungstate basic**,  $(\text{YbO})_2\text{WO}_4$ .

Ppt. (Cleve, Z. anorg. 1902, 32. 153.)

**Ytterbium metatungstate**,  $\text{Yb}_2\text{O}_3, 12\text{WO}_3 + 35\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Cleve.)

**Yttrium tungstate**,  $\text{Y}_2(\text{WO}_4)_3 + 6\text{H}_2\text{O}$ .

Very sl. sol. in  $\text{H}_2\text{O}$ , but more sol. in  $\text{Na}_2\text{WO}_4 + \text{Aq}$ . (Berlin.)

**Zinc tungstate**,  $\text{ZnWO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . (Geuther and Forsberg, A. 120. 270.)

+  $\text{H}_2\text{O}$ . Sol. in 500 pts.  $\text{H}_2\text{O}$ .

**Zinc ditungstate**,  $\text{ZnW}_2\text{O}_7 + 3\text{H}_2\text{O}$  (?).

Sol. in 10 pts.  $\text{H}_2\text{O}$  at  $15^\circ$ , but solution soon decomposes. (Lefort.)

**Zinc tritungstate**,  $\text{ZnW}_3\text{O}_{10} + 5\text{H}_2\text{O}$ .

Insol. in boiling  $\text{H}_2\text{O}$ . Sol. in  $\text{ZnSO}_4 + \text{Aq}$ , or  $\text{Na}_4\text{W}_2\text{O}_{17} + \text{Aq}$ . (Gibbs.)

**Zinc metatungstate**,  $\text{ZnW}_2\text{O}_{11} + 10\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Loses crystal  $\text{H}_2\text{O}$  by ignition, and becomes insol. in  $\text{H}_2\text{O}$ . (Scheibler, J. pr. 88. 273.)

+  $8\text{H}_2\text{O}$ . More sol. in  $\text{H}_2\text{O}$  than magnesium comp. (Wyrouboff, Bull. Soc. Min. 1892, 15. 72.)

**Zinc tungstate**,  $\text{Zn}_4\text{W}_{10}\text{O}_{34} + 18\text{H}_2\text{O} = 4\text{ZnO}, 10\text{WO}_3 + 18\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in excess of zinc sulphate or of sodium tungstate + Aq. (Gibbs, Proc. Am. Acad. 15. 14.)

+  $29\text{H}_2\text{O}$ . (Gibbs.)

**Zinc paratungstate**,  $5\text{ZnO}, 12\text{WO}_3 + 37\text{H}_2\text{O}$ .

(Gonzalez, J. pr. (2) 36. 44.)

**Zinc tungstate**,  $\text{Zn}_2\text{W}_{12}\text{O}_{71} + 66\text{H}_2\text{O} = 9\text{ZnO}, 22\text{WO}_3 + 66\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$ . (Gibbs.)

**Zinc tungstate ammonia**,  $\text{ZnWO}_4, 4\text{NH}_3 + 3\text{H}_2\text{O}$ .

Decomp. in the air. (Briggs, Chem. Soc. 1904, 85. 677.)

**Pertungstic acid**.

See Pertungstic acid.

**Tungstoarsenic acid**.

See Arseniotungstic acid.

**Tungstoboric acid**.

See Borotungstic acid.

**Tungstocyanhydric acid**,  $\text{H}_4\text{W}(\text{CN})_8 + 6\text{H}_2\text{O}$ .

Hydroscopic.

Sol. in  $\text{H}_2\text{O}$  and abs. alcohol. Insol. in ether, benzene etc. (Olsson, Z. anorg. 1914, 88. 71.)

**Ammonium tungstocyanide**,  $(\text{NH}_4)_4\text{W}(\text{CN})_8$ .

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. slowly.

Insol. in organic solvents. (Olsson, Z. anorg. 1914, 88. 62.)

**Cadmium tungstocyanide**,  $\text{Cd}_4\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ . Sl. sol. in dil.  $\text{HCl}$ . Sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$ . Insol. in organic solvents. (Olsson, Z. anorg. 1914, 88. 68.)

**Cæsium tungstocyanide**,  $\text{Cs}_4\text{W}(\text{CN})_8$ .

Easily sol. in  $\text{H}_2\text{O}$  forming stable solutions. Insol. in alcohol and other organic solvents (Olsson.)

**Calcium tungstocyanide**,  $\text{Ca}_4\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. slowly.

Insol. in organic solvents. (Olsson.)

**Lead tungstocyanide**,  $\text{Pb}_4\text{W}(\text{CN})_8 + 4\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . Solution decomp. after short time.

Insol. in organic solvents. (Olsson.)

**Magnesium tungstocyanide**,  $\text{Mg}_4\text{W}(\text{CN})_8 + 6\text{H}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ . Aqueous solution decomp. on heating.

Insol. in organic solvents. (Olsson.)

**Manganous tungstocyanide**,  $\text{Mn}_2\text{W}(\text{CN})_8 + 8\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  and in acids.

Insol. in organic solvents. (Olsson.)



**Potassium tungstocyanide**,  $K_4W(CN)_8 + 2H_2O$ .

Easily sol. in  $H_2O$  from which it can be cryst. 10 ccm.  $H_2O$  dissolve 13-14 g. salt at  $18^\circ$ .

Insol. in alcohol, ether and other organic solvents. (Olsson.)

**Rubidium tungstocyanide**,  $Rb_4W(CN)_8 + 3H_2O$ .

Easily sol. in  $H_2O$ . Can be cryst. from  $H_2O$ .

Insol. in alcohol and other organic solvents. (Olsson.)

**Silver tungstocyanide**,  $Ag_4W(CN)_8$ .

Insol. in  $H_2O$ .

Insol. in acids. Decomp. by dil. HCl.

Sol. in hot conc.  $NH_4OH + Aq$ .

Insol. in organic solvents. (Olsson.)

**Sodium tungstocyanide**,  $Na_4W(CN)_8 + 2\frac{1}{2}H_2O$ .

Hydroscopic.

Easily sol. in  $H_2O$ .

Insol. in organic solvents. (Olsson.)

**Strontium tungstocyanide**,  $Sr_4W(CN)_8 + 8H_2O + 9H_2O$ .

Easily sol. in  $H_2O$ . Aqueous solution decomp. on standing.

Insol. in organic solvents. (Olsson.)

**Thallium tungstocyanide**,  $Tl_4W(CN)_8$ .

Difficultly sol. in cold  $H_2O$ , more sol. in hot  $H_2O$ .

Insol. in organic solvents. (Olsson.)

**Zinc tungstocyanide**,  $Zn_3W(CN)_8 + 4H_2O$ .

Insol. in  $H_2O$ , and acids.

Sol. in conc.  $NH_4OH + Aq$ . (Olsson.)

**Metatungstoidic acid.**

**Ammonium metatungstoidate**,  $2(NH_4)_2O, 2I_2O_5, 4WO_3 + 12H_2O$ .

Very sl. sol. in  $H_2O$ . (Chrétien, A. ch. 1898, (7) 15. 431.)

**Potassium tungstoidate**,  $K_2H_2WIO_6$ .

(Blomstrand, J. pr. (2) 40. 327.)

$2K_2O, 2I_2O_5, 4WO_3 + 8H_2O$ .

5.13 g. are sol. in 1 l.  $H_2O$  at  $15^\circ$ ; 8.25 g. at  $100^\circ$ . (Chrétien, A. ch. 1898, (7) 15. 431.)

**Tungstoperiodic acid.**

**Ammonium sodium tungstoperiodate**,  $2(NH_4)_2O, Na_2O, I_2O_5, 2WO_3 + 16H_2O$ .

Ppt. (Rosenheim, A. 1899, 303. 64.)

**Barium tungstoperiodate**,  $5BaO, I_2O_5, 12WO_3 + 12H_2O$ .

Ppt. (Rosenheim.)

**Potassium tungstoperiodate**,  $5K_2O, I_2O_5, 12WO_3 + 8H_2O$ .

Sol. in  $H_2O$ . (Rosenheim.)

**Sodium tungstoperiodate**,  $3Na_2O, I_2O_5, 2WO_3 + 4H_2O$ .

Ppt.

$5Na_2O, I_2O_5, 12WO_3 + 16H_2O$ . Sol. in  $H_2O$ . (Rosenheim.)

**Strontium tungstoperiodate**,  $5SrO, I_2O_5, 12WO_3 + 23H_2O$ .

Sol. in  $H_2O$ . (Rosenheim.)

**Tungstophosphoric acid,**  
*See Phosphotungstic acid.*

**Tungstosilicic acid,**  
*See Silicotungstic acid.*

**Tungstotungstic acid.**

**Lithium tungstotungstate**,  $Li_2O, WO_3 + WO_3, 3WO_3$ .

Insol. in boiling  $H_2O$  and conc. HCl. (Hallopeau, C. R. 1898, 127. 514.)

**Potassium tungstotungstate**,  $K_2O, WO_3 + WO_3, 3WO_3$ .

Insol. in hot  $H_2O$ , and conc. HCl. (Hallopeau, Bull. Soc. 1899, (3) 21. 267.)

**Tungstous acid.**

**Sodium tungstite**,  $Na_2W_2O_6$ .

*See Tungstate tungsten oxide, sodium.*

**Tungstovanadic acid.**

*See Vanadotungstic acid.*

**Tungstyl dibromide**,  $WO_3Br_2$ .

Not decomp. by cold  $H_2O$ . (Roscoe.)

**Tungstyl tetrabromide**,  $WOBr_4$ .

Extremely deliquescent. Decomposes at once in moist air or with  $H_2O$ .

**Tungstyl dichloride**,  $WO_2Cl_2$ .

Not decomp. by cold, and but slowly by boiling  $H_2O$ . Sol. in alkalies and ammonia.

**Tungstyl tetrachloride**,  $WOCl_4$ .

Easily decomp. by  $H_2O$  or moist air.

Very sol. in  $CS_2$  and  $S_2Cl_2$ . Sl. sol. in benzene. (Smith, J. Am. Chem. Soc. 1899, 21. 1008.)

**Tungstyl tetrafluoride**,  $WOF_4$ .

Sol. in  $H_2O$  with decomp. Very hydroscopic.

Insol. in carbon tetrachloride.

Sl. sol. in carbon bisulphide, dry benzene and ether.

Easily sol. in chloroform and absolute alcohol. (Ruff, Z. anorg. 1907, **52**, 265.)

**Tungstyl tetrafluoride ammonia**,  $2\text{WOF}_4 \cdot \text{NH}_3$ .

Sol. in  $\text{H}_2\text{O}$  with decomp.

Insol. in liquid  $\text{NH}_3$ . (Ruff, Z. anorg. 1907, **52**, 266.)

**Ultramarine blue**,  $2\text{Na}_3\text{Al}_2\text{Si}_5\text{O}_{14} \cdot \text{Na}_2\text{S}_2$  (?)

Not attacked by solutions of alkalis or  $\text{NH}_4\text{OH} + \text{Aq}$ . Decomp. by acids or acid salts + Aq. Decomp. by alum + Aq.

**Ultramarine green**,  $\text{Na}_3\text{Al}_2\text{Si}_5\text{O}_{14} \cdot \text{Na}_2\text{S}$  (?)

Decomp. by mineral acids. Not attacked by alkalis. Decomp. by alum + Aq.

**Ultramarine white**,  $2\text{Na}_3\text{Al}_2\text{Si}_5\text{O}_{14} \cdot \text{Na}_2\text{S}$  (?)

**Uranic acid**,  $\text{H}_2\text{UO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids. Very sol. in cold dil.  $\text{HNO}_3 + \text{Aq}$ . Sl. sol. in boiling  $\text{NH}_4\text{Cl} + \text{Aq}$ . Insol. in  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH} + \text{Aq}$ . Easily sol. in  $(\text{NH}_4)_2\text{CO}_3$ ,  $\text{KHCO}_3$ , and  $\text{NaHCO}_3 + \text{Aq}$ ; less in  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Ebelmen.)

Easily sol. in malic and tartaric acids to form complex compds. (Itzig, B. 1901, **34**, 3822.)

$\text{H}_2\text{UO}_4$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in acids. (Ebelmen.)

### Uranates.

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids.

### Ammonium uranate.

Sl. sol. in pure  $\text{H}_2\text{O}$ ; insol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{OH}$ .

Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . (Peligot, A. ch. (3) **5**, 11.)

$(\text{NH}_4)_2\text{O}$ ,  $4\text{UO}_3 + 7\text{H}_2\text{O}$ . (Grubler, Disser, 1906.)

$(\text{NH}_4)_2\text{O}$ ,  $6\text{UO}_3 + 10\text{H}_2\text{O}$ . Insol. in cold and hot  $\text{H}_2\text{O}$  and alkalis + Aq. Very sol. in  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and acetic acid + Aq. (Zehenter, M. 1900, **21**, 235.)

### Barium uranate, $\text{BaUO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids.

$\text{BaU}_2\text{O}_7$ . As above. (Ditte, C. R. **95**, 988.)

$\text{BaU}_2\text{O}_{10} + 4\frac{1}{2}\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ . and alcohol.

Easily sol. in cold dil.  $\text{HCl}$  or  $\text{HNO}_3$  and in hot acetic acid. (Zehenter, M. 1904, **25**, 200.)

$\text{Ba}_3\text{U}_2\text{O}_{17} + 8\text{H}_2\text{O}$ . Nearly insol. in hot or cold  $\text{H}_2\text{O}$ ,  $\text{KOH} + \text{Aq}$ . and alcohol.

Easily sol. in cold dil.  $\text{HCl}$  or  $\text{HNO}_3$  and in hot acetic acid. (Zehenter.)

$\text{Ba}_3\text{U}_2\text{O}_{17} + 11\text{H}_2\text{O}$ . Same properties as  $\text{BaU}_2\text{O}_{10}$ . (Zehenter.)

**Bismuth uranate**,  $\text{Bi}_2\text{O}_3 \cdot \text{UO}_3 + \text{H}_2\text{O}$ .

Min. *Uranosphaerite*.

**Calcium uranate**,  $\text{CaUO}_4$ .

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ditte, C. R. **95**, 988.)

$\text{CaU}_2\text{O}_7$ . Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. (Ditte.)

**Cobalt uranate**.

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Persoz, J. pr. **3**, 216.)

Sol. in  $\text{HNO}_3 + \text{Aq}$ ; insol. in  $\text{KNO}_3 + \text{Aq}$ . (Ebelmen, A. ch. (3) **5**, 222.)

**Cupric uranate**,  $\text{CuU}_2\text{O}_7$ .

Insol. in  $\text{H}_2\text{O}$ . (Debray, A. ch. (3) **61**, 451.)

**Lead uranate**,  $\text{PbUO}_4$ .

If ignited, very difficultly sol. in  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ . (Wertheim, J. pr. **29**, 228.)

Insol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 + \text{Aq}$ . (Persoz.)

$3\text{PbO}$ ,  $2\text{UO}_3$ . Sol. in dil.  $\text{HNO}_3 + \text{Aq}$ . (Ditte, A. ch. (6) **1**, 338.)

$\text{PbU}_2\text{O}_{10}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ .

Insol. in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH}$  and cold acetic acid. Sol. in hot acetic acid. (Zehenter, M. 1904, **25**, 215.)

$\text{Pb}_3\text{U}_2\text{O}_{17} + 4\text{H}_2\text{O}$ . Insol. in hot or cold  $\text{H}_2\text{O}$ . Sol. in  $\text{HNO}_3$ . Insol. in  $\text{KOH} + \text{Aq}$ ,  $\text{NH}_4\text{OH}$ , alcohol and ether. Sl. sol. in cold, more easily sol. in hot acetic acid. (Zehenter.)

**Lithium uranate**,  $\text{Li}_2\text{UO}_4$ .

Insol. in  $\text{H}_2\text{O}$ , but decomp. thereby. Sol. in dil. acids.

**Magnesium uranate**,  $\text{MgUO}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Nearly insol. in cold  $\text{HCl} + \text{Aq}$ . Slowly sol. in  $\text{HCl} + \text{Aq}$  on warming,

and more rapidly by addition of a little  $\text{HNO}_3 + \text{Aq}$ . (Ditte.)

$\text{MgU}_2\text{O}_7$ . Ppt. (Berzelius.)

**Neodymium uranate**,  $\text{Nd}_2(\text{U}_2\text{O}_{10})_3 + 18\text{H}_2\text{O}$ .

Ppt. (Orloff, Ch. Z. 1907, **31**, 1119.)

**Potassium uranate**,  $\text{K}_2\text{UO}_4$  (?)

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids, etc., exactly as  $\text{Na}_2\text{UO}_4$ . (Ditte.)

$\text{K}_2\text{U}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids, even acetic acid. (Zimmermann, B. **14**, 440.)

Insol. in  $\text{K}_2\text{CO}_3 + \text{Aq}$ , but easily sol. in alkali hydrogen carbonates + Aq. Sol. in  $\text{HCl} + \text{Aq}$ . (Ebelmen, A. ch. (3) **5**, 220.)

$\text{K}_2\text{O}$ ,  $4\text{UO}_3 + 5\text{H}_2\text{O}$ . (Zehenter, M. 1900, **21**, 235.)

$\text{K}_2\text{O}$ ,  $6\text{UO}_3 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Drenckmann, Zeit. ges. Nat. **17**, 113.)

$+ 10\text{H}_2\text{O}$ . Nearly insol. in cold and hot  $\text{H}_2\text{O}$ . Easily sol. in hot acetic acid, dil.  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$  and  $\text{HNO}_3$ . Insol. in  $\text{KOH} + \text{Aq}$ , alcohol and ether. ((Zehenter, M. 1900, **21**, 235.)

**Potassium hydroxylamine uranate,**  
 $\text{UO}_4(\text{NH}_4\text{O})(\text{NH}_4\text{OK}) + \text{H}_2\text{O}.$ 

Sl. sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Hofmann, A. 1899, 307. 318.)

**Rubidium uranate,  $\text{RbUO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 1. 338.)

**Silver uranate,  $\text{Ag}_2\text{U}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Alibegoff, A. 233. 117.)

**Sodium uranate,  $\text{Na}_2\text{UO}_4$  (?)**

Insol. in  $\text{H}_2\text{O}$ ; sol. in dil. acids. Sol. in alkali carbonates + Aq. (Ditte.)

$\text{Na}_2\text{U}_2\text{O}_7 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids. (Stolba, Z. anal. 3. 74.)

$\text{Na}_2\text{O} \cdot 3\text{UO}_3$ . Insol. in  $\text{H}_2\text{O}$ . Easily sol. in very dil. acids. (Drenckmann.)

$\text{Na}_2\text{O} \cdot 5\text{UO}_3 + 5\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ , alcohol,  $\text{NH}_4\text{OH}$ ,  $\text{KOH}$  + Aq. Sol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ . Sl. sol. even on boiling in conc. acetic acid. (Zehenter, M. 1900, 21. 235.)

**Sodium hydroxylamine uranate,**  
 $\text{UO}_4(\text{NH}_4\text{O})(\text{NH}_4\text{ONa}) + \text{H}_2\text{O}.$ 

Sol. in  $\text{H}_2\text{O}$ . (Hofmann, A. 1899, 307. 319.)

$\text{UO}_4(\text{NH}_4\text{ONa})_2 + 6\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ . (Hofmann.)

**Strontium uranate,  $\text{SrUO}_4$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in dil. acids.

$\text{SrU}_2\text{O}_7$ . As above. (Ditte, C. R. 95. 988.)  
Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in all acids especially oxalic.

+  $\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . Sol. in all acids especially oxalic. (J. C. C. 1896, II. 512.)

**Thallous uranate.**

Ppt. (Bolton, Am. Chemist, 1872, 2. 456.)

**Zinc uranate.**

Insol. in  $\text{H}_2\text{O}$ ; sol. in  $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$  + Aq. (Persoz, J. pr. 3. 216.) Sol. in  $\text{HNO}_3$  + Aq; insol. in  $\text{KNO}_3$ , and  $\text{NH}_4\text{NO}_3$  + Aq. (Ebelmen, A. ch. (3) 5. 221.)

**Peruranic acid.**

See Peruranic acid.

**Uranium, U.**

Not attacked by  $\text{H}_2\text{O}$ . Slowly decomp. by cold dil.  $\text{H}_2\text{SO}_4$  + Aq, rapidly on warming. Easily sol. in dil. or conc.  $\text{HCl}$  + Aq. Fused U is slightly attacked by conc. or fuming  $\text{HNO}_3$ , or conc.  $\text{H}_2\text{SO}_4$ . Amorphous U, however, is easily attacked thereby. Not attacked by acetic acid,  $\text{KOH}$ ,  $\text{NaOH}$ , or  $\text{NH}_4\text{OH}$  + Aq. (Zimmermann, B. 15. 849.)

When finely divided, it is decomp. by  $\text{H}_2\text{O}$  slowly at ordinary temps. and rapidly at  $100^\circ$ . (Moissan, C. R. 1896, 122. 1091.)

**Uranium antimonide,  $\text{U}_3\text{Sb}_2$ .**

Violently attacked by conc.  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383.)

**Uranium arsenide,  $\text{U}_3\text{As}_2$ .**

Violently attacked by conc.  $\text{HNO}_3$ . (Colani, C. R. 1903 137. 383.)

**Uranium boride,  $\text{UB}_3$ .**

Sol. in  $\text{HNO}_3$  and  $\text{HF}$ . Decomp. by fused alkalies. (Wedekind, B. 1913, 46. 1204.)

**Uranium tribromide,  $\text{UBr}_3$ .**

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  with hissing. (Alibegoff, A. 233. 117.)

**Uranium tetrabromide,  $\text{UBr}_4$ .**

Anhydrous. Very deliquescent. Sol. in  $\text{H}_2\text{O}$  with hissing. (Hermann.)

Insol. in alcohol. (v. Unruh, Dissert, 1909.) Sol. in acetone. (Eidmann, C. C. 1899, II. 1014); methyl acetate (Naumann, B. 1909, 42. 3790); ethyl acetate. (Naumann, B. 1904, 37. 3601.)

+  $8\text{H}_2\text{O}$ . Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Rammelsberg.)

**Uranium carbide,  $\text{UC}_2$ .**

(Ruff and Heinzelmann, Z. anorg. 1911, 71. 72.)

Attacked slowly by  $\text{H}_2\text{O}$ . Slowly attacked by cold dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$  + Aq. Conc. acids, except  $\text{HNO}_3$ , react sl. in the cold, violently on heating. (Moissan, Bull. Soc. 1897, (3) 17. 12.)

Sol. in fused  $\text{KNO}_3$  and  $\text{KClO}_3$ ; sol. in dil. acids in the cold and in conc. acids on heating; decomp. by  $\text{H}_2\text{O}$ . (Moissan, C. R. 1896, 122. 276.)

**Uranium trichloride,  $\text{UCl}_3$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Peligot.)

Very unstable. (Zimmermann.)

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$  with decomp. Sol. in conc.  $\text{HCl}$  and solution is much more stable than aqueous one. (Rosenheim and Loebel, Z. anorg. 1906, 57. 234.)

**Uranium tetrachloride,  $\text{UCl}_4$ .**

Anhydrous. Extremely deliquescent.

Sol. in  $\text{H}_2\text{O}$  with evolution of heat. Decomp. on boiling. Sol. in  $\text{NH}_4\text{Cl}$  + Aq without decomp.

$\text{HCl}$  increases its solubility in  $\text{H}_2\text{O}$ . (Aloy, Dissert. 1901.)

Sol. in alcohol, acetone, acetic ether, benzoic ether. Insol. in ether,  $\text{CHCl}_3$  and  $\text{C}_6\text{H}_6$ . (Loebel.)

Sol. in ethyl acetate. (Naumann, B. 1904, 37. 3601.)

**Uranium pentachloride,  $\text{UCl}_5$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  with evolution of heat and decomposition. (Roscoe, B. 7. 1131.)

Sol. in acetic acid, acetic ether, benzaldehyde, glycerine, benzyl alcohol (trace), nitrobenzene (trace), xylidine and p-toluidine (on warming).

Insol. in aniline, ligroin, pyridine, quinoline, thioethyl ether, thioamyl ether and  $\text{CS}_2$  (Pimmer, Dissert. 1904.)

Sol. in abs. alcohol. Insol. in ether,  $\text{C}_6\text{H}_6$ , nitrobenzene, ethylene bromide. Sl. sol. in  $\text{CCl}_4$  and  $\text{CHCl}_3$ . Sol. in benzoic ether, acetone and trichloroacetic acid. Best solvents are ethyl acetate and benzonitrile. Sol. in many organic compounds containing oxygen. (Loebel, Dissert. 1907.)

#### Uranium difluoride, $\text{UF}_2 + 2\text{H}_2\text{O}$ .

Ppt (Giollitti and Agamennone, C. C. 1906, I. 1130.)

#### Uranium tetrafluoride, $\text{UF}_4$ .

Insol. in  $\text{H}_2\text{O}$ . Very sl. sol. in dil. acids. Sol. in hot conc.  $\text{H}_2\text{SO}_4$ , and slowly in warm conc.  $\text{HNO}_3$  + Aq. (Bolton, J. B. 1866. 209.)

#### Uranium hexafluoride, $\text{UF}_6$ .

Very sol. in  $\text{H}_2\text{O}$ . (Ditte, A. ch. (6) 1. 339.)

Fumes in the air.

Very hygroscopic; sol. in  $\text{H}_2\text{O}$ . (Ruff, B. 1909, 42. 495.)

Very hygroscopic. Sol. in  $\text{H}_2\text{O}$ . Nearly insol. in  $\text{CS}_2$ . Insol. in paraffine oil. Sol. in symmetrical tetrachlorethane (best solvent),  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , and nitrobenzene. (v. Unruh, Dissert. 1909.)

Decomp. by  $\text{H}_2\text{O}$ , alcohol and ether. Nearly insol. in  $\text{CS}_2$ .

Sol. in  $\text{CHCl}_3$ ,  $\text{CCl}_4$ , nitrobenzene and  $\text{C}_2\text{H}_5\text{Cl}$ . (Ruff, Z. anorg. 1911, 72. 81.)

#### Uranium hydrogen fluoride, $\text{UF}_6 \cdot 8\text{HF}$ (?).

Sol. in  $\text{H}_2\text{O}$ . (Ditte.)

Is  $\text{UO}_2\text{F}_2 \cdot \text{HF} + \text{H}_2\text{O}$ . (Smithells)

#### Uranous hydroxide, $\text{UO}_2 \cdot x\text{H}_2\text{O}$ .

Easily sol. in dil. acids.

Insol. in alkali hydrates and carbonates + Aq. (Berzelius.)

Sol. in alkali carbonates + Aq. (Rammelsberg.)

$\text{U}(\text{OH})_4$ . Sol. in dil. acids. (Aloy, Bull. Soc. 1899, (3) 21. 613.)

#### Uranouranic hydroxide, $\text{U}_2\text{O}_5 \cdot 6\text{H}_2\text{O}$ (?).

Easily sol. in acids.

Decomp. by  $(\text{NH}_4)_2\text{CO}_3$  + Aq, which dissolves out  $\text{UO}_2$ . (Berzelius.)

#### Uranic hydroxide.

See Uranic acid.

#### Uranium tetraiodide, $\text{UI}_4$ .

Sol. in  $\text{H}_2\text{O}$ . (Guichard, C. R. 1907, 145. 921.)

#### Uranium iodide.

Sol. in ethyl acetate. (Naumann, B. 1904 37. 3601.)

#### Uranium nitride, $\text{U}_3\text{N}_4$ .

(Colani, C. R. 1903, 137. 383.)

#### Uranium suboxide, $\text{UO}$ (?).

(Guyard, Bull. Soc. (2) 1. 89.)

Does not exist. (Zimmermann, A. 213. 301.)

$\text{U}_2\text{O}_3$  (?). Ppt. Decomp. by  $\text{H}_2\text{O}$  and in the air. (Peligot.)

#### Uranium dioxide (Uranous oxide), $\text{UO}_2$ .

Insol. in dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  + Aq.

Sol. in conc.  $\text{H}_2\text{SO}_4$ , and easily in  $\text{HNO}_3$  + Aq. (Peligot.)

Insol. in  $\text{NH}_4\text{Cl}$  + Aq. (Rose.)

Only sl. sol. in  $\text{H}_2\text{SO}_4$ , but a considerable amount is converted into the sulphate which is nearly insol. in  $\text{H}_2\text{SO}_4$ .

Slowly sol. in  $\text{HCl}$ , the amount dissolved in a given time varying widely with the method of preparation of the oxide. (Colani, C. R. 1912, 155. 1251.)

Sl. more sol. in  $\text{HNO}_3$  than in aqua regia. (Raynaud, Bull. Soc. 1912, (4) 11. 802.)

Very sol. in conc.  $\text{HNO}_3$ ; less sol. in dil.  $\text{HNO}_3$ . 1 gram is sol. in 3100 grams  $\text{HCl}$  (1.17) at  $17^\circ$ ; 4650 grams  $\text{HBr}$  (1.52) at  $17^\circ$ ; 2200 grams  $\text{H}_2\text{SO}_4$  (1.79) at  $17^\circ$ ; 12,000 grams acetic acid at  $19^\circ$ . (Raynaud, C. R. 1911, 153. 1481.)

Sl. attacked by liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

Min. *Uraninite*. Easily sol. in warm  $\text{HNO}_3$  + Aq. Not attacked by  $\text{HCl}$  + Aq.

#### Uranium trioxide (Uranic oxide), $\text{UO}_3$ .

Sol. in  $\text{HNO}_3$  + Aq. (Peligot.)

Insol. in boiling K tartrate + Aq. (Kahlenberg and Hilmyer, Am. Ch. J. 1894, 16. 102.)

Sol. in oleic acid. (Gibbons, Arch. Pharm. 1883, 221. 621.)

See Uranic acid.

#### Uranium tetroxide, $\text{UO}_4$ .

Decomp. by  $\text{HCl}$  + Aq. (Fairley, Chem. Soc. 31. 133.)

+  $2\text{H}_2\text{O}$ . Very hygroscopic. (Zimmermann.)

+  $3\text{H}_2\text{O}$ .

#### Uranium pentoxide, $\text{U}_2\text{O}_5$ .

Sol. in acids. (Peligot.)

Mixture of  $\text{UO}_2$  and  $\text{U}_2\text{O}_5$ . (Rammelsberg, Pogg. 59. 5.)

Mixture of  $\text{UO}_2$  and  $\text{U}_2\text{O}_5$ . (Zimmermann, A. 232. 273.)

#### Uranouranic oxide, $\text{U}_2\text{O}_5$ .

*Green uranium oxide*. Very slowly and slightly sol. in dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4$  + Aq; more easily when conc. Completely sol. in boiling  $\text{H}_2\text{SO}_4$ . Easily sol. in  $\text{HNO}_3$  + Aq.

**Uranous oxychloride,  $\text{UO}_2, \text{UCl}_4 + \text{H}_2\text{O}$ .**

Moderately sol. in  $\text{H}_2\text{O}$ . (Aloy, Dissert. 1901.)

$2\text{UO}_2, \text{UCl}_4 + \text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Orloff, C. C. 1903, II. 484.)  
 $+13\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Orloff.)

$4\text{UO}_2, \text{UCl}_4$ . Very sol. in  $\text{H}_2\text{O}$  and alcohol. (Orloff.)

$5\text{UO}_2, \text{UCl}_4 + 10\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Aloy, Dissert, 1901.)

**Uranous oxyfluoride,  $\text{UOF}_2 + 2\text{H}_2\text{O}$ .**

(Giollitti and Agamennone, C. C. 1906, I. 1130.)

**Uranous oxysulphide,  $\text{U}_2\text{O}_3\text{S}_2 = \text{UO}_3, 2\text{US}_2$ .**

Slightly attacked by dil., easily by conc.  $\text{HCl} + \text{Aq}$ . Sol. in cold  $\text{HNO}_3 + \text{Aq}$ . (Hermann, J. B. 1861. 258.)

**Uranic oxy-compounds.**

See Uranyl compounds.

**Uranium phosphide,  $\text{U}_2\text{P}_3$ .**

Violently attacked by conc.  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383.)

$\text{U}_2\text{P}_3$ . Slowly attacked by  $\text{H}_2\text{O}$ , not by dil.  $\text{HCl} + \text{Aq}$ . More easily attacked by conc.  $\text{HCl} + \text{Aq}$ . Quickly decomp. by boiling conc.  $\text{HNO}_3$  and  $\text{HNO}_3 + \text{HCl}$ . (Colani, A. ch. 1907, (8) 12. 59.)

**Uranium selenide,  $\text{USe}$ .**

Spontaneously inflammable. Sol. in fuming  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383.)

$\text{USe}_2$ . As  $\text{US}_2$ . (Colani, C. C. 1903, II. 707.)

$\text{U}_2\text{Se}_3$ . (Colani.)

**Uranium disilicide,  $\text{USi}_2$ .**

Sol. in cold or hot conc.  $\text{HF}$ ; insol. in  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and aqua regia. (Defacqz, C. R. 1908, 147. 1051.)

**Uranium monosulphide,  $\text{US}$ .**

(Alibegoff, A. 233. 117.)

**Uranium sesquisulphide,  $\text{US}_2$ .**

Not attacked by  $\text{HCl}$  or dil.  $\text{HNO}_3 + \text{Aq}$ . Oxidised by fuming  $\text{H}_2\text{SO}_4$  or aqua regia. (Alibegoff, A. 233. 117.)

**Uranium disulphide,  $\text{US}_2$ .**

Insol. in cold or boiling dil.  $\text{HCl} + \text{Aq}$ . Sol. in cold conc.  $\text{HCl} + \text{Aq}$ . Decomp. by  $\text{HNO}_3 + \text{Aq}$ . (Hermann, J. B. 1861. 258.)

**Uranium telluride,  $\text{UTe}_2$ .**

Violently attacked by conc.  $\text{HNO}_3$ . (Colani, C. R. 1903, 137. 383.)

**Uranosotungstic acid.**

Potassium uranosotungstate,  $9\text{K}_2\text{O}, 6\text{UO}_2, 8\text{WO}_3 + 34\text{H}_2\text{O}$ .

Insol. in  $\text{H}_2\text{O}$  and in  $\text{HCl}$ . (Gibbs, Am. Ch. J. 1895, 17. 175.)

Sodium uranosotungstate,  $12\text{Na}_2\text{O}, 6\text{UO}_2, 8\text{WO}_3 + 25\text{H}_2\text{O}$ .

Insol. in cold  $\text{H}_2\text{O}$ . (Gibbs.)

**Uranyl bromide,  $\text{UO}_2\text{Br}_2$ .**

Sol. in  $\text{H}_2\text{O}$ . (de Coninck, C. C. 1903, I. 693.)

Sol. in ether. (v. Unruh, Dissert. 1909.)  
 $+7\text{H}_2\text{O}$ . Deliquescent. Sol. in  $\text{H}_2\text{O}$ .

**Uranyl bromide ammonia,  $\text{UO}_2\text{Br}_2, 2\text{NH}_3$ .**

(v. Unruh, Dissert. 1909.)

$\text{UO}_2\text{Br}_2, 3\text{NH}_3$ . (v. Unruh.)

$\text{UO}_2\text{Br}_2, 4\text{NH}_3$ . (v. Unruh.)

**Uranyl chloride,  $\text{UO}_2\text{Cl}_2$ .**

Anhydrous. Very deliquescent. Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.

Very sol. in  $\text{H}_2\text{O}$ .

Sp. gr. of  $\text{UO}_2\text{Cl}_2 + \text{Aq}$  at  $t^\circ$ .

$t^\circ$	% $\text{UO}_2\text{Cl}_2$	Sp. gr.
14.6	1	1.0056
16.3	2	1.0112
13.7	3	1.0161
13.1	4	1.0215
14.2	5	1.0260
15.2	6	1.0313
14.3	7	1.0366
14.5	8	1.0418
15.0	9	1.0469
14.8	10	1.0517

(de Coninck, A. ch. 1904, (8) 3. 500.)

Sol. in conc.  $\text{HCl}$ , conc.  $\text{HNO}_3$ , and in selenic acid.

Decomp. by  $\text{H}_2\text{SO}_4$ . (de Coninck, A. ch. 1904, (8) 3. 504.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790); acetone. (Naumann, B. 1904, 37. 4328.)

$+ \text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , alcohol, and ether.  
 $+ 3\text{H}_2\text{O}$ . Deliquescent.

Very sol. in  $\text{H}_2\text{O}$ . 1 pt. is sol. in 0.134 pts.  $\text{H}_2\text{O}$  at  $18^\circ$  and solution, which is saturated, contains 76.2%  $\text{UO}_2\text{Cl}_2$  or 88.2%  $\text{UO}_2\text{Cl}_2 + 3\text{H}_2\text{O}$ . Sp. gr. of solution = 2.740. The solubility increases with rise in temp.

Sol. in alcohol and in ether. (Mylilius and Dietz, B. 1901, 34. 2775.)

**Uranyl hydrogen chloride,  $\text{UO}_2\text{Cl}_2, \text{HCl} + 2\text{H}_2\text{O}$ .**

Cryst. at  $-10^\circ$  from sat. solution of  $\text{UO}_2\text{Cl}_2$  in  $\text{HCl} + \text{Aq}$ .

Fumes in the air. (Aloy, Bull. Soc. 1901, (3) 25. 154.)

**Uranyl chloride ammonia,  $\text{UO}_2(\text{NH}_4\text{Cl})_2$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Regelsberger, A. 227. 119.)

$\text{UO}_2(\text{NH}_4\text{NH}_2\text{Cl})\text{NH}_4\text{Cl}$ . Decomp. by  $\text{H}_2\text{O}$ . (Regelsberger.)

$\text{UO}_2(\text{NH}_4\text{NH}_2\text{Cl})_2$ . Decomp. by  $\text{H}_2\text{O}$ . (Regelsberger.)

**Uranyl fluoride,  $\text{UO}_2\text{F}_2$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Smithells, Chem. Soc. 43. 125.)

Insol. in  $\text{H}_2\text{O}$  or dil. acids. Very sl. sol. in  $\text{HF} + \text{Aq}$ . Sol. in  $\text{H}_2\text{SO}_4 + \text{aqua regia}$ . (Ditte, A. ch. (6) 1. 339.)

Insol. in ether and amyl alcohol. (v. Unruh, Dissert. 1909.)

$\text{UOF}_4$ . Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 91. 115.)

True composition is  $\text{UO}_2\text{F}_2$ . (Smithells.)

**Uranyl hydrogen fluoride,  $\text{UO}_2\text{F}_2 \cdot \text{HF} + \text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Smithells, Chem. Soc. 43. 131.)

**Uranyl fluoride ammonia,  $\text{UO}_2\text{F}_2 \cdot 2\text{NH}_3$ .**

(v. Unruh, Dissert. 1909.)

$\text{UO}_2\text{F}_2 \cdot 3\text{NH}_3$ . (v. Unruh.)

$\text{UO}_2\text{F}_2 \cdot 4\text{NH}_3$ . (v. Unruh.)

**Uranyl iodide,  $\text{UO}_2\text{I}_2$ .**

Ppt. Deliquescent. (Aloy, A. ch. 1910, (7) 24. 417.)

Deliquescent.

Sol. in alcohol, ether and benzene. (Aloy, Dissert. 1901.)

Sol. in acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328); methyl acetate. (Naumann, B. 1909, 42. 3790.)

**Uranyl iodide ammonia,  $\text{UO}_2\text{I}_2 \cdot 2\text{NH}_3$ .**

(Aloy, Dissert. 1901.)

$\text{UO}_2\text{I}_2 \cdot 3\text{NH}_3$ . (Aloy.)

$\text{UO}_2\text{I}_2 \cdot 4\text{NH}_3$ . (Aloy.)

**Uranyl selenide,  $\text{UO}_2\text{Se}$ .**

Very slowly decomp. by  $\text{H}_2\text{O}$ .

Easily sol. in cold  $\text{HCl}$ . Violently attacked by cold  $\text{HNO}_3$ . Not attacked by dil. alkalis. (Milbauer, Z. anorg. 1904, 42. 450.)

**Uranyl sulphide,  $\text{UO}_2\text{S}$ .**

Sl. sol. in pure  $\text{H}_2\text{O}$ . Sol. in dil. insol. in absolute alcohol. Sol. in conc.  $\text{HCl} + \text{Aq}$ , also in dil. acids. Decomp. by caustic alkalis  $+ \text{Aq}$ . Partly sol. in  $(\text{NH}_4)_2\text{S} + \text{Aq}$ .

**Metavanadic acid,  $\text{HVO}_3$ .**

Insol. in  $\text{H}_2\text{O}$ ; sol. in acids and alkalis.

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

$+ \frac{1}{2}\text{H}_2\text{O}$ .

See Vanadium pentoxide.

**Pyrovanadic acid,  $\text{H}_4\text{V}_2\text{O}_7$ .**

Insol. in  $\text{H}_2\text{O}$ . Sol. in acids and alkalis.

**Vanadates.**

The alkali, Ba, and Pb metavanadates are sl. sol. in  $\text{H}_2\text{O}$ , the others are more easily sol. Insol. in alcohol.

**Aluminum metavanadate.**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Aluminum divanadate.**

Very sl. sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Ammonium metavanadate,  $(\text{NH}_4)\text{VO}_3$ .**

(a) Very slowly and sparingly sol. in cold  $\text{H}_2\text{O}$ . Easily sol. in hot  $\text{H}_2\text{O}$ . (Berzelius.)

Easily sol. in  $\text{H}_2\text{O}$  at about  $70^\circ$ . Very sl. sol. at above and below that temperature. (Guyard, Bull. Soc. (2) 25. 355.)

10 g. dissolve in 1 litre cold, and 63 g. in 1 litre hot  $\text{H}_2\text{O}$  with partial decomp. (Ditte, C. R. 102. 918.)

**Solubility in  $\text{H}_2\text{O}$  at  $t^\circ$ .**

$t^\circ$	Solubility, mol. per litre
18	0.03715
25	0.05189
35	0.08980
45	0.13406
55	0.17041
70	0.25994

(Meyer, Z. Elektrochem, 1909, 15. 266.)

**Solubility in  $\text{NH}_4\text{OH} + \text{Aq}$  at  $t^\circ$ .**

$\text{NH}_4\text{OH} + \text{Aq}$	$t^\circ$	Solubility, mol. per litre
0.0677-N	18	0.04763
0.2452-N		0.06798
0.5872-N		0.1029
0.0677-N	25	0.06026
0.2452-N		0.07303
0.5872-N		0.1080

(Meyer, Z. Elektrochem, 1909, 15. 268.)

Extremely sl. sol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ . (v. Hauer.)

Insol. in sat.  $\text{NH}_4\text{Cl} + \text{Aq}$ .

Solubility in salts + Aq at t°.		
Salt solution	t°	Solubility, mol. per litre
0.05-N NH <sub>4</sub> Cl + Aq	18	0.01419
	25	0.02246
	35	0.04445
	45	0.07575
	55	0.09544
0.1-N NH <sub>4</sub> Cl + Aq	18	0.00356
	25	0.00995
	35	0.02347
	45	0.04507
	55	0.06314
0.05-N NH <sub>4</sub> NO <sub>3</sub> + Aq	18	0.01433
	25	0.02364
0.1-N NH <sub>4</sub> NO <sub>3</sub> + Aq	18	0.00497
	25	0.01050

(Meyer, Z. Elektrochem, 1909, 15. 267.)

Insol. in alcohol. (v. Hauer.)

(b) Sol. in cold H<sub>2</sub>O, from which it is pptd. by alcohol. (Berzelius.)

**Ammonium divanadate**, (NH<sub>4</sub>)<sub>2</sub>V<sub>2</sub>O<sub>11</sub> + 4H<sub>2</sub>O.

Sol. in H<sub>2</sub>O, from which it is precipitated by sat. NH<sub>4</sub>Cl + Aq or alcohol. (v. Hauer, W. A. B. 21. 337.)

Correct formula is (NH<sub>4</sub>)<sub>2</sub>V<sub>2</sub>O<sub>10</sub> + 2H<sub>2</sub>O, according to Rammelsberg (B. A. B. 1883. 3.) + 3H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Ditte, C. R. 102. 918.)

**Ammonium trivanadate**, (NH<sub>4</sub>)<sub>2</sub>V<sub>3</sub>O<sub>16</sub>.

Anhydrous. Nearly insol. in hot or cold H<sub>2</sub>O. (Norblad, B. 8. 126.)

1.5 g. dissolve in 1 litre of boiling H<sub>2</sub>O. (Ditte, C. R. 102. 918.)

+ 5H<sub>2</sub>O. Very sl. sol. in H<sub>2</sub>O. (Ditte.)  
+ 6H<sub>2</sub>O (?). Very sol. in H<sub>2</sub>O. (v. Hauer, W. A. B. 39. 455.)

Could not be obtained. (Norblad; also Rammelsberg, B. A. B. 1883. 3.)

**Ammonium vanadate**, (NH<sub>4</sub>)<sub>2</sub>V<sub>2</sub>O<sub>10</sub> + 2H<sub>2</sub>O.

Correct formula of v. Hauer's divanadate, according to Rammelsberg (B. A. B. 1883. 3.)

Sl. sol. in H<sub>2</sub>O.

**Ammonium sesquivanadate**, (NH<sub>4</sub>)<sub>4</sub>V<sub>3</sub>O<sub>17</sub> + 4 or 6H<sub>2</sub>O.

Very sol. in H<sub>2</sub>O. (Ditte, C. R. 102. 918.)

**Ammonium pentavanadate**, (NH<sub>4</sub>)<sub>4</sub>V<sub>5</sub>O<sub>27</sub> + 10H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Rammelsberg, B. A. B. 1883. 3.)

**Ammonium hydroxylamine vanadate**, VO<sub>2</sub>N<sub>2</sub>H<sub>10</sub>.

Rapidly decomp. by H<sub>2</sub>O. (Hofmann and Kohlschütter, Z. anorg. 1898, 16. 472.)

HVO<sub>3</sub>, 3NH<sub>3</sub>O, 2NH<sub>3</sub> = VO<sub>2</sub>N<sub>2</sub>H<sub>10</sub>. Rapidly decomp. by H<sub>2</sub>O. (Hofmann and Kohlschütter.)

**Ammonium potassium vanadate**, K<sub>2</sub>V<sub>2</sub>O<sub>11</sub>, (NH<sub>4</sub>)<sub>2</sub>V<sub>2</sub>O<sub>17</sub> + 9H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1844.)

**Ammonium sodium vanadate**, Na<sub>2</sub>V<sub>2</sub>O<sub>11</sub>, (NH<sub>4</sub>)<sub>2</sub>V<sub>2</sub>O<sub>17</sub> + 15H<sub>2</sub>O.

Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1841.)

**Ammonium uranyl vanadate**, (NH<sub>4</sub>)<sub>2</sub>O, 2UO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub> + H<sub>2</sub>O.

Insol. in H<sub>2</sub>O, NH<sub>4</sub>OH + Aq, or dil. HCl, H<sub>2</sub>O<sub>2</sub> + Aq. (Carnot, C. R. 104. 1850.)

**Barium metavanadate**, Ba(VO<sub>3</sub>)<sub>2</sub> + H<sub>2</sub>O.

Somewhat sol. in H<sub>2</sub>O before ignition  
Sol. in conc. H<sub>2</sub>SO<sub>4</sub>. (Berzelius.)

**Barium pyrovanadate**, Ba<sub>2</sub>V<sub>2</sub>O<sub>7</sub>.

Somewhat sol. in H<sub>2</sub>O. (Roscoe.)

**Barium vanadate**, Ba<sub>2</sub>V<sub>2</sub>O<sub>17</sub> + 14H<sub>2</sub>O.

(Ditte, C. R. 104. 1705.)

Ba<sub>2</sub>V<sub>10</sub>O<sub>38</sub> + 19H<sub>2</sub>O. 1 pt. is sol. in 5200 pts. H<sub>2</sub>O at 20-25°. Much more sol. in hot, but decomp. by boiling H<sub>2</sub>O. (v. Hauer, W. A. B. 21. 344.)

Sol. in about 5000 pts. H<sub>2</sub>O. (Manasse, C. C. 1886. 773.)

Ba<sub>2</sub>V<sub>10</sub>O<sub>38</sub> + 2H<sub>2</sub>O. (Norblad.)

**Bismuth vanadate**, Bi<sub>2</sub>(VO<sub>4</sub>)<sub>3</sub>.

Min. *Pucherite*. Sol. in HCl + Aq with evolution of Cl.

**Cadmium vanadate**, Cd(VO<sub>3</sub>)<sub>2</sub>.

(Ditte, C. R. 102. 918.)

CdV<sub>2</sub>O<sub>16</sub> + 24H<sub>2</sub>O. Sl. sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1705.)

**Cadmium potassium vanadate**, CdK<sub>2</sub>V<sub>2</sub>O<sub>17</sub> + 9H<sub>2</sub>O.

(Radau, A. 251. 148.)

Cd<sub>2</sub>V<sub>10</sub>O<sub>38</sub>, K<sub>2</sub>V<sub>10</sub>O<sub>38</sub> + 27H<sub>2</sub>O. 1000 pts. H<sub>2</sub>O dissolve 5.4 pts. at 18°. (Radau.)

**Cadmium vanadate bromide**, 3Cd<sub>2</sub>(VO<sub>4</sub>)<sub>3</sub>, CdBr<sub>2</sub>.

Very sol. in dil. acids. (de Schulten, Bull. Soc. 1900, (3) 23. 160.)

**Cadmium vanadate chloride**, 3Cd<sub>2</sub>(VO<sub>4</sub>)<sub>3</sub>, CdCl<sub>2</sub>.

Very sol. in dil. acids. (de Schulten, Bull. Soc. 1900, (3) 23. 159.)

**Cæsium metavanadate**, CsVO<sub>3</sub>.

(Chabré, A. ch. 1902, (7) 26. 228.)

**Calcium metavanadate,  $\text{Ca}(\text{VO}_3)_2 + 4\text{H}_2\text{O}$ .**

Much more sol. than  $\text{Sr}(\text{VO}_3)_2$ , and solution is not precipitated by alcohol. (Berzelius.)

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ ; insol. in alcohol. (Scheuer, Z. anorg. 1898, 16. 304.)

**Calcium pyrovanadate,  $\text{Ca}_2\text{V}_2\text{O}_7 + 5\text{H}_2\text{O}$ .**

Precipitate.

+  $2\text{H}_2\text{O}$ . Very sol. in dil. acids. (Ditte C. R. 104. 1705.)

+  $2\frac{1}{2}\text{H}_2\text{O}$ . (Roscoe.)

**Calcium divanadate,  $\text{CaV}_2\text{O}_{11} + 9\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

When fused is nearly insol. in  $\text{H}_2\text{O}$ . (v. Hauer.)

+  $6\text{H}_2\text{O}$ . (Manasse, A. 240. 23.)

**Calcium trivanadate,  $\text{CaV}_3\text{O}_{17} + 12\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Calcium vanadate,  $\text{Ca}_3\text{V}_3\text{O}_{21} + 15\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Manasse, A. 204. 23.)

$\text{Ca}_2\text{V}_4\text{O}_{28} + 7\text{H}_2\text{O}$  (?). Sl. sol. in  $\text{H}_2\text{O}$ . Probably a mixture. (Manasse, A. 240. 23.)

$\text{Ca}_2\text{V}_5\text{O}_{33} + 26\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Manasse, A. 240. 23.)

**Calcium copper vanadate,  $(\text{Ca}, \text{Cu})_4\text{V}_2\text{O}_8 + \text{H}_2\text{O}$ .**

Min. *Volborthite*. Sol. in  $\text{HNO}_3 + \text{Aq}$ .

**Calcium potassium vanadate,  $\text{CaK}_3\text{V}_3\text{O}_{21} + 22\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Manasse, A. 240. 23.)

**Calcium vanadate chloride,  $\text{Ca}_3(\text{VO}_4)_2, \text{CaCl}_2$ .**  
(Hautefeuille, C. R. 77. 896.)**Chromium vanadate,  $\text{CrVO}_4$ .**

Absolutely insol. in  $\text{H}_2\text{O}$  containing  $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$  and  $\text{HC}_2\text{H}_3\text{O}_2$ . (Carnot, C. R. 104. 1850.)

**Cobaltous metavanadate,  $\text{Co}(\text{VO}_3)_2 + 3\text{H}_2\text{O}$ .**

Easily sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

**Cobaltous potassium vanadate,  $\text{CoKV}_2\text{O}_{14} + 8\text{H}_2\text{O}$ .**

1000 pts.  $\text{H}_2\text{O}$  dissolve 4.8 pts. of this salt. (Radau, A. 251. 140.)

$\text{Co}_2\text{K}_2\text{V}_4\text{O}_{28} + 21\text{H}_2\text{O}$ . (Radau.)

**Cupric metavanadate.**

Sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Cupric pyrovanadate,  $\text{Cu}_2\text{V}_2\text{O}_7 + 3\text{H}_2\text{O}$ .**

Sol. in hot  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)

Could not be obtained. (Radau, A. 251.

150.)

**Cupric lead vanadate,  $5(\text{Cu}, \text{Pb})\text{O}, \text{V}_2\text{O}_5 + 2\text{H}_2\text{O}$ .**

Min. *Moltramite*.

$3\text{CuO}, \text{V}_2\text{O}_5, 3(3\text{PbO}, \text{V}_2\text{O}_5), 6\text{CuO}_2\text{H}_2 + 12\text{H}_2\text{O}$ . Min. *Psillacinnite*.

**Cupric potassium vanadate,  $\text{CuKV}_2\text{O}_{14} + 17\text{H}_2\text{O}$ .**

Moderately sol. in warm  $\text{H}_2\text{O}$ . 100 pts.  $\text{H}_2\text{O}$  dissolve 11.1 pts. at  $18^\circ$ . (Radau, A. 251. 151.)

**Didymium vanadate,  $\text{Di}_2(\text{VO}_4)_3$ .**

Precipitate. (Cleve.)

$\text{Di}_2\text{V}_{10}\text{O}_{30} + 28\text{H}_2\text{O}$ . Precipitate. (Cleve, Bull. Soc. (2) 43. 365.)

**Glucinum metavanadate (?).**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Glucinum divanadate (?).**

Difficultly sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Indium metavanadate,  $\text{In}(\text{VO}_3)_2 + 2\text{H}_2\text{O}$ .**

Ppt. (Renz, Dissert. 1902.)

**Iron (ferrous) metavanadate.**

Ppt. Sol. in  $\text{HCl} + \text{Aq}$ . (Berzelius.)

**Iron (ferric) metavanadate.**

Somewhat sol. in  $\text{H}_2\text{O}$ . (Berzelius.)

**Lead metavanadate,  $\text{Pb}(\text{VO}_3)_2$ .**

Sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . Not completely decomp. by  $\text{H}_2\text{SO}_4$  or by boiling with  $\text{K}_2\text{CO}_3 + \text{Aq}$ . (Berzelius.)

Min. *Dechenite*. Easily sol. in dil.  $\text{HNO}_3 + \text{Aq}$ , and decomp. by  $\text{HCl} + \text{Aq}$ .

**Lead pyrovanadate, basic,  $2\text{Pb}_2\text{V}_2\text{O}_7, \text{PbO}$ .**

Insol. in boiling  $\text{H}_2\text{O}$  or  $\text{HC}_2\text{H}_3\text{O}_2$ . De-comp. by  $\text{HNO}_3 + \text{Aq}$  with separation of  $\text{V}_2\text{O}_5$ , which dissolves on warming. (Roscoe.)

**Lead pyrovanadate,  $\text{Pb}_2\text{V}_2\text{O}_7$ .**

Sol. in warm dil.  $\text{HNO}_3 + \text{Aq}$ . (Ditte, C. R. 104. 1705.)

Min. *Desclouzeite*. Sol. in cold dil.  $\text{HNO}_3 + \text{Aq}$ .

**Lead divanadate,  $\text{PbV}_2\text{O}_{11}$ .**

(Ditte, C. R. 104. 1705.)

**Lead orthovanadate,  $\text{Pb}_2(\text{VO}_4)_3$ .**

Insol. in  $\text{H}_2\text{O}$ . (Roscoe, A. suppl. 8. 109.)

**Lead zinc orthovanadate,  $4\text{Pb}_2(\text{VO}_4)_3$ ,**

$3\text{Zn}_2(\text{VO}_4)_3$ .

Min. *Eusynchite*. Easily sol. in  $\text{HNO}_3 + \text{Aq}$ .



**Lead zinc vanadate, (Pb, Zn)<sub>2</sub>V<sub>2</sub>O<sub>7</sub> + H<sub>2</sub>O.**

Min. *Descloizite*. Sol. in excess of HNO<sub>3</sub> + Aq.

**Lead vanadate chloride, 3Pb<sub>2</sub>(VO<sub>3</sub>)<sub>2</sub>, PbCl<sub>2</sub>.**

Min. *Vanadinite*. Easily sol. in HNO<sub>3</sub> + Aq.

**Lithium vanadate, basic, Li<sub>2</sub>V<sub>2</sub>O<sub>7</sub> + 6H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1168.)  
Li<sub>2</sub>V<sub>2</sub>O<sub>7</sub> + H<sub>2</sub>O, and 14H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Ditte.)

**Lithium metavanadate, LiVO<sub>3</sub>.**

Easily sol. in H<sub>2</sub>O. (Berzelius.)  
+ 2H<sub>2</sub>O. Quite easily sol. in H<sub>2</sub>O. (Rammelsberg, B. A. B. 1883. 3.)

**Lithium divanadate, Li<sub>2</sub>V<sub>2</sub>O<sub>11</sub> + 9H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Norblad.)  
Correct formula is Li<sub>2</sub>V<sub>2</sub>O<sub>14</sub> + 12H<sub>2</sub>O. (Rammelsberg.)  
+ 8, or 12H<sub>2</sub>O. (Ditte, C. R. 104. 1168.)

**Lithium orthovanadate, Li<sub>3</sub>VO<sub>4</sub>.**

Insol. in H<sub>2</sub>O. (Rammelsberg, B. A. B. 1883. 3.)

**Lithium pyrovanadate, Li<sub>4</sub>V<sub>2</sub>O<sub>7</sub> + 4H<sub>2</sub>O.**

Very sol. in H<sub>2</sub>O. (Rammelsberg, B. 16. 1676.)  
+ 3H<sub>2</sub>O. (Ditte, C. R. 104. 1168.)

**Lithium vanadate, Li<sub>3</sub>V<sub>2</sub>O<sub>14</sub> + 7H<sub>2</sub>O.**

Difficultly sol. in H<sub>2</sub>O. (Rammelsberg.)  
+ 12H<sub>2</sub>O. Very efflorescent. Correct formula for v. Hauer's divanadate. (Rammelsberg.)

Li<sub>4</sub>V<sub>2</sub>O<sub>17</sub> + 16H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1168.)

+ 15H<sub>2</sub>O. (Rammelsberg.)

+ 11H<sub>2</sub>O. (R.)

+ 3H<sub>2</sub>O. (R.)

Li<sub>3</sub>V<sub>2</sub>O<sub>13</sub> + 15H<sub>2</sub>O. Not very easily sol. in H<sub>2</sub>O. (Rammelsberg.)

Li<sub>3</sub>V<sub>2</sub>O<sub>22</sub> + 12H<sub>2</sub>O. Moderately sol. in H<sub>2</sub>O. (Rammelsberg.)

Li<sub>10</sub>V<sub>12</sub>O<sub>33</sub> + 30H<sub>2</sub>O. Efflorescent. Very sol. in H<sub>2</sub>O. (Rammelsberg.)

**Magnesium metavanadate, Mg(VO<sub>3</sub>)<sub>2</sub>.**

Very easily sol. in H<sub>2</sub>O. (Berzelius.)  
+ 6H<sub>2</sub>O. Very sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1705.)

**Magnesium divanadate, MgV<sub>2</sub>O<sub>11</sub> + 8H<sub>2</sub>O.**

Difficultly sol. in H<sub>2</sub>O, but much more sol. than barium divanadate. (v. Hauer.)  
+ 9H<sub>2</sub>O. (Ditte, C. R. 104. 1705.)

**Magnesium trivanadate, Mg<sub>3</sub>V<sub>2</sub>O<sub>17</sub> + 4½H<sub>2</sub>O.**

Very sl. sol. in H<sub>2</sub>O. (Manasse, A. 240. 23.)

**Magnesium vanadate, Mg<sub>2</sub>V<sub>10</sub>O<sub>33</sub> + 28H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Sugira and Baker, Chem. Soc. 85. 715.)

**Manganous metavanadate, Mn(VO<sub>3</sub>)<sub>2</sub> + 4H<sub>2</sub>O.**

Very sl. sol. in cold, somewhat more sol. in hot H<sub>2</sub>O. Easily sol. in dil. acids. (Radau, A. 251. 125.)

Sl. sol. in H<sub>2</sub>O<sub>2</sub>; insol. in alcohol. (Scheuer, Z. anorg. 1898, 16. 304.)

**Manganous pyrovanadate, Mn<sub>2</sub>V<sub>2</sub>O<sub>7</sub>.**

Sl. sol. in hot dil. HNO<sub>3</sub> + Aq. (Ditte, C. R. 96. 1048.)

**Manganous potassium vanadate, MnKV<sub>2</sub>O<sub>14</sub> + 8H<sub>2</sub>O.**

100 pts. H<sub>2</sub>O dissolve 1.7 pts. salt at 18°.

Easily sol. in acids. (Radau, A. 251. 129.)

3Mn<sub>2</sub>V<sub>2</sub>O<sub>7</sub>, K<sub>4</sub>V<sub>2</sub>O<sub>11</sub> + 54H<sub>2</sub>O. (Radau.)

7Mn(VO<sub>3</sub>)<sub>2</sub>, 2KVO<sub>3</sub> + 25H<sub>2</sub>O. (Radau.)

11Mn(VO<sub>3</sub>)<sub>2</sub>, 2KVO<sub>3</sub> + 48H<sub>2</sub>O. (Radau.)

**Mercuric vanadate.**

Sl. sol. in H<sub>2</sub>O.

**Nickel vanadate, Ni(VO<sub>3</sub>)<sub>2</sub>.**

Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1705.)

**Nickel orthovanadate, Ni<sub>3</sub>(VO<sub>4</sub>)<sub>2</sub>.**

Insol. in H<sub>2</sub>O; sol. in HNO<sub>3</sub> + Aq. (Ditte, C. R. 96. 1049.)

**Nickel divanadate, NiV<sub>2</sub>O<sub>11</sub> + 3H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 1705.)

**Nickel potassium vanadate, 5Ni(VO<sub>3</sub>)<sub>2</sub>, 2KVO<sub>3</sub> + 25H<sub>2</sub>O.**

Ni<sub>2</sub>K<sub>2</sub>V<sub>10</sub>O<sub>33</sub> + 17H<sub>2</sub>O. Very sl. sol. in hot H<sub>2</sub>O.

NiKV<sub>2</sub>O<sub>14</sub> + 8H<sub>2</sub>O.

2Ni<sub>2</sub>V<sub>2</sub>O<sub>7</sub>, K<sub>4</sub>V<sub>2</sub>O<sub>11</sub> + 69H<sub>2</sub>O. 1000 pts. H<sub>2</sub>O dissolve 1.7 pts. of salt at 17.5°. (Radau, A. 251. 137.)

**Potassium vanadate, basic, K<sub>2</sub>V<sub>2</sub>O<sub>7</sub> + 20H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Ditte, C. R. 104. 902.)

**Potassium metavanadate, KVO<sub>3</sub>.**

*Anhydrous*. Slowly sol. in cold, more easily in hot H<sub>2</sub>O. Insol. in alcohol. (Berzelius.)

Completely sol. in a little cold H<sub>2</sub>O. (Norblad.)

+ H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Rammelsberg.)

+ 1½H<sub>2</sub>O. (Ditte.)

+ 1½H<sub>2</sub>O. (Ditte.)

+ 2H<sub>2</sub>O. (Ditte.)

+ 3H<sub>2</sub>O. (Ditte, C. R. 104. 902.)

+ 7H<sub>2</sub>O. (Rammelsberg.)

**Potassium divanadate,  $K_2V_2O_{11} + 4H_2O$ .**

Sol. in cold or lukewarm  $H_2O$ . Decomp. by hot  $H_2O$ . (Rammelsberg.)

- +3 $H_2O$ . (Berzelius.)
- +3½ $H_2O$ . Sol. in warm  $H_2O$ . (Norblad.)
- +8 or 10 $H_2O$ . (Ditte, C. R. 104. 902.)
- +6 $H_2O$ . (Ephraim, Z. anorg. 1903, 35. 76.)

**Potassium trivanadate,  $K_3V_3O_{15}$ .**

Anhydrous. Nearly insol. in  $H_2O$ . (Norblad.)

- +6 $H_2O$ . Insol. in cold or hot  $H_2O$ . (Norblad.)
- +1, and 5 $H_2O$ . (Ditte, C. R. 104. 902.)

**Potassium orthovanadate,  $K_3VO_4 + 4\frac{1}{2}$  or 6 $H_2O$ .**

Deliquescent. Sol. in  $H_2O$ . (Ditte, C. R. 104. 902.)

Decomp. by  $H_2O$  into  $K_4V_2O_7$  and KOH. (Rammelsberg, B. A. B. 1883. 3.)

**Potassium pyrovanadate,  $K_4V_2O_7 + 3H_2O$ .**

Deliquescent. Easily sol. in  $H_2O$ . Insol. in alcohol. (Norblad.)

- +4 $H_2O$ . (Ditte, C. R. 104. 902.)

**Potassium vanadate,  $K_3V_3O_{15} + 5H_2O$ .**

100 pts.  $H_2O$  dissolve 19.2 pts. at 17.5°. (Radau, A. 251. 120.)

- +4½ $H_2O$ . (Radau.)
- $K_4V_2O_7 + 2H_2O$ . Slowly sol. in  $H_2O$ . (Rammelsberg.)

+6 $H_2O$ . (Ditte, C. R. 104. 902.)

+7 $H_2O$ . (Friedheim, B. 23. 1526.)

$K_4V_{10}O_{27} + 12H_2O$ . Very sol. in  $H_2O$ . (Manasse, A. 240. 42.)

$K_{10}V_3O_{33} + 7H_2O$ . Sol. in  $H_2O$ . (Rammelsberg.)

$K_3V_3O_{15} + 1\frac{1}{2}H_2O$ . Very al. sol. in  $H_2O$ . (Ephraim, Z. anorg. 1903, 35. 75.)

$K_4V_{10}O_{27}$ . (Ephraim, Z. anorg. 1903, 35. 78.)

**Potassium sodium vanadate,  $2(2K_2O, 3V_2O_5), 3(2Na_2O, 3V_2O_5) + 30H_2O$ .**

(Friedheim, Z. anorg. 1894, 5. 442.)

$2K_2O, 3V_2O_5, 4(2Na_2O, 3V_2O_5) + 35H_2O$ . Efflorescent. (Friedheim, Z. anorg. 1894, 5. 441.)

**Potassium strontium vanadate,  $K_2Sr_2V_4O_{28} + 20H_2O$ .**

Sol. in  $H_2O$ . (Manasse, A. 240. 23.)

$K_4Sr_2V_4O_{28} + 30H_2O$ . As above. (Manasse.)

$K_4Sr_2V_4O_{28} + 18H_2O$ . As above. (Manasse.)

**Potassium zinc vanadate,  $KZnV_4O_{16} + 8H_2O$ .**

1000 pts.  $H_2O$  dissolve 4.1 pts. of the salt. (Radau, A. 251. 145.)

$2K_2V_{14}O_{38}, 3Zn_4V_{14}O_{38} + 90H_2O$ . (Radau.)

**Potassium vanadate cyanide,  $K_4V_2O_7, 4KCN + 14H_2O$ .**

Easily decomp.

Insol. in alcohol. (Petersen, Z. anorg. 1904, 38. 343.)

**Samarium vanadate,  $Sm_2O_3, 5V_2O_5 + 28H_2O$ .**

(Cleve.)

+24 $H_2O$ . (Cleve.)

**Samarium orthovanadate.**

Precipitate.

**Silver metavanadate,  $AgVO_3$ .**

Sol. in  $HNO_3$  or dil.  $NH_4OH + Aq$ . (Berzelius.)

Insol. in liquid  $NH_3$ . (Gore, Am. Ch. J. 1898, 20. 829.)

**Silver orthovanadate,  $Ag_3VO_4$ .**

Ppt. Easily sol. in  $HNO_3$  or  $NH_4OH + Aq$ . (Roscoe, Proc. Roy. Soc. 18. 316.)

**Silver pyrovanadate,  $Ag_3V_2O_7$ .**

Ppt. (Roscoe.)

Sol. in  $NH_4OH + Aq$ . (Ditte, C. R. 104. 1705.)

**Silver vanadate,  $Ag_3V_2O_{11}$ .**

Sol. in 21,414 pts.  $H_2O$  at 14°, and 13,617 pts. at 100°. (Carnelley, A. 166. 155.)

**Silver vanadate ammonia,  $6AgVO_3, 4NH_3 + 8H_2O$ .**

(Ditte, C. R. 104. 1705.)

**Sodium vanadate, basic,  $Na_3V_2O_7 + 26$  or  $30H_2O$ .**

Very sol. in  $H_2O$ . (Ditte.)

**Sodium metavanadate,  $NaVO_3$ .**

Anhydrous. Slowly sol. in cold, very easily in hot  $H_2O$ . (Norblad.)

100 g.  $H_2O$  dissolve at:

25° 40° 60° 75°

21.10 26.23 32.97 38.83 g.  $NaVO_3$ .

(McAdam and Pierle, J. Am. Chem. Soc. 1912, 34. 606.)

+2 $H_2O$ . Easily sol. in  $H_2O$ .

100 g.  $H_2O$  dissolve at:

25° 40° 60°

15.23 29.93 68.36 g.  $NaVO_3$ .

At 75° a value was obtained which showed that the solid phase had changed into the less sol. modification. (McAdam and Pierle, J. Am. Chem. Soc. 1912, 34. 607.)

+½ $H_2O$ . (Ditte, C. R. 104. 1061.)

+3, 4, and 5 $H_2O$ . (Ditte.)

**Sodium divanadate,  $Na_2V_2O_{11}$ .**

Anhydrous. Sl. sol. even in warm  $H_2O$ , but easily sol. on addition of acids.

+9H<sub>2</sub>O. Easily sol. in cold H<sub>2</sub>O. Insol. in alcohol. (Norblad.)  
 +5H<sub>2</sub>O. (Ditte, C. R. 104. 1061.)  
 Not obtained by Rammelsberg (B. A. B. 1833. 3.)

**Sodium trivanadate, Na<sub>3</sub>V<sub>3</sub>O<sub>11</sub>+9H<sub>2</sub>O.**

Insol. in cold or hot H<sub>2</sub>O. (Norblad.)  
 Composition is Na<sub>3</sub>V<sub>10</sub>O<sub>43</sub>+24H<sub>2</sub>O. (Rammelsberg.)  
 +3H<sub>2</sub>O. (Ditte, C. R. 104. 1061.)

**Sodium orthovanadate, Na<sub>3</sub>VO<sub>4</sub>+16H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O, but decomp. into Na<sub>3</sub>V<sub>2</sub>O<sub>7</sub> and KOH. Precipitated by an excess of alcohol. (Roscoe, A. suppl. 8. 102.)  
 +7H<sub>2</sub>O. (Hall, Chem. Soc. 51. 96.)  
 +10., and 12H<sub>2</sub>O. Less sol. in dil. NaOH +Aq than in H<sub>2</sub>O. (Baker, A. 229. 286.)

**Sodium pyrovanadate, Na<sub>4</sub>V<sub>2</sub>O<sub>7</sub>+18H<sub>2</sub>O.**

Easily sol. in H<sub>2</sub>O. Insol. in alcohol. (Norblad.)  
 Sol. in alcohol. (Ditte, C. R. 104. 1061.)  
 +8H<sub>2</sub>O. (Ditte.)

**Sodium sesquivanadate, Na<sub>4</sub>V<sub>3</sub>O<sub>17</sub>.**

Anhydrous. Insol. in H<sub>2</sub>O or NH<sub>4</sub>OH +Aq. (Rammelsberg.)  
 +10H<sub>2</sub>O. (Norblad.)  
 +16H<sub>2</sub>O. Efflorescent. (Rammelsberg.)  
 +18H<sub>2</sub>O. (Ditte.)

**Sodium pentavanadate, Na<sub>5</sub>V<sub>10</sub>O<sub>37</sub>+3½H<sub>2</sub>O.**

Scarcely sol. in H<sub>2</sub>O. (Rammelsberg.)

**Sodium vanadate, Na<sub>3</sub>V<sub>2</sub>O<sub>11</sub>+6H<sub>2</sub>O.**

Difficultly sol. in cold H<sub>2</sub>O. (Carnelley, A. 166. 155.)  
 +2H<sub>2</sub>O. (Carnelley.)  
 Na<sub>3</sub>V<sub>10</sub>O<sub>43</sub>+24H<sub>2</sub>O. Correct formula for Norblad's trivanadate. (Rammelsberg.)  
 Na<sub>3</sub>O, 4V<sub>2</sub>O<sub>5</sub>+7½H<sub>2</sub>O. (Baragiola, Dissert. 1902.)  
 +8½H<sub>2</sub>O. (Baragiola.)  
 3Na<sub>2</sub>O, 5V<sub>2</sub>O<sub>5</sub>+22H<sub>2</sub>O. (Prandtl and Lustig, Z. anorg. 1907, 53. 405.)  
 4Na<sub>2</sub>O, 7V<sub>2</sub>O<sub>5</sub>+33H<sub>2</sub>O. (Friedheim, Z. anorg. 1894, 5. 443.)  
 5Na<sub>2</sub>O, 8V<sub>2</sub>O<sub>5</sub>+39H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Friedheim, Z. anorg. 1894, 5. 441.)

**Sodium vanadate fluoride, 2Na<sub>3</sub>VO<sub>4</sub>, NaF+19H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Rammelsberg, W. Ann. 20. 928.)

**Strontium metavanadate, Sr(VO<sub>3</sub>)<sub>2</sub>+4H<sub>2</sub>O.**

Difficultly sol. in cold H<sub>2</sub>O. (Norblad.)

**Strontium divanadate, SrV<sub>2</sub>O<sub>11</sub>+9H<sub>2</sub>O.**

Sl. sol. in H<sub>2</sub>O, but much more sol. than barium divanadate. (v. Hauer.)

Sol. in H<sub>2</sub>O<sub>2</sub>+Aq free from H<sub>2</sub>SO<sub>4</sub>. Insol. in alcohol. (Scheuer, Z. anorg. 1898, 16. 303.)

**Strontium trivanadate, SrV<sub>3</sub>O<sub>14</sub>+14H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O, but decomposes slowly on boiling. Easily sol. in hot H<sub>2</sub>O acidified with HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>, and crystallizes therefrom without decomp. (v. Hauer, J. pr. 76. 156.)

**Strontium tetra vanadate, SrV<sub>4</sub>O<sub>21</sub>+11H<sub>2</sub>O.**

Sol. in hot H<sub>2</sub>O with partial decomposition. (Manasse, A. 240. 34.)

**Strontium vanadate, Sr<sub>2</sub>V<sub>2</sub>O<sub>22</sub>+14H<sub>2</sub>O.**

Sol. in H<sub>2</sub>O. (Manasse, A. 240. 23.)  
 SrV<sub>10</sub>O<sub>39</sub>+30H<sub>2</sub>O. Sol. in H<sub>2</sub>O. (Norblad.)

**Thallous metavanadate, TlVO<sub>3</sub>.**

Sol. in 11,534 pts. H<sub>2</sub>O at 11°, and 4756 pts. at 100°. (Carnelley.)

**Thallous orthovanadate, Tl<sub>2</sub>VO<sub>4</sub>.**

Sl. sol. in H<sub>2</sub>O. Sol. in 999 pts. H<sub>2</sub>O at 15°, and 574 p. s. at 100°. (Carnelley, Chem. Soc. (2) 11. 323.)

**Thallous pyrovanadate, Tl<sub>2</sub>V<sub>2</sub>O<sub>7</sub>.**

Sol. in 4996 pts. H<sub>2</sub>O at 14°, and 3840 pts. H<sub>2</sub>O at 100°. (Carnelley.)

**Thallous vanadate, Tl<sub>12</sub>V<sub>5</sub>O<sub>28</sub>.**

Sol. in 3406 pts. H<sub>2</sub>O at 14°, and 533 pts. at 100°. (Carnelley.)

Tl<sub>12</sub>V<sub>10</sub>O<sub>31</sub>. Sol. in 9372 pts. H<sub>2</sub>O at 11°, and 3366 pts. at 100°. (Carnelley.)

Tl<sub>12</sub>V<sub>10</sub>O<sub>41</sub>. Ppt. (Carnelley)

**Thorium vanadate, Th<sub>2</sub>O<sub>12</sub>(VO)<sub>4</sub>, 16V<sub>2</sub>O<sub>5</sub>+24H<sub>2</sub>O (?)**

Sol. in H<sub>2</sub>O. (Cleve.)  
 ThO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub>+6H<sub>2</sub>O. Sol. in acids. (Volck, Z. anorg. 1894 6. 167.)

**Uranyl vanadate, 2UO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub>, (UO<sub>2</sub>)<sub>2</sub>V<sub>2</sub>O<sub>7</sub>.**

Insol. in H<sub>2</sub>O. (Carnot, C. R. 104. 1850.)

**Vanadium vanadate, 2VO<sub>3</sub>, V<sub>2</sub>O<sub>5</sub>=V<sub>2</sub>O<sub>5</sub>.**

Insol. in H<sub>2</sub>O. Sol. in dil. H<sub>2</sub>SO<sub>4</sub> or HNO<sub>3</sub> +Aq. (Rammelsberg.)  
 Slowly oxidised by HNO<sub>3</sub>+Aq. Slowly sol. in NH<sub>4</sub>OH+Aq. Easily sol. in HCl+Aq (Ditte, C. R. 101. 1487.)  
 +2½H<sub>2</sub>O. (Brierley.)  
 2VO<sub>3</sub>, 2V<sub>2</sub>O<sub>5</sub>+8H<sub>2</sub>O. Insol. in H<sub>2</sub>O. (Brierley, Chem. Soc. 49. 31.)

**Ytterbium vanadate, 3Yb<sub>2</sub>O<sub>3</sub>, 5V<sub>2</sub>O<sub>5</sub>+3H<sub>2</sub>O.**

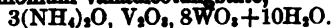
Yb<sub>2</sub>O<sub>3</sub>, 15V<sub>2</sub>O<sub>5</sub>. Ppt. (Cleve, Z. anorg. 1902, 32. 150.)

**Yttrium vanadate.**

Precipitate. (Berselius.)

**Zinc vanadate,  $\text{Zn}(\text{VO}_3)_2 \cdot 2\text{H}_2\text{O}$ .**Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 104. 1705.)**Zinc pyrovanadate,  $\text{Zn}_2\text{V}_2\text{O}_7$ .**Appreciably sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 96. 1048.)**Pervanadic acid.**

See Pervanadic acid.

**Vanadicotungstic acid.****Ammonium vanadicotungstate,**Very sol. in  $\text{H}_2\text{O}$ .

Insol. in organic solvents. (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1227.)

**Vanadicoxovanadic acid.****Ammonium vanadicoxovanadate,  $(\text{NH}_4)_2\text{O}$ ,  $2\text{VO}_2$ ,  $4\text{V}_2\text{O}_5 + 8\text{H}_2\text{O}$ .**Sl. sol. in cold and warm  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 7. 209.) $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $2\text{V}_2\text{O}_5 + 14\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Brierley, Chem. Soc. 49. 30.) $3(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5 + 6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Brierley.)**Potassium —,  $2\text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 6\text{H}_2\text{O}$ .**Sol. in hot  $\text{H}_2\text{O}$ . (Brierley, Chem. Soc. 49. 30.) $5\text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $4\text{V}_2\text{O}_5 + \text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Brierley.) $\text{K}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $8\text{V}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ .Sol. in conc.  $\text{H}_2\text{SO}_4$ . (Prandtl, B. 1905, 38. 660.)**Sodium —,  $2\text{Na}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $\text{V}_2\text{O}_5 + 13\text{H}_2\text{O}$ .**Easily sol. in  $\text{H}_2\text{O}$ . Insol. in conc. solutions of salts, especially acetate. (Brierley, Chem. Soc. 49. 30.) $2\text{Na}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $5\text{V}_2\text{O}_5$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in conc.  $\text{H}_2\text{SO}_4$ . Not attacked by boiling with conc.  $\text{HNO}_3$ . Slowly attacked by hot dil.  $\text{NH}_4\text{OH} + \text{Aq.}$  (Prandtl, B. 1905, 38. 659.)**Vanadioarsenic acid.**

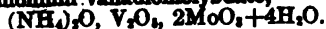
See Arseniovanadic acid.

**Vanadioliodic acid.**

See Iodovanadic acid.

**Vanadiomolybdic acid,  $8\text{MoO}_3$ ,  $\text{V}_2\text{O}_5 + 5\text{H}_2\text{O}$ .**Very sl. sol. in  $\text{H}_2\text{O}$ , and sl. sol. in boiling  $\text{HNO}_3 + \text{Aq.}$  (Ditte, C. R. 102. 757.)

Could not be obtained. (Friedheim, B. 24. 1173.)

**Ammonium vanadiomolybdate,**Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.) $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $2\text{MoO}_3 + 8\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck.) $2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $3\text{MoO}_3 + 6\text{H}_2\text{O}$ . (Euler-Chelpin, Dissert, 1895.) $(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $3\text{MoO}_3 + 17\text{H}_2\text{O}$ . (Euler-Chelpin.) $2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$  and  $+ 8\text{H}_2\text{O}$ . (Euler-Chelpin.) $3(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $4\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Milch, Dissert. Berlin, 1887.) $+ 9\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1019.) $+ 11\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Correct composition of above compounds is = $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5 + 2(\text{NH}_4)_2\text{O}$ ,  $2\text{MoO}_3 + 11\text{H}_2\text{O}$ . (Friedheim, B. 24. 1173.)Moderately sol. in  $\text{H}_2\text{O}$  and can be recryst. therefrom. (Euler-Chelpin, Dissert, 1895.) $2(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $4\text{MoO}_3 + 11\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.) $2(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3$ . Nearly insol. in cold  $\text{H}_2\text{O}$ . (Euler-Chelpin, Dissert. 1895.) $+ 8\text{H}_2\text{O}$ . Nearly insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.) $3(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 8\frac{1}{2}\text{H}_2\text{O}$ . Very easily sol. in  $\text{H}_2\text{O}$ . (Liebert, Dissert. 1891.) $4(\text{NH}_4)_2\text{O}$ ,  $12\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 24\text{H}_2\text{O}$ . Practically insol. in  $\text{H}_2\text{O}$ . (Friedheim and Castendyck, B. 1900, 33. 1615.) $2(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 5\text{H}_2\text{O}$ . Sol. in a large amount of  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 5. 361.) $+ 6\text{H}_2\text{O}$ . Rather sl. sol. in  $\text{H}_2\text{O}$ . Easily sol. in acids. (Liebert, Dissert, 1891.)

Composition is double the above formula, or—

 $4(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 12\text{H}_2\text{O}$ . Rather difficultly sol. in  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5 + 3(\text{NH}_4)_2\text{O}$ ,  $4\text{MoO}_3$ . (Friedheim.) $3(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 7\text{H}_2\text{O}$ . (Isenburg, Dissert, 1901.) $5(\text{NH}_4)_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 12\text{H}_2\text{O}$  and  $+ 14\text{H}_2\text{O}$ . (Euler-Chelpin, Dissert, 1895.) $5(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $7\text{MoO}_3 + 13\text{H}_2\text{O}$  and  $+ 16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$  and can be recryst. therefrom. (Toggenburg, Dissert, 1902.) $5(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $8\text{MoO}_3 + 14\text{H}_2\text{O}$ . (Stamm, Dissert, 1906.) $5(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 10\text{H}_2\text{O}$ . Quite easily sol. in  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{O}$ ,  $2\text{V}_2\text{O}_5 + 4[(\text{NH}_4)_2\text{O}, 3\text{MoO}_3] + 10\text{H}_2\text{O}$ . $6(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . Composition is  $(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5 + 5(\text{NH}_4)_2\text{O}$ ,  $12\text{MoO}_3$ . (F.) $8(\text{NH}_4)_2\text{O}$ ,  $4\text{V}_2\text{O}_5$ ,  $13\text{MoO}_3 + 21\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Isenburg, Dissert, 1901.) $8(\text{NH}_4)_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 15\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Gibbs.) Could not be obtained. (Friedheim.) $10(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $24\text{MoO}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Milch.) Could not be obtained. (Friedheim.)

**Ammonium barium vanadiomolybdate**,  
 $5(\text{NH}_4)_2\text{O}$ ,  $15\text{BaO}$ ,  $6\text{V}_2\text{O}_5$ ,  $36\text{MoO}_3$ .

(Milch.)

$(\text{NH}_4)_2\text{O}$ ,  $\text{BaO}$ ,  $\text{V}_2\text{O}_5$ ,  $\text{MoO}_3 + 6\text{H}_2\text{O}$ .

(Euler-Chelpin, Dissert, 1895.)

$3(\text{NH}_4)_2\text{O}$ ,  $\text{BaO}$ ,  $3\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 9\text{H}_2\text{O}$ .  
 Sl. sol. in cold and hot  $\text{H}_2\text{O}$ . (Euler-Chelpin.)

**Ammonium potassium** —,  $(\text{NH}_4)_2\text{O}$ ,  $3\text{K}_2\text{O}$ ,  
 $2\text{V}_2\text{O}_5$ ,  $4\text{MoO}_3 + 5\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Euler-Chelpin.)

$(\text{NH}_4)_2\text{O}$ ,  $3\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 9\text{H}_2\text{O}$ .  
 (Euler-Chelpin.)

$\frac{1}{2}(\text{NH}_4)_2\text{O}$ ,  $3\frac{1}{2}\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Jacoby, Dissert. 1900.)

**Ammonium sodium** —,  $(\text{NH}_4)_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  
 $2\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 12\text{H}_2\text{O}$ .

(Euler-Chelpin, Dissert, 1895.)

**Barium** —,  $\text{BaO}$ ,  $\text{V}_2\text{O}_5$ ,  $\text{MoO}_3 + 7\text{H}_2\text{O}$ .

(Euler-Chelpin.)

**Barium** —,  $3\text{BaO}$ ,  $2\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3$ .

(Milch.)

$+8\text{H}_2\text{O}$ . (Euler-Chelpin.)

$5\text{BaO}$ ,  $4\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 28\text{H}_2\text{O}$ . Sol. in  
 hot  $\text{H}_2\text{O}$ . (Euler-Chelpin.)

$3\text{BaO}$ ,  $\text{V}_2\text{O}_5$ ,  $8\text{MoO}_3 + 2\text{BaO}$ ,  $\text{H}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  
 $8\text{MoO}_3 + 28\text{H}_2\text{O}$ . Sol. in hot  $\text{H}_2\text{O}$ . (Gibbs,  
 Am. Ch. J. 5. 361.)

$7\text{BaO}$ ,  $3\text{V}_2\text{O}_5$ ,  $18\text{MoO}_3 + 16\text{H}_2\text{O} = \text{BaO}$ ,  
 $3\text{V}_2\text{O}_5 + 6(\text{BaO}$ ,  $3\text{MoO}_3) + 16\text{H}_2\text{O}$ . Sl. sol.  
 in  $\text{H}_2\text{O}$ .

$+36\text{H}_2\text{O}$  and  $+48\text{H}_2\text{O}$ . (Liebert, Dis-  
 sert. 1891.)

**Potassium** —,  $\text{K}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $3\text{MoO}_3 + 15\text{H}_2\text{O}$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . (Euler-Chelpin,  
 Dissert, 1895.)

$3\text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $4\text{MoO}_3 + 8\text{H}_2\text{O} = \text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  
 $+2(\text{K}_2\text{O}$ ,  $2\text{MoO}_3) + 8\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

$+7\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ . (Euler-  
 Chelpin.)

$+9\text{H}_2\text{O}$ . Easily sol. in cold  $\text{H}_2\text{O}$ . (Euler-  
 Chelpin.)

$2\text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $5\text{MoO}_3 + 10\text{H}_2\text{O}$ . Nearly  
 insol. in cold, very sl. sol. in hot  $\text{H}_2\text{O}$ . (Euler-  
 Chelpin.)

$3\text{K}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 5\text{H}_2\text{O}$ . (Euler-Chel-  
 pin.)

$2\text{K}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 6\text{H}_2\text{O}$ . Very sl. sol.  
 in cold, easily sol. in hot  $\text{H}_2\text{O}$ . (Liebert.)

$4\text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 12\text{H}_2\text{O} = \text{K}_2\text{O}$ ,  
 $2\text{V}_2\text{O}_5 + 3(\text{K}_2\text{O}$ ,  $4\text{MoO}_3) + 12\text{H}_2\text{O}$ . Sl. sol.  
 in  $\text{H}_2\text{O}$ . (Friedheim.)

$5\text{K}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 12\text{H}_2\text{O} = \text{K}_2\text{O}$ ,  
 $2\text{V}_2\text{O}_5 + 4(\text{K}_2\text{O}$ ,  $3\text{MoO}_3) + 12\text{H}_2\text{O}$ . Rather sl.  
 sol. in  $\text{H}_2\text{O}$ . (Friedheim.)

Sl. sol. in cold, easily sol. in hot  $\text{H}_2\text{O}$ .  
 (Liebert, Dissert, 1891.)

$3\text{K}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 15\text{H}_2\text{O}$ . (Liebert.)

**Potassium sodium vanadiomolybdate**,  $\text{K}_2\text{O}$ ,  
 $4\text{Na}_2\text{O}$ ,  $2\text{V}_2\text{O}_5$ ,  $12\text{MoO}_3 + 18\text{H}_2\text{O}$ .

(Euler-Chelpin, Dissert 1895.)

**Sodium** —,  $2\text{Na}_2\text{O}$ ,  $\text{V}_2\text{O}_5$ ,  $6\text{MoO}_3 + 16\text{H}_2\text{O}$ .

(Euler-Chelpin, Dissert, 1895.)

**Vanadiophosphoric acid**.

See Phosphovanadic acid.

**Vanadiouselenious acid**,  $3\text{V}_2\text{O}_5$ ,  $4\text{SeO}_2 + 4\text{H}_2\text{O}$ .

$+6\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . Can be  
 cryst. from  $\text{H}_2\text{O}$ .

$+10\text{H}_2\text{O}$ . Difficultly sol. in  $\text{H}_2\text{O}$ . Can be  
 cryst. from  $\text{H}_2\text{O}$ . (Prandtl, B. 1905, 38.  
 1307.)

**Ammonium vanadiouselenite**,

$4(\text{NH}_4)_2\text{O}$ ,  $6\text{V}_2\text{O}_5$ ,  $5\text{SeO}_2 + 13\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by boiling  $\text{H}_2\text{O}$ .  
 $3(\text{NH}_4)_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $6\text{SeO}_2 + 2\text{H}_2\text{O}$ . Ppt.  
 (Prandtl, B. 1905, 38. 1309.)

$(\text{NH}_4)_2\text{H}_2\text{V}_2\text{O}_{17}$ ,  $12\text{SeO}_2 + 2\text{H}_2\text{O}$ . Ppt.  
 $+4\text{H}_2\text{O}$ . Ppt. (Prandtl, Z. anorg. 1911,  
 73. 231.)

**Ammonium silver** —,  $2\frac{1}{2}(\text{NH}_4)_2\text{O}$ ,  $1\frac{1}{2}\text{Ag}_2\text{O}$ ,  
 $6\text{V}_2\text{O}_5$ ,  $5\text{SeO}_2 + 12\text{H}_2\text{O}$ ,  $+16\text{H}_2\text{O}$  and  
 $+22\text{H}_2\text{O}$ .

(Prandtl, Z. anorg. 1907, 53. 402.)

**Lithium** —,  $4\text{Li}_2\text{O}$ ,  $6\text{V}_2\text{O}_5$ ,  $5\text{SeO}_2 + 30\text{H}_2\text{O}$ .

Very sol. in  $\text{H}_2\text{O}$ . (Prandtl.)

**Potassium** —,  $4\text{K}_2\text{O}$ ,  $6\text{V}_2\text{O}_5$ ,  $5\text{SeO}_2 + 13\text{H}_2\text{O}$ .

$3\text{K}_2\text{O}$ ,  $3\text{V}_2\text{O}_5$ ,  $6\text{SeO}_2$ . (Prandtl, B. 1905.  
 38. 1309.)

**Sodium** —,  $4\text{Na}_2\text{O}$ ,  $6\text{V}_2\text{O}_5$ ,  $5\text{SeO}_2 + 20\text{H}_2\text{O}$ .

Very. sol. in  $\text{H}_2\text{O}$ . (Prandtl, Z. anorg.  
 1907, 53. 403.)

**Vanadiousulphuric acid**,  $\text{V}_2\text{O}_5$ ,  $3\text{SO}_2 + 3\text{H}_2\text{O}$ .

Deliquescent. Sol. in  $\text{H}_2\text{O}$ , but is decomp.  
 by boiling. (Ditte, C. R. 102. 757.)

See Sulphate, vanadium.

**Vanadiousulphurous acid**.

**Ammonium vanadiousulphite**,

$3(\text{V}_2\text{O}_5\text{SO}_2)$ ,  $(\text{NH}_4)_2\text{O}$ ,  $\text{SO}_2 + 4\text{H}_2\text{O}$ .

(Gain, C. R. 1907, 144. 1158.)

**Cæsium** —,  $(\text{V}_2\text{O}_5\text{SO}_2)$ ,  $3(\text{Cs}_2\text{O}\text{SO}_2) + 8\text{H}_2\text{O}$ .

(Gain.)

**Lithium** —,  $(\text{V}_2\text{O}_5\text{SO}_2)$ ,  $5(\text{Li}_2\text{O}\text{SO}_2) + 8\text{H}_2\text{O}$ .

(Gain.)

**Potassium vanadiosulphite**,  $3\text{SO}_2, (\text{V}_2\text{O}_5), \text{SO}_2, (\text{K}_2\text{O}) + 5\text{H}_2\text{O}$ .  
(Gain.)

**Rubidium** —,  $(\text{V}_2\text{O}_5, \text{SO}_2), 2(\text{Rb}_2\text{O}, \text{SO}_2) + 2\text{H}_2\text{O}$ .  
(Gain.)

**Sodium** —,  $5(\text{V}_2\text{O}_5, \text{SO}_2), (\text{Na}_2\text{O}, \text{SO}_2) + 2\text{H}_2\text{O}$ .  
(Gain.)

**Thallium** —,  $3(\text{V}_2\text{O}_5, \text{SO}_2), (\text{Tl}_2\text{O}, \text{SO}_2) + 8\text{H}_2\text{O}$ .  
(Gain.)

**Vanadiotungstic acid**,  $6\text{H}_2\text{O}, \text{V}_2\text{O}_5, 10\text{WO}_3 + 16\text{H}_2\text{O}$ .

Very sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .  
(Gibbs, Am. Ch. J. 5. 361.)

$6\text{H}_2\text{O}, \text{V}_2\text{O}_5, 16\text{WO}_3 + 30\text{H}_2\text{O}$ . Readily sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

$17\text{H}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3 + 24\text{H}_2\text{O}$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 228.)

**Aluminum sodium vanadiotungstate**,  $7\text{Al}_2\text{O}_3, 27\text{Na}_2\text{O}, 36\text{V}_2\text{O}_5, 144\text{WO}_3 + 504\text{H}_2\text{O} = 3(\text{Al}_2\text{O}_3, 9\text{Na}_2\text{O}, 48\text{WO}_3), 4(\text{Al}_2\text{O}_3, 9\text{V}_2\text{O}_5) + 504\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3055.)

**Ammonium** —,  $(\text{NH}_4)_2\text{O}, 3\text{V}_2\text{O}_5, \text{WO}_3 + 6\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rammelsberg, B. 1. 158.)  
 $2(\text{NH}_4)_2\text{O}, \text{V}_2\text{O}_5, 4\text{WO}_3 + 4\text{H}_2\text{O}$ . (Friedheim and Löwy, Z. anorg. 1894. 6. 24.)

$4(\text{NH}_4)_2\text{O}, 2\text{H}_2\text{O}, \text{V}_2\text{O}_5, 5\text{WO}_3 + 11\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Gibbs, Am. Ch. J. 5. 361.)

$2(\text{NH}_4)_2\text{O}, \text{V}_2\text{O}_5, 5\text{WO}_3 + 10\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1019.)

$31(\text{NH}_4)_2\text{O}, 14\text{V}_2\text{O}_5, 60\text{WO}_3 + 58\text{H}_2\text{O} = 5[5(\text{NH}_4)_2\text{O}, 12\text{WO}_3], 2[3(\text{NH}_4)_2\text{O}, 7\text{V}_2\text{O}_5]$ . Sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3051.)

$7(\text{NH}_4)_2\text{O}, 4\text{V}_2\text{O}_5, 14\text{WO}_3 + 16\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 197.)

$8(\text{NH}_4)_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 4\text{H}_2\text{O}$ . Efflorescent. Very sol. in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 216.)

**Barium** —,  $19\text{BaO}, 10\text{V}_2\text{O}_5, 36\text{WO}_3 + 94\text{H}_2\text{O} = 3(5\text{BaO}, 12\text{WO}_3), 2(2\text{BaO}, 5\text{V}_2\text{O}_5) + 94\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3052.)  
 $8\text{BaO}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 44\text{H}_2\text{O}$ .

Efflorescent. Not very sol. in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 218.)

Composition is  $6\text{BaO}, 12\text{WO}_3, 3\text{V}_2\text{O}_5 + 39\text{H}_2\text{O}$ . (Friedheim.)

$6\text{BaO}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 34\text{H}_2\text{O}$ . Not easily sol. in  $\text{H}_2\text{O}$ . (Friedheim and Löwy, Z. anorg. 1894. 6. 18.)

$4\text{BaO}, 4\text{V}_2\text{O}_5, 12\text{WO}_3 + 41\text{H}_2\text{O}$ . Less sol.

than preceding salt. Decomp. by boiling or by mineral acids. (Rosenheim.)

Composition is  $4\text{BaO}, 12\text{WO}_3, 3\text{V}_2\text{O}_5 + 30\text{H}_2\text{O}$ . (Friedheim.)

**Calcium vanadiotungstate**,  $2\text{CaO}, \text{V}_2\text{O}_5, 2\text{WO}_3 + 12\text{H}_2\text{O}$ .

(Friedheim and Löwy, Z. anorg. 1894. 6. 20.)

**Magnesium sodium** —,  $\text{MgO}, 6\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 42\text{H}_2\text{O} = 5\text{Na}_2\text{O}, 12\text{WO}_3 + \text{MgO}, \text{Na}_2\text{O}, 3\text{V}_2\text{O}_5 + 42\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3054.)

**Potassium** —,  $4\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 30\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ .

Composition is potassium *metatungstate* vanadate,  $3(\text{K}_2\text{O}, 4\text{WO}_3) + \text{K}_2\text{O}, 3\text{V}_2\text{O}_5 + 30\text{H}_2\text{O}$ . (Friedheim, B. 23. 1515.)

$8\text{K}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 24\text{H}_2\text{O}$ . Very efflorescent. Easily sol. in  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 214.)

Formula is  $6\text{K}_2\text{O}, 12\text{WO}_3, 3\text{V}_2\text{O}_5 + 24\text{H}_2\text{O}$ , which is a double salt,  $5\text{K}_2\text{O}, 12\text{WO}_3 + \text{K}_2\text{O}, 3\text{V}_2\text{O}_5$ . (Friedheim, B. 23. 1505.)

**Potassium sodium** —,  $(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 22\text{H}_2\text{O}), 4(5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 22\text{H}_2\text{O})$  or  $\text{Na}_2\text{O}, 4\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 22\text{H}_2\text{O}$ .

(Friedheim and Löwy, Z. anorg. 1894. 6. 22.)

$4(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O}), 3(5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O})$ . (Friedheim and Löwy.)

$5(5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O}), 5\text{K}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 24\text{H}_2\text{O}$ . (Friedheim and Löwy.)

**Silver** —,  $8\text{Ag}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O}$ .

Somewhat sol. in cold  $\text{H}_2\text{O}$ , more easily upon addition of little  $\text{HNO}_3$ . Decomp. by warm  $\text{H}_2\text{O}$ . (Rosenheim, A. 251. 224.)

$3\text{Ag}_2\text{O}, 2\text{V}_2\text{O}_5, 6\text{WO}_3 + 3\text{H}_2\text{O}$ . Nearly insol. in cold  $\text{H}_2\text{O}$ . Decomp. by addition of  $\text{HNO}_3$  or upon warming. (Rosenheim.)

**Sodium** —,  $5\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 6\text{WO}_3 + 36\text{H}_2\text{O}$ .  
Sol. in  $\text{H}_2\text{O}$ .

Composition is  $3(\text{Na}_2\text{O}, 2\text{WO}_3) + 2(\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5) + 36\text{H}_2\text{O}$ . (Friedheim, B. 23. 1527.)  
 $+ 38\text{H}_2\text{O}$ . Sol. in 1.25 pts.  $\text{H}_2\text{O}$  at  $13.8^\circ$ . (Friedheim and Löwy.)

$2\text{Na}_2\text{O}, 2\text{V}_2\text{O}_5, 3\text{WO}_3 + 20\text{H}_2\text{O}$ . Very sol. in  $\text{H}_2\text{O}$ .

Composition is  $\text{Na}_2\text{O}, 3\text{WO}_3 + \text{Na}_2\text{O}, 2\text{V}_2\text{O}_5 + 20\text{H}_2\text{O}$ , double salt of sodium *tritungstate* and *divanadate*. (Friedheim, B. 23. 1523.)

$4\text{Na}_2\text{O}, 3\text{V}_2\text{O}_5, 12\text{WO}_3 + 38\text{H}_2\text{O} = 3(\text{Na}_2\text{O}, 4\text{WO}_3) + \text{Na}_2\text{O}, 3\text{V}_2\text{O}_5 + 38\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . (Rothenbach, B. 23. 3050.)

$8\text{Na}_2\text{O}, 4\text{V}_2\text{O}_5, 16\text{WO}_3, 9\text{H}_2\text{O} + 48\text{H}_2\text{O}$ .

**Efflorescent.** Easily sol. in  $H_2O$ . (Rosenheim, A. 261. 210.)

Formula is  $6Na_2O, 12WO_3, 3V_2O_5 + 42H_2O$ , and is a double salt of sodium *paratungstate*,  $5Na_2O, 12WO_3$ , and sodium *trivanadate*,  $Na_2O, 3V_2O_5$ . (Friedheim, B. 23. 1505.)

$7Na_2O, V_2O_5, 12WO_3 + 29H_2O$ . Easily sol. in  $H_2O$ . (Friedheim and Löwy, Z. anorg. 1894, 6. 15.)

$8Na_2O, V_2O_5, 14WO_3 + 60H_2O$  and  $+66H_2O$  (Friedheim and Löwy.)

**Strontium vanadotungstate**,  $19SrO, 36WO_3, 10V_2O_5 + 122H_2O = 3(5SrO, 12WO_3, 2(2SrO, 5V_2O_5) + 122H_2O$ .

Sol. in  $H_2O$ . (Rothenbach, B. 23. 3053.)

### Vanadious acid.

See Hypovanadic acid.

### Vanadovanadicomolybdic acid.

**Ammonium vanadovanadicomolybdate**,  $11(NH_4)_2O, 4V_2O_5, VO_3, 28MoO_3 + 48H_2O$ .

Sl. sol. in cold, sol. in hot  $H_2O$  without decomp. (Gibbs, Am. Ch. J. 5. 391.)

**Barium —**,  $14BaO, 2V_2O_5, 3VO_3, 30MoO_3 + 48H_2O$ .

Precipitate. Very sl. sol. in cold, decomp. by hot  $H_2O$ . (Gibbs.)

### Vanadovanadicotungstic acid.

**Ammonium vanadovanadicotungstate**,  $6(NH_4)_2O, 2V_2O_5, 3VO_3, 12WO_3 + 12H_2O$ .

Sol. in  $H_2O$ . (Gibbs, Am. Ch. J. 5. 391.)

**Silver —**,  $6Ag_2O, 2V_2O_5, 3VO_3, 12WO_3 + 8H_2O$ .

Precipitate. Very sl. sol. in cold, sol. in much warm  $H_2O$ . (Gibbs.)

**Sodium —**,  $6Na_2O, 2V_2O_5, 3VO_3, 12WO_3$ . Very sol. in  $H_2O$ . (Gibbs.)

### Vanadium, V.

Insol. in  $H_2O$ ,  $HCl$ , dil.  $H_2SO_4$  + Aq. and cold conc.  $H_2SO_4$ . Sol. in hot conc.  $H_2SO_4$ . Slowly sol. in  $HF$  + Aq. Easily sol. in dil. or conc.  $HNO_3$  + Aq. Not attacked by hot or cold  $NaOH$  or  $KOH$  + Aq. (Roscoe, A. suppl. 7. 85.)

Does not alter in the air; not acted upon by  $HCl$  and very slowly by  $H_2SO_4$ . (Moissan, C. R. 1896, 122. 1299.)

### Vanadium boride, VB.

Sol. in  $HF$  and  $HNO_3$ . Decomp. by fused alkalis. (Wedekind, B. 1913, 46. 1203.)

### Vanadium tribromide, $VBBr_3$ .

Very deliquescent; quickly decomposes. (Roscoe, A. suppl. 8. 99.)

+  $6H_2O$ . Sol. in  $H_2O$  with decomp. (Locke and Edwards, Am. Ch. J. 1898, 20. 600.)

Sol. in  $H_2O$ , alcohol and ether. Insol. in  $HBr$ . (Piccini, Z. anorg. 1899, 19. 398.)

### Vanadium carbide, VC.

Insol. in  $HCl$  and  $H_2SO_4$ .

Sol. in  $HNO_3$  in the cold, and in fused  $KNO_3$  and  $KClO_3$ . (Moissan, C. R. 1896, 122. 1300.)

### Vanadium dichloride, $VCl_2$ .

Very deliquescent. Sol. in  $H_2O$ , alcohol, and ether. (Roscoe, A. suppl. 7. 79.)

### Vanadium trichloride, $VCl_3$ .

Deliquescent. Sol. in  $H_2O$ , absolute alcohol, and ether.

+  $6H_2O$ . Sol. in  $H_2O$ ; sl. sol. in conc.  $HCl$  + Aq.

Sol. in alcohol and ether. (Piccini, Z. anorg. 1899, 19. 395.)

### Vanadium tetrachloride, $VCl_4$ .

Sol. with decomp. in  $H_2O$ , alcohol, and ether. (Roscoe.)

Sol. in  $H_2O$  with decomp.

Sol. in fuming  $HCl$  with decomp.

Sol. in anhydrous  $CHCl_3$  or glacial acetic acid apparently without chemical change. (Koppel, Z. anorg. 1905, 45. 346.)

### Vanadium difluoride, $VF_2$ .

Sol. in  $HF$  with evolution of  $H_2$  and formation of  $VF_3$ . (Manchot, A. 1907, 357. 135.)

### Vanadium trifluoride, $VF_3$ .

Nearly insol. in  $H_2O$  and organic solvents. (Ruff, B. 1911, 44. 2544.)

+  $3H_2O$ . Efflorescent. Easily sol. in cold, extremely sol. in hot  $H_2O$  with decomp.

Can be recryst. from  $HF$  + Aq. Insol. in strong alcohol. (Petersen, J. pr. (2) 40. 48.)

### Vanadium tetrafluoride, $VF_4$ .

Very hygroscopic.

Easily sol. in  $H_2O$ .

Difficultly sol. in  $SO_2Cl_2$  and  $SiCl_4$ .

Sol. in  $POCl_3$  with evolution of gas.

Sol. in acetone and acetic acid.

Difficultly sol. in alcohol and  $CHCl_3$ .

(Ruff, B. 1911, 44. 2545.)

### Vanadium pentafluoride, $VF_5$ .

Easily sol. in  $H_2O$ .

Easily sol. in alcohol,  $CHCl_3$ , acetone, and ligroin.

Insol. in  $CS_2$ . Decomp. toluene and ether. (Ruff, B. 1911, 44. 2549.)

### Vanadium trifluoride with $MF$ .

See Fluovanadate, M.

**Vanadium hydride,**

Stable. Does not react with boiling  $\text{H}_2\text{O}$ .  
Not attacked by boiling  $\text{HCl}$ , but oxidized by hot  $\text{H}_2\text{SO}_4$ .

Sol. in boiling  $\text{HNO}_3$ . (Muthmann, A. 1907, 355. 86.)

**Vanadium dihydroxide,  $\text{VO}$ ,  $\text{zH}_2\text{O}$ .**

Insol. in  $\text{KOH}$  or  $\text{NaOH}+\text{Aq}$ .  
 $\text{V}(\text{OH})_2$ . Sol. in  $\text{HCl}$ . (Locke and Edwards, Am. Ch. J. 1898, 20. 598.)

**Vanadium trihydroxide,  $\text{V}_2\text{O}_3$ ,  $\text{zH}_2\text{O}$ .**

Easily sol. in all acids. (Petersen, J. pr. (2) 40. 49.)

**Vanadium tetrahydroxide (Hypovanadic hydroxide),  $\text{V}_2\text{O}_5(\text{OH})_4+5\text{H}_2\text{O}$ .**

Easily sol. in acids or alkalis. (Crow, Chem. Soc. 30. 453.)

**Vanadium triiodide,  $\text{VI}_3+6\text{H}_2\text{O}$ .**

Very hygroscopic; sol. in  $\text{H}_2\text{O}$ . Only sl. sol. in cold conc.  $\text{HI}+\text{Aq}$ .

Sol. in alcohol. (Piccini, Z. anorg. 1899, 19. 399.)

**Vanadium nitride,  $\text{V}_2\text{N}$ .**

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HCl}$ , and  $\text{KOH}+\text{Aq}$ . Sol. in  $\text{HNO}_3+\text{H}_2\text{SO}_4$ .

Decomp. by fusing with  $\text{KOH}$ . (Muthmann, A. 1907, 355. 93.)

Insol. in liquid  $\text{NH}_3$ . (Gore, Am. Ch. J. 1898, 20. 830.)

$\text{VN}$ . (Roscoe, A. suppl. 6. 114.)

$\text{VN}_2$ . Not attacked by cold  $\text{HNO}_3+\text{Aq}$ . (Uhrlaub, Pogg. 103. 134.)

**Vanadium dioxide,  $\text{VO}$ .**

Insol. in  $\text{H}_2\text{O}$ ; easily sol. in dil. acids. (Roscoe, A. suppl. 6. 95.)

**Vanadium trioxide,  $\text{V}_2\text{O}_3$ .**

Oxidised in  $\text{H}_2\text{O}$  in contact with air and then dissolves. Insol. in acids, except  $\text{HNO}_3$ , and in alkalis  $+\text{Aq}$ . (Roscoe, A. suppl. 6. 99.)

Easily sol. in  $\text{HF}$ . (Petersen, J. pr. (2) 40. 48.)

**Vanadium tetroxide,  $\text{VO}_2$ .**

Sol. in acids and alkalis  $+\text{Aq}$ .

**Vanadium pentoxide,  $\text{V}_2\text{O}_5$ .**

Sol. in about 1000 pts.  $\text{H}_2\text{O}$ . (Berzelius.)

Sol. in acids, alkali hydrates, and carbonates  $+\text{Aq}$ . Insol. in absolute, very sl. sol. in dil. alcohol.

Insol. in glacial  $\text{HC}_2\text{H}_3\text{O}_2$ .

Sol. in conc.  $\text{KF}+\text{Aq}$ . (Ditte, C. R. 105. 1067.)

Sol. in  $\text{H}_2\text{C}_2\text{O}_4+\text{Aq}$  and alkali oxalates  $+\text{Aq}$ . (Halberstadt, Z. anal. 22. 1.)

Three modifications.—(a) Forms hydrates

with 2, and  $5\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ . 1 l. of sat. solution contains 8 g.  $\text{V}_2\text{O}_5$ .

( $\beta$ )  $\text{V}_2\text{O}_5, 2\text{H}_2\text{O}$ . Very sl. sol. in  $\text{H}_2\text{O}$ . 1 l. of sat. solution contains 0.5 g.  $\text{V}_2\text{O}_5$ .

( $\gamma$ )  $\text{V}_2\text{O}_5, 5\text{H}_2\text{O}$ . Less sol. in  $\text{H}_2\text{O}$  than  $\beta$  1 l.  $\text{H}_2\text{O}$  contains 0.05 g.  $\text{V}_2\text{O}_5$ , when saturated. (Ditte, C. R. 101. 698.)

See Vanadic acid.

**Vanadium oxide,  $\text{V}_2\text{O}_5=2\text{VO}_2, \text{V}_2\text{O}_5$ .**

See Vanadate, vanadium.

$\text{V}_2\text{O}_5, \text{V}_2\text{O}_5, +\frac{1}{2}\text{H}_2\text{O}$ . (Brierley, Chem. Soc. 49. 30.)

See also Vanadiovanadic acid.

$\text{V}_2\text{O}_5, 2\text{V}_2\text{O}_5+8\text{H}_2\text{O}$ .

See Vanadate, vanadium.

**Vanadium pentoxide with MF.**

See Fluorovanadate, M.

**Vanadium oxy compounds.**

See Vanadyl compounds.

**Vanadium silicide,  $\text{V}_2\text{Si}$ .**

Insol. in  $\text{H}_2\text{O}$ .

Not attacked by  $\text{HCl}$ ,  $\text{HNO}_3$  or  $\text{H}_2\text{SO}_4$ . Readily attacked by  $\text{HF}$ .

Not attacked by  $\text{KOH}+\text{Aq}$ ,  $\text{NaOH}+\text{Aq}$  or  $\text{NH}_4\text{OH}$ . Decomp. by fused  $\text{KOH}$ .

Insol. in alcohol, ether and benzene. (Moissan, C. R. 1902, 135. 496.)

$\text{VSi}_2$ . Sol. in  $\text{HF}$ ; insol. in acids and alkalis.

Decomp. by fused  $\text{KOH}$ . (Moissan, C. R. 1902, 135. 78.)

**Vanadium disulphide,  $\text{V}_2\text{S}_3$ .**

Insol. in boiling dil. or conc.  $\text{HCl}$ , dil.  $\text{H}_2\text{SO}_4+\text{Aq}$ , or cold conc.  $\text{H}_2\text{SO}_4$ . Easily sol. in hot dil. or conc.  $\text{HNO}_3+\text{Aq}$ , or in boiling conc.  $\text{H}_2\text{SO}_4$ . Insol. in alkalis  $+\text{Aq}$ . Sl. sol. in  $\text{KSH}+\text{Aq}$ ; sol. in  $\text{NH}_4\text{SH}+\text{Aq}$ . (Kay, Chem. Soc. 37. 728.)

**Vanadium trisulphide,  $\text{V}_2\text{S}_5$ .**

Insol. in cold  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4+\text{Aq}$ . Very sl. sol. in hot  $\text{HCl}$  or dil.  $\text{H}_2\text{SO}_4+\text{Aq}$ . More sol. in  $\text{HNO}_3+\text{Aq}$  or conc.  $\text{H}_2\text{SO}_4$ . Sl. sol. in  $\text{NaOH}$  or  $\text{NH}_4\text{OH}+\text{Aq}$ . Easily sol. in  $(\text{NH}_4)_2\text{S}$  or  $\text{NH}_4\text{SH}+\text{Aq}$ , also in  $\text{K}_2\text{S}+\text{Aq}$ . (Kay, Chem. Soc. 37. 728.)

**Vanadium pentasulphide,  $\text{V}_2\text{S}_7$ .**

Sl. attacked by hot conc.  $\text{HCl}$  or hot dil.  $\text{H}_2\text{SO}_4+\text{Aq}$ ; sol. in hot conc.  $\text{H}_2\text{SO}_4$ . Sol. in hot dil.  $\text{HNO}_3+\text{Aq}$ . Sl. sol. in  $\text{NH}_4\text{OH}+\text{Aq}$ , but easily dissolved by  $\text{NaOH}+\text{Aq}$ . Sl. sol. in  $\text{Na}_2\text{S}+\text{Aq}$ . Sol. in  $\text{NH}_4\text{SH}+\text{Aq}$ . (Kay.)

**Vanadium sulphochloride sulphur chloride,  $4\text{VSCl}_2, \text{S}_2\text{Cl}_2$ .**

Decomp. in the air. (Koppel, Z. anorg. 1905, 45. 357.)



**Vanadous acid.****Ammonium vanadite, basic,  $2(\text{NH}_4)_2\text{O} \cdot \text{V}_2\text{O}_4$ .**

Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1310.)

**Ammonium vanadite,  $(\text{NH}_4)_2\text{V}_2\text{O}_5 + 3\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ . (Crow, Chem. Soc. 30. 460.)

+  $x\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol, ether and ammonia.

(Koppel, Z. anorg. 1903, 36. 297.)

+  $3\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Mawrow, Z. anorg. 1907, 55. 150.)

**Barium vanadite,  $\text{BaV}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

Ppt. (Koppell, Z. anorg. 1903, 36. 300.)

+  $5\text{H}_2\text{O}$ . Precipitate. Easily sol. in  $\text{HNO}_3$ , or  $\text{HCl} + \text{Aq}$ . (Crow, Chem. Soc. 30. 460.)

**Lead vanadite,  $\text{PbV}_2\text{O}_5$ .**

Ppt. (Crow.)

**Potassium vanadite,  $\text{K}_2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol, ether and ammonia.

(Koppel, Z. anorg. 1903, 36. 300.)

+  $7\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . Insol. in cold, sol. in hot  $\text{KOH} + \text{Aq}$ . Insol. in alcohol. (Crow.)

+  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1310.)

**Silver vanadite,  $\text{Ag}_2\text{V}_2\text{O}_5$ .**

Ppt. (Crow.)

**Sodium vanadite,  $\text{Na}_2\text{V}_2\text{O}_5 + 4\text{H}_2\text{O}$ .**

Sol. in  $\text{H}_2\text{O}$ .

Insol. in alcohol, ether and ammonia.

(Koppel, Z. anorg. 1903, 36. 299.)

+  $7\text{H}_2\text{O}$ . Easily sol. in  $\text{H}_2\text{O}$ . (Crow, Chem. Soc. 30. 459.)

**Vanadosotungstic acid.****Ammonium vanadosotungstate,  $5(\text{NH}_4)_2\text{O} \cdot 2\text{V}_2\text{O}_5 \cdot 14\text{WO}_3 + 13\text{H}_2\text{O}$ .**

Very sol. in  $\text{H}_2\text{O}$ . (E. F. Smith, J. Am. Chem. Soc. 1903, 25. 1228.)

**Vanadous acid.**

See Hypovanadic acid.

**Vanadovanadic acid.**

See Vanadicovanadic acid.

**Vanadyl bromide,  $\text{VOBr}_3$ .**

Very sl. sol. in  $\text{H}_2\text{O}$ , acetic anhydride, ethyl acetate, and acetone.

Insol. in alcohol, ether, acetic acid,  $\text{CHCl}_3$ , toluene and  $\text{CCl}_4$ . (Ruff, B. 1911, 44. 2537.)

**Vanadyl dibromide,  $\text{VOBr}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Roscoe.)

**Vanadyl tribromide,  $\text{VOBr}_3$ .**

Very deliquescent, and quickly decomposes in moist air. Sol. in  $\text{H}_2\text{O}$ . (Roscoe.)

**Vanadyl bromide,  $\text{V}_2\text{O}_5\text{Br}_3 \cdot 2\text{HBr} + 7\text{H}_2\text{O}$ .**

Very deliquescent. (Ditte, C. R. 102. 1310.)

**Vanadyl semichloride,  $\text{V}_2\text{O}_5\text{Cl}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Roscoe, A. suppl. 6. 114.)

**Vanadyl monochloride,  $\text{VOCl}$ .**

Insol. in  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Roscoe.)

**Vanadyl dichloride,  $\text{VOCl}_2$ .**

Deliquescent. Slowly decomp. by  $\text{H}_2\text{O}$ . Easily sol. in  $\text{HNO}_3 + \text{Aq}$ . (Roscoe.)

**Vanadyl trichloride,  $\text{VOCl}_3$ .**

Deliquescent. Sol. in  $\text{H}_2\text{O}$  and alcohol with decomp. (Bedson, A. 180. 235.)

Sol. in ether with combination.

**Divanadyl chloride,  $\text{V}_2\text{O}_5\text{Cl}_3 + 5\text{H}_2\text{O}$ .**

Deliquescent, and sol. in  $\text{H}_2\text{O}$ , fuming  $\text{HCl}$ , or alcohol. (Crow, Chem. Soc. 30. 457.)

**Vanadyl chloride,  $\text{V}_2\text{O}_5\text{Cl}_2 + 4\text{H}_2\text{O}$ .**

Very deliquescent. (Ditte, C. R. 102. 1310.)

**Vanadyl platinum chloride.**

See Chloroplatinate, vanadyl.

**Vanadyl trichloride ammonia,  $\text{VOCl}_3 \cdot x\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . (Roscoe.)

**Vanadyl difluoride,  $\text{VOF}_2$ .**

Insol. in  $\text{H}_2\text{O}$ . Insol. in alcohol, ether,  $\text{CHCl}_3$ . Sl. sol. in acetone. (Ruff, B. 1911, 44. 2546.)

**Vanadyl trifluoride,  $\text{VOF}_3$ .**

Very hygroscopic. Easily sol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{POCl}_3$  with evolution of gas. Difficultly sol. in  $\text{PCl}_5$  and  $\text{AsCl}_3$ . Sol. in hot  $\text{CHCl}_3$  and acetic anhydride. (Ruff, B. 1911, 44. 2547.)

**Vanadyl fluoride with MF.**

See Fluoxyvanadate, and Fluoxhypovanadate, M.

**Vanadyl iodide,  $\text{V}_2\text{O}_5\text{I}_3 \cdot 3\text{HI} + 10\text{H}_2\text{O}$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ . (Ditte, C. R. 102. 1310.)

$\text{V}_2\text{O}_5\text{I}_3 \cdot 2\text{HI} + 8\text{H}_2\text{O}$ . As above.

**Vanadyl sulphide,  $\text{VOS}$  (?).**

(a) Insol. in  $\text{H}_2\text{O}$ , alkalis, alkali sulphides +  $\text{Aq}$ . Sol. in acids, except nitric acid and aqua regia. (Berzelius.)

(b) Sol. in alkalis, alkali carbonates, and sulphides + Aq. Insol. in acids. (Berzelius.)

### Water, H<sub>2</sub>O.

Water is the most universal solvent. It absorbs all gases, usually with an increase of volume, seldom, as in the case of NH<sub>3</sub>, with a diminution of volume. It dissolves almost all solids in greater or less quantity, and mixes with or dissolves considerable amounts of many liquids.

Miscible with alcohol. Sol. in 36 pts. ether. Sol. in 30-33 vols. ethyl acetate. (Becker.) Sol. in 5 vols. iodhydric.

Sl. sol. in most of the fatty oils.

### Solubility in organic solvents at t°.

Solvent	t°	G. H <sub>2</sub> O in 100 g. of the solution
Benzene	+3	0.030
	23	0.060
	40	0.114
	55	0.184
	66	0.255
	77	0.337
Petroleum bpt. 190-250° at atmos. pressure	-2	0.0012
	+18	0.005
	23	0.007
	30	0.008
	36	0.012
	53	0.026
	59	0.031
	61	0.035
	66	0.043
	79	0.063
	85	0.075
	94	0.097
Paraffin oil bpt. 200-300° at 10 mm. pressur	+16	0.003
	50	0.013
	65	0.022
	73	0.030
	77	0.035
	94	0.055

(Groschuff, Z. Elektrochem, 1911, 17. 350.)

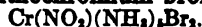
### White precipitate, fusible.

See Mercurdiammonium chloride.

### White precipitate, infusible.

See Mercuric chloramide.

### Xanthochromium bromide,



Sol. in H<sub>2</sub>O. Resembles the chloride. (Christensen, J. pr., (2) 24. 74.)

— carbonate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{CO}_3.$

Easily sol. in H<sub>2</sub>O. (Christensen.)

### Xanthochromium chloride,



More sol. in H<sub>2</sub>O than the roseo, but less than the purpleo salt.

Solution decomp. by light or boiling. Decomp. by dil. acids. Sol. in NaOH + Aq and in NH<sub>4</sub>OH + Aq (sp. gr. 0.91). Insol. in alcohol. (Christensen, J. pr. (2) 24. 74.)

— chloroplatinate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{PtCl}_6.$

Insol. in pure H<sub>2</sub>O, but sol. when warmed with H<sub>2</sub>O containing HCl, with formation of a new double salt. (Christensen.)

— mercuric chloride,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{Cl}_2, 2\text{HgCl}_2.$

Precipitate. Decomp. by long contact with H<sub>2</sub>O. (Christensen.)

— chromate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{CrO}_4.$

Difficultly sol. in H<sub>2</sub>O. (Christensen.)

— dichromate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{Cr}_2\text{O}_7.$

Difficultly sol. in H<sub>2</sub>O. (Christensen.)

— dithionate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{S}_2\text{O}_8.$

Insol. in cold H<sub>2</sub>O. (Christensen.)

— hydroxide,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2(\text{OH})_2.$

Known only in solution. (Christensen.)

— iodide,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{I}_2.$

Quite difficultly sol. in H<sub>2</sub>O. (Christensen.)

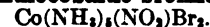
— nitrate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2(\text{NO}_3)_2.$

Sol. in about 150 pts. H<sub>2</sub>O. (Christensen.)

— sulphate,  $\text{Cr}(\text{NO}_2)(\text{NH}_4)_2\text{SO}_4 + \text{H}_2\text{O}.$

Sol. in H<sub>2</sub>O and (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> + Aq. (Christensen.)

### Xanthocobaltic bromide,



Easily sol. in cold H<sub>2</sub>O. (Werner and Miolati, Gazz. ch. it. 23, 2. 140.)

— bromonitrate,  $\text{Co}(\text{NO}_2)(\text{NH}_4)_2(\text{NO}_3)\text{Br}.$

Sl. sol. in cold, more easily in hot H<sub>2</sub>O. (Gibbs.)

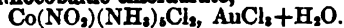
— chloride,  $\text{Co}(\text{NO}_2)(\text{NH}_4)_2\text{Cl}_2.$

Sl. sol. in cold H<sub>2</sub>O, and decomp. by boiling therewith. Insol. in HCl + Aq and alkali chlorides + Aq. Easily decomp. by boiling with acids, even dilute. (Gibbs and Genth.)

Sol. in 50 pts. cold H<sub>2</sub>O. (Jørgensen, Z. anorg. 5. 172.)

— mercuric chloride,  $\text{Co}(\text{NO}_2)(\text{NH}_4)_2\text{Cl}_2, 2\text{HgCl}_2 + \text{H}_2\text{O}.$

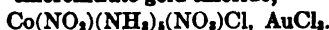
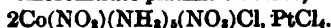
Insol. in cold, sl. sol. in hot H<sub>2</sub>O without decomp. More sol. in acidified H<sub>2</sub>O. (Gibbs and Genth.)

**Xanthocobaltic chloraurate,**

Can be easily crystallised out of hot  $\text{H}_2\text{O}$ . (Gibbs and Genth, Sill. Am. J. (2) **24**. 90.)

— **chlorenitrate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)\text{Cl}$ .

Sl. sol. in cold, more easily in hot  $\text{H}_2\text{O}$ .

— **chloronitrate gold chloride**,— **chloronitrate platinic chloride**,— **chloroplatinate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{Cl}_2$ ,  $\text{PtCl}_4 + \text{H}_2\text{O}$ .

Scarcely sol. in hot or cold  $\text{H}_2\text{O}$ . Can be recryst. from dil.  $\text{HNO}_3 + \text{Aq}$ . Sol. in hot dil.  $\text{HCl} + \text{Aq}$ . (Gibbs and Genth, Sill. Am. J. (2) **24**. 91.)

— **chromate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{CrO}_4 + \text{H}_2\text{O}$ .

Very sl. sol. in cold, and but slightly sol. in hot  $\text{H}_2\text{O}$ . (Gibbs.)

— **dichromate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{Cr}_2\text{O}_7$ .

Easily sol. in hot  $\text{H}_2\text{O}$ .

— **ferrocyanide**,  $[\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{Fe}(\text{CN})_6] + 7\text{H}_2\text{O}$ .

Nearly insol. in cold, decomp. by warm  $\text{H}_2\text{O}$ .  $+ 6\text{H}_2\text{O}$ . (Braun, A. **132**. 47.)

— **iodide**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{I}_2$ .

Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— **iodosulphate**,

Sol. in  $\text{H}_2\text{O}$ .

— **periodosulphate**,

Easily decomp. by hot  $\text{H}_2\text{O}$ .

— **nitrate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_3)_2$ .

Sl. sol. in cold, moderately sol. in hot  $\text{H}_2\text{O}$ . Decomp. by boiling. Much less sol. than  $\text{NH}_4\text{Cl}$  or  $(\text{NH}_4)_2\text{SO}_4$  in cold  $\text{H}_2\text{O}$ . Insol. in  $\text{HNO}_3$ . (Gibbs and Genth.)

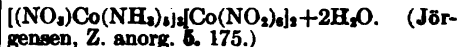
— **nitrite**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .

Sol. in  $\text{H}_2\text{O}$ . (Gibbs.)

— **cobaltic nitrite**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2(\text{NO}_2)_2 + 2\text{H}_2\text{O}$ .

Sl. sol. in  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. **11**. 8.)

Is nitratopurpureocobaltic cobaltic nitrite,



$[\text{Co}(\text{NO}_2)(\text{NH}_3)_2]_2[\text{Co}(\text{NO}_2)_2]_2$ . Not so difficultly sol. as the luteo salt. (Jørgensen.)

**Xanthocobaltic tetramine cobaltic nitrite**,

Can be recryst. from hot  $\text{H}_2\text{O}$ . (Gibbs, Proc. Am. Acad. **11**. 8.)



Xanthocobaltic diamine cobaltic nitrite. Very sl. sol. in cold  $\text{H}_2\text{O}$ . (Jørgensen, Z. anorg. **5**. 180.)

— **oxalate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{C}_2\text{O}_4$ .

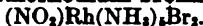
Nearly insol. in cold, sl. sol. in hot  $\text{H}_2\text{O}$ .

— **sulphate**,  $\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{SO}_4$ .

Moderately sol. in hot, much less in cold  $\text{H}_2\text{O}$ . Sol. without decomp. in  $\text{H}_2\text{SO}_4 + \text{Aq}$ . (Gibbs and Genth.)

Sol. in 25 pts. hot  $\text{H}_2\text{O}$  acidified with  $\text{HCl} + \text{H}_2\text{O}_2$ . (Jørgensen, Z. anorg. **5**. 172.)

$4\text{Co}(\text{NO}_2)(\text{NH}_3)_2\text{SO}_4, 3\text{H}_2\text{SO}_4$ . Decomp. by  $\text{H}_2\text{O}$ , not by absolute alcohol. (Jørgensen.)

**Xanthorhodium bromide**,

Moderately sol. in  $\text{H}_2\text{O}$ . (Jørgensen, J. pr. (2) **34**. 394.)

— **chloride**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{Cl}_2$ .

Much more sol. in  $\text{H}_2\text{O}$  than the nitrate.

— **chloroplatinate**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{PtCl}_4$ .

Ppt. Extremely sl. sol. in cold  $\text{H}_2\text{O}$ .

— **dithionate**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{S}_2\text{O}_6 + \text{H}_2\text{O}$ .

Nearly insol. in  $\text{H}_2\text{O}$ .

— **fluosilicate**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{SiF}_6$ .

Ppt.

— **hydroxide**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2(\text{OH})_2$ .— **nitrate**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2(\text{NO}_3)_2$ .

Moderately sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Insol. in alcohol. Less sol. in conc.  $\text{NH}_4\text{OH} + \text{Aq}$  than in  $\text{H}_2\text{O}$ .

Insol. in dil.  $\text{HNO}_3 + \text{Aq}$ ; sol. in  $\text{HNO}_3 + \text{Aq}$  of 1.4 sp. gr.

— **oxalate**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{C}_2\text{O}_4$ .

Nearly insol. in cold  $\text{H}_2\text{O}$ . Very sl. sol. in warm  $\text{H}_2\text{O}$ . Easily sol. in dil.  $\text{HCl} + \text{H}_2\text{O}_2 + \text{Aq}$ .

— **sulphate**,  $(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{SO}_4$ .

Slowly sol. in cold, quite easily in hot  $\text{H}_2\text{O}$ .  $4(\text{NO}_2)_2\text{Rh}(\text{NH}_3)_2\text{SO}_4, 3\text{H}_2\text{SO}_4$ . Sl. sol. in cold, easily in hot  $\text{H}_2\text{O}$ . Can be recrystallized from dil.  $\text{H}_2\text{SO}_4 + \text{Aq}$ .

**Xenon, Xe.**Absorption by  $H_2O$  at  $t^\circ$ .

$t^\circ$	Absorption-coefficient
0	0.2189
10	0.1500
20	0.1109
30	0.0900
40	0.0812
50	0.0878

(Antropoff, Roy. Soc. Proc. 1910, **83**, A, 480.)**Ytterbium, Yb.****Ytterbium bromide,  $YbBr_2 + 8H_2O$ .**Very sol. in  $H_2O$ . Hygroscopic. (Cleve, Z. anorg. 1902, **32**, 135.)**Ytterbium chloride,  $YbCl_3 + 6H_2O$ .**Very sol. in  $H_2O$ . (Cleve, Z. anorg. 1902, **32**, 134.)Mpt. 150-155°. Anhydrous salt is sol. in  $H_2O$  and in alcohol. (Matignon, A. ch. 1906, (8) **8**, 442.)**Ytterbium oxide,  $Yb_2O_3$ .**

Slowly attacked by cold or warm acids, but easily sol. at 100°.

**Ytterbium oxychloride,  $YbOCl$ .**Ppt. (Cleve, Z. anorg. 1902, **32**, 135.)**Yttrium, Y.**Decomposes  $H_2O$ . (Cleve, Bull. Soc. (2) **21**, 344.) Decomp.  $H_2O$  slightly at ord. temp., more rapidly by boiling. Easily sol. in dil. acids, even acetic acid. Slightly acted upon by conc.  $H_2SO_4$ . Decomposes hot  $KOH + Aq$  and cold  $NH_4Cl + Aq$ . Not attacked by  $NH_4OH + Aq$ . (Popp, A. **131**, 179.)

Popp's yttrium contained erbium.

**Yttrium bromide,  $YBr_3$ .**Sol. in  $H_2O$  with evolution of heat. (Duboin, C. R. **107**, 243.) $+9H_2O$ . Deliquescent. Easily sol. in  $H_2O$  and alcohol. Insol. in ether. (Cleve.)**Yttrium carbide,  $YC_2$ .**Decomp. by  $H_2O$  and by dil acids; very slowly attacked by conc. acids. (Moissan, C. R. 1896, **123**, 575.)Decomp. by  $H_2O$  and dil. acids. (Pettersson, B. 1895, **23**, 2421.)**Yttrium chloride,  $YCl_3$ .***Anhydrous.* Sol. in  $H_2O$  with evolution of heat. (Cleve.) $+6H_2O$ . Deliquescent. Very sol. in  $H_2O$ . Sl. sol. in alcohol. Insol. in ether. (Cleve.)

Mpt. 156-160°; sol. in alcohol.

60.1 grams anhydrous salt are sol. in 100 grams of abs. alcohol at 15°.

6.5 grams are sol. in 100 grams pyridine. (Matignon, A. ch. 1906, (8) **8**, 437.)**Yttrium fluoride,  $YF_3 + \frac{1}{2}H_2O$ .**

Nearly insol. in dil. acids. (Cleve.)

**Yttrium hydroxide,  $Y_2O_3, 6H_2O$  or  $Y_2O_3H_4 + 3H_2O$ .**Insol. in  $H_2O$ .Insol. in  $KOH$  or  $NaOH + Aq$ . Easily sol. in acids. Sol. in alkali carbonates  $+ Aq$ . When freshly pptd., easily sol. in  $NH_4Cl + Aq$ .**Yttrium iodide,  $YI_3$ .**Very deliquescent. Easily sol. in  $H_2O$  and alcohol.

Sl. sol. in ether. (Cleve.)

**Yttrium oxide,  $Y_2O_3$ .**Insol. in  $H_2O$ . Sl. sol. in cold  $HCl, HNO_3$ , or dil.  $H_2SO_4 + Aq$ , but gradually completely sol. on warming. Insol. in  $NH_4OH$  and al. sol. in  $KOH + Aq$ . Sol. in  $HC_2H_3O_2 + Aq$ . Somewhat sol. in  $K_2CO_3 + Aq$ .**Yttrium peroxide,  $Y_2O_5$ .**(Cleve, Bull. Soc. (2) **43**, 53.)**Yttrium oxychloride,  $Y_2O_3Cl_2$ .**Insol. in  $H_2O$ . (Popp.)**Yttrium sulphide,  $Y_2S_3$ .**Not prepared in pure state. Impure is insol. in  $H_2O$ , and partially decomp. thereby. Easily sol. in acids with decomp. (Popp.)**Zinc, Zn.**Not attacked by pure cold  $H_2O$ . Slowly oxidised by boiling  $H_2O$ . Pure  $H_2O$  free from  $O$  dissolved nothing from 2500 sq. mm. Zn. Presence of air containing  $CO_2$  caused a solution of 3.5 mg. Zn, which maximum was reached in 2 days. Air without  $CO_2$  also caused a slight action. (Snyders, B. **11**, 936.)100 ccm. distilled  $H_2O$  dissolved 14 mg. Zn from 11.8 sq. cm. in one week, during which air free from  $CO_2$  was passed through the liquid, and 19 mg. when air containing  $CO_2$  was used. (Wagner, Dingl. **231**, 260.)Filtered rain water was found to contain 20 mg. Zn per l. (Burg, Isis, **1873**, 119.)Very pure  $H_2O$ , when conducted through a great length of galvanized iron pipe, contained 1.7 pts. Zn to 100,000 pts.  $H_2O$ . (Davies, J. Soc. Chem. Ind. 1899, **18**, 102.)Action of  $H_2O$  on Zn in galvanized pipes is caused by electrolysis. (Smetham, C. N. 1879, **39**, 236.)All kinds of  $H_2O$  attack Zn, rain water the least.In distilled  $H_2O$  exposed to air Zn is abun-

dantly coated with  $\text{ZnCO}_3$ ,  $2\text{ZnO}+3\text{H}_2\text{O}$ . By allowing 32 g. Zn to stand in 270 cc. distilled  $\text{H}_2\text{O}$  in a flask loosely stoppered with filter paper, 1.2 pts. Zn to 100,000 pts.  $\text{H}_2\text{O}$  was found in solution in 1-2 days. (Smith, J. Soc. Chem. Ind. 1904, 23, 475.)

Sol. in all acids. Very slowly sol. in dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4+\text{Aq}$  in glass vessels if Zn is pure. According to Jacquelin, 24 hours were necessary to dissolve 6 g. pure zinc. When fused at the lowest possible temperature, it is much more slowly sol. than when heated to a red heat. In both cases it is much more rapidly dissolved if cooled quickly. (Bolley, A. 95, 294; Rammelsberg.)

Dil.  $\text{H}_2\text{SO}_4+\text{Aq}$  dissolves given % zinc in the same length of time (B=according to Bolley, R=according to Rammelsberg):

	Slowly cooled		Rapidly cooled	
	B	R	B	R
Cast at the melting point	42.5	74.1	13.0	0.9
Cast at a red heat	100.0	69.4	85.5	9.5

50 ccm.  $\text{H}_2\text{SO}_4+\text{Aq}$  dissolved in 2 hours the following amts. from 1 sq. cm. Zn at  $t^\circ$ .

$t^\circ$	Strength of acid	Grms. dissolved
20	$\text{H}_2\text{SO}_4$	0.000
130	"	0.075
150	"	0.232
20	$\text{H}_2\text{SO}_4+\text{H}_2\text{O}$	0.002
130	"	0.142
150	"	0.345
20	$\text{H}_2\text{SO}_4+2\text{H}_2\text{O}$	0.002
130	"	4.916
150	"	5.450
20	$\text{H}_2\text{SO}_4+3\text{H}_2\text{O}$	0.005
130	"	3.080
20	$\text{H}_2\text{SO}_4+4\text{H}_2\text{O}$	0.049
130	"	0.456
20	$\text{H}_2\text{SO}_4+5\text{H}_2\text{O}$	0.027
130	"	0.337
20	$\text{H}_2\text{SO}_4+6\text{H}_2\text{O}$	0.018
100	"	3.16

(Calvert and Johnson, Chem. Soc. 19, 437.)

C. P. zinc is more quickly sol. in dil. acids in vacuo than under normal pressure, the ratio being about 1:6.5. The rate of solubility increases slowly with rise of temp. from  $0^\circ$  to  $98^\circ$ , when it amounts to about 4 times that at  $0^\circ$ , but from  $98^\circ$ – $100^\circ$  the increase is thirteenfold. Thus, as an average of 6 experiments, dil.  $\text{H}_2\text{SO}_4+\text{Aq}$  (1:20) dissolves in 30 minutes 2.1 mg. Zn at  $0^\circ$ ; 4.9 mg. at  $20^\circ$ ; 7.4 mg. at  $60^\circ$ ; 9.3 mg. at  $98^\circ$ ; but 122.1 mg. at  $100^\circ$ . If, however, the acid was prevented from boiling by increasing the pressure, the sudden increase between  $98^\circ$  and  $100^\circ$  does not take place.

The rate of solubility in dil.  $\text{H}_2\text{SO}_4+\text{Aq}$  (1:20) is also increased 175 times by the addition of  $\text{CrO}_3$  and 306 times by the addition of  $\text{H}_2\text{O}_2$ . The above phenomena are explained by assuming the formation of a condensed hydrogen atmosphere around the metal, which prevents the further action of the acid. (Weeren, B. 24, 1785.)

Not attacked by  $\text{HNO}_3+\text{Aq}$  of 1.512 to 1.419 sp. gr. at a temp. of  $-18^\circ$  or less, but violently attacked if temp. is raised.  $\text{HNO}_3+\text{Aq}$  of 1.419–1.401 sp. gr. does not attack Zn at temp. of a freezing mixture, but violently at  $0^\circ$ . More dil.  $\text{HNO}_3+\text{Aq}$  attacks Zn even at  $-20^\circ$ . (Millon, A. ch. (3) 6, 99.)

Sol. in  $\text{H}_2\text{CO}_3+\text{Aq}$ . (Berzelius.)

Solubility of Zn in acids is very much affected by the presence of small quantities of various metallic salts. Small amts. of  $\text{PtCl}_4+\text{Aq}$  accelerated the action of  $\text{H}_2\text{SO}_4+\text{Aq}$  149 times, and  $\text{As}_2\text{O}_3$  123 times.  $\text{HgCl}_2$  has a strong retarding action owing to pptn. of Hg on the Zn.

The rate of solution of Zn in acids and the effect of changes in concentration and temperature and of the presence of inorganic salts and organic substances on this rate has been studied. 26 Tables are given. (Ericson-Aurén, Z. anorg. 1901, 27, 209–253.)

Speed of solution in  $\text{H}_2\text{SO}_4$  and in  $\text{HCl}$ . (Centnerszwer, Z. phys. Ch. 1914, 87, 692.)

Various saline solutions have a strong solvent power in presence of  $\text{PtCl}_4$ , i.e.  $\text{KCl}$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4+\text{Aq}$ .  $\text{PtCl}_4$  also causes Zn to decompose distilled  $\text{H}_2\text{O}$ .  $\text{CuSO}_4$  has a similar but less energetic effect.

In all the above cases the disengagement of hydrogen is slower in the dark than in the light. (Millon, C. R. 21, 37.)

According to Barreswill (C. R. 21, 292) the above reactions are all caused by galvanic action due to pptd. metal, and a piece of Pt in contact with the Zn causes the same action as the  $\text{PtCl}_4$  in solution.

Easily sol. in alkalis +  $\text{Aq}$ , even  $\text{NH}_4\text{OH}+\text{Aq}$ , especially when the Zn is in contact with Fe. Sol. in  $\text{NaCl}+\text{Aq}$  with pptn. of  $\text{ZnO}$ . (Siersch, J. B. 1867, 257.)

Sol. in sat. alkali and alkali-earth chlorides +  $\text{Aq}$ . (Post, 1872.)

Sol. in  $\text{NH}_4$  salts +  $\text{Aq}$ . (Lorin, J. B. 1865, 124.)

Sol. in sat.  $\text{Na}_2\text{SO}_4$ ,  $\text{K}_2\text{SO}_4$ ,  $\text{MgSO}_4$ ,  $\text{NaNO}_3$ ,  $\text{KNO}_3$ ,  $\text{Ba}(\text{NO}_3)_2$ ,  $\text{CaCl}_2$ ,  $\text{MgCl}_2$ , and  $\text{NH}_4\text{NO}_3+\text{Aq}$ . Chlorides and sulphates (especially  $\text{Na}_2\text{SO}_4$  and  $\text{MgCl}_2$ ) have strongest action,  $\text{MgSO}_4$  and nitrates the least. The action was greatly increased by heat. (Snyders, B. 11, 936.)

Sol. in boiling  $\text{NH}_4\text{Cl}+\text{Aq}$ . Sol. in neutral  $\text{FeCl}_3+\text{Aq}$  with pptn. of Fe, especially easily at  $100^\circ$ . (Capitaine, C. R. 9, 737.)

Sol. in  $\text{NiSO}_4+\text{Aq}$  with pptn. of  $\text{NiO}$ . (Tupputi.)

Sol. in conc. hot  $\text{ZnCl}_2+\text{Aq}$ , but Zn oxy-

chloride is pptd. on diluting. (Ordway, Am. J. Sci. (2) **23**, 222.)

Sol. in  $\text{GISO}_4 + \text{Aq}$ . (Debray.)

Solubility of Zn in dilute solutions of salts: 100 ccm. of solutions of the given salts were allowed to act one week on 11.8 sq. cm. Zn while a current of air with or without  $\text{CO}_2$  was passed through the solution.

Salt	G. salt in 100 ccm. solution	Mg. Zn dissolved without $\text{CO}_2$	Mg. Zn dissolved with $\text{CO}_2$
NaCl or KCl	0.5	7	38
$\text{NH}_4\text{Cl}$	1.0	51	36
$\text{MgCl}_2$	0.83	18	54
$\text{K}_2\text{SO}_4$	1.0	30	53
$\text{KNO}_3$	1.0	9	37
$\text{Na}_2\text{CO}_3$	1.0	13	..
NaOH	0.923	60	..
$\text{CaO}_2\text{H}_2$	Sat	3	..

(Wagner, Dingl. **221**, 260.)

Action of dil. salt solutions (1%) on Zn. The following amts. of Zn in mg. were dissolved from 2500 sq. mm. Zn in 14 days by 400 ccm. 1% solution of the given salts:

Salt	Mg. Zn	Salt	Mg. Zn
NaCl	11.2	$\text{NaNO}_3$	6
KCl	14.8	$\text{Ba(NO}_3)_2$	8
$\text{CaCl}_2$	15.2	$\text{NH}_4\text{Cl}$	24.0
$\text{MgCl}_2$	17.2	$(\text{NH}_4)_2\text{SO}_4$	31.6
$\text{BaCl}_2$	13.2	$\text{NH}_4\text{NO}_3$	26.0
$\text{K}_2\text{SO}_4$	12.0	$\text{NaHCO}_3$	0
$\text{MgSO}_4$	8.8	$\text{K}_2\text{CO}_3$	0
$\text{KNO}_3$	6.8	$\text{Na}_2\text{CO}_3$	0

Sl. attacked by  $\text{H}_2\text{O}$  at  $80^\circ$ , by hot conc.  $\text{NH}_4\text{OH}$ ; attacked by  $\text{H}_3\text{PO}_4$  or  $\text{NaCl} + \text{Aq}$ ; very sl. attacked by  $\text{NaNO}_3 + \text{Aq}$  or  $\text{KNO}_3 + \text{Aq}$  at  $100^\circ$ . (Smith, J. Soc. Chem. Ind. 1904, **23**, 476.)

$\frac{1}{2}$  ccm. oleic acid dissolves 0.0240 g. Zn in 6 days. (Gates, J. phys. Chem. 1911, **15**, 143.)

Attacked by cane sugar + Aq at  $115^\circ$ . (Klein and Berg, C. R. **102**, 1170.)

#### Zinc amide, $\text{Zn(NH}_2)_2$ .

Decomp. by  $\text{H}_2\text{O}$  and alcohol. Insol. in ether. (Frankland, Phil. Mag. (4) **15**, 149.)

#### Zinc antimonide, $\text{ZnSb}$ .

Does not decomp. boiling  $\text{H}_2\text{O}$  except slightly. Not attacked by dil. mineral acids, but decomp. by conc.  $\text{HCl}$  or  $\text{HNO}_3 + \text{Aq}$ . (Cooke, Proc. Am. Acad. **5**, 348.)

$\text{Zn}_3\text{Sb}_2$ . Decomp.  $\text{H}_2\text{O}$  rapidly at  $100^\circ$ .

Violently decomp. by dil.  $\text{HCl}$  or  $\text{H}_2\text{SO}_4 + \text{Aq}$ , also by  $\text{HNO}_3 + \text{Aq}$ . Completely sol. in  $\text{HCl} + \text{Aq}$  mixed with a little  $\text{HNO}_3$ . (Cooke.)

#### Zinc azoimide, basic, $\text{Zn(OH)N}_3$ .

Very sl. sol. in  $\text{H}_2\text{O}$ . Decomp. by hot  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1898, (2) **58**, 293.)

#### Zinc azoimide ammonia, $\text{ZnN}_3 \cdot 2\text{NH}_3$ .

Insol. in  $\text{H}_2\text{O}$ , but gradually decomp. thereby. (Dennis, J. Am. Chem. Soc. 1907 **29**, 20.)

#### Zinc bromide, $\text{ZnBr}_2$ .

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Sat.  $\text{ZnBr}_2 + \text{Aq}$  contains at:

$-20^\circ$	$+4^\circ$	$22^\circ$	$97^\circ$
66.3	68.8	77.5	83.6% $\text{ZnBr}_2$

$107^\circ$	$170^\circ$	$210^\circ$	$375^\circ$ (mpt.)
83.8	85.0	89.3	100% $\text{ZnBr}_2$

(Étard, A. ch. 1894, (7) **2**, 541.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$35^\circ$	$40^\circ$	$60^\circ$	$80^\circ$	$100^\circ$
85.45	85.53	86.08	86.57	87.05 g. $\text{ZnBr}_2$

(Diets, Z. anorg. 1899, **20**, 250.)

See also below under hydrated salts.

Sp. gr. of  $\text{ZnBr}_2 + \text{Aq}$  at  $19.5^\circ$  containing

18.3	31.7	43.2 % $\text{ZnBr}_2$
1.1849	1.3519	1.5276

52.6	59.1	68 % $\text{ZnBr}_2$
1.7082	1.8525	2.1027

(Kremers, Pogg. **108**, 117.)

Sp. gr. of  $\text{ZnBr}_2 + \text{Aq}$  at  $19.5^\circ$ .

% $\text{ZnBr}_2$	Sp. gr.	% $\text{ZnBr}_2$	Sp. gr.	% $\text{ZnBr}_2$	Sp. gr.
5	1.045	25	1.265	45	1.560
10	1.093	30	1.330	50	1.650
15	1.196	35	1.400	55	1.755
20	1.204	40	1.475	60	1.875

(Kremers, calculated by Gerlach, Z. anal. **8**, 285.)

Sol. in conc.  $\text{HCl}$  or  $\text{HC}_2\text{H}_3\text{O}_2 + \text{Aq}$ , also in  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol. in  $\text{AlBr}_3$ . (Isbekow, Z. anorg. 1913, **84**, 27.)

Very sl. sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, **20**, 830.)

Sol. in alcohol and ether. (Berthemot, J. Pharm. **14**, 610.)

Sol. in methyl acetate. (Naumann, B. 1909, **42**, 3790.)

Insol. in ethyl acetate. (Naumann, B. 1910, 43. 314.)

More sol. in anhydrous ether than in abs. alcohol. Insol. in  $\text{CS}_2$ . (Hampe, Ch. Z. 1887, 11. 846.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Mol. weight determined in pyridine. (Werner, Z. anorg. 1897, 15. 22.)

+ $\text{H}_2\text{O}$ . (Lescœur, A. ch. 1894, (7) 2. 78.) + $2\text{H}_2\text{O}$ . Very hygroscopic.

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

—8° 0° 13° 25° 30° 37° (mpt.)  
79.06 79.55 80.76 82.46 84.08 86.20 g.  $\text{ZnBr}_2$ .

(Diets, Z. anorg. 1899, 20. 250.)

+ $3\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

—15° —10° —5° (mpt.)  
77.13 78.45 80.64 g.  $\text{ZnBr}_2$ .

(Diets, Z. anorg. 1899, 20. 250.)

**Zinc bromide ammonia,  $\text{ZnBr}_2 \cdot 2\text{NH}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ . Sl. sol. in cold, more easily in warm  $\text{NH}_4\text{OH} + \text{Aq}$ . (Rammelsberg, Pogg. 55. 240.)

+ $\frac{1}{2}\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  with separation of  $\text{ZnO}$ . (André, C. R. 96. 703.)

+ $\text{H}_2\text{O}$ . Above salt of Rammelsberg's has this composition. (André.)

$3\text{ZnBr}_2 \cdot 8\text{NH}_3 + 2\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (André.)

$3\text{ZnBr}_2 \cdot 10\text{NH}_3 + \text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (André.)

$2\text{ZnBr}_2 \cdot 10\text{NH}_3$ . Efflorescent. Decomp. by  $\text{H}_2\text{O}$ . (André.)

**Zinc bromide cupric oxide,  $\text{ZnBr}_2 \cdot 3\text{CuO} + 2\text{H}_2\text{O}$ .**

+ $4\text{H}_2\text{O}$ . (Mailhe, C. R. 1901, 133. 227.)

**Zinc bromide hydrazine,  $\text{ZnBr}_2 \cdot 2\text{N}_2\text{H}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq}$ . (Fransen, Z. anorg. 1908, 60. 277.)

**Zinc chloride,  $\text{ZnCl}_2$ .**

Very deliquescent, and sol. in  $\text{H}_2\text{O}$ .

Sol. in 0.333 pt.  $\text{H}_2\text{O}$  at 18.75°. (Abl.)

$\text{ZnCl}_2 + \text{Aq}$  sat. at 12.5° contains 78.5%  $\text{ZnCl}_2$ . (Hassensfratz, A. ch. 38. 291.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

15° 20° 41° 60° 100°  
79.12 81.19 82.21 83.51 86.01 g.  $\text{ZnCl}_2$ .

(Diets, Z. anorg. 1899, 20. 245.)

$\text{ZnCl}_2 + \text{Aq}$  containing 1 pt  $\text{ZnCl}_2$  in 1.8205 pts.  $\text{H}_2\text{O}$  at 18° has sp. gr. = 1.3666. (Hitrtorf, Z. phys. Ch. 1902, 39. 628.)

Solubility in  $\text{H}_2\text{O}$  at t°.  
100 g.  $\text{H}_2\text{O}$  dissolve g.  $\text{ZnCl}_2$ .

t°	Solid phase	% $\text{ZnCl}_2$	
—5	ice	14	
—10	"	25	
—40	"	83	
—62	ice:4aq	104	cryohydrate point
—50	$\text{ZnCl}_2 + 4\frac{1}{2}\text{H}_2\text{O}$	113	
—40	"	127	
—30	4aq:3aq	160	transition point
—10	$\text{ZnCl}_2 + 3\frac{1}{2}\text{H}_2\text{O}$	189	
0	"	208	
+5	"	230	
6.5	"	252	mpt.
5	"	282	
0	3aq:1½aq	309	eutectic point
0	$\text{ZnCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$	235	
6.5	2½aq:3aq	252	transition point
10	$\text{ZnCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$	272	
12.5	"	303	mpt.
11.5	2½aq:1½aq	335	eutectic point
9	2½aq:1aq	360	eutectic point
6	$\text{ZnCl}_2 + 2\frac{1}{2}\text{H}_2\text{O}$	385	
—6	$\text{ZnCl}_2 + 1\frac{1}{2}\text{H}_2\text{O}$	298	
+10	"	330	
20	"	368	
26	1½aq:1aq	423	transition point
28.3	1½aq: $\text{ZnCl}_2$	433	transition point
0	$\text{ZnCl}_2 + \text{H}_2\text{O}$	342	
10	"	364	
20	"	396	
28	1aq: $\text{ZnCl}_2$	436	transition point
31	$\text{ZnCl}_2 + \text{H}_2\text{O}$	477	
25	$\text{ZnCl}_2$	432	
40	"	452	
60	"	488	
80	"	543	
100	"	615	
262	"	...	mpt.

(Mylius and Diets, Z. anorg. 1905, 44. 217.)

See also below under hydrated salts.

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at 19.5°.

% $\text{ZnCl}_2$	Sp. gr.	% $\text{ZnCl}_2$	Sp. gr.
13.8	1.1275	37.5	1.3859
25.8	1.2466	49.2	1.5551

(Kremers, Pogg. 106. 360.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at 19.5°.

% $\text{ZnCl}_2$	Sp. gr.	% $\text{ZnCl}_2$	Sp. gr.	% $\text{ZnCl}_2$	Sp. gr.
1	1.010	25	1.238	45	1.488
5	1.045	30	1.291	50	1.566
10	1.091	35	1.352	55	1.650
15	1.137	40	1.420	60	1.740
20	1.186	..	...	..	..

(Gerlach, Z. anal. 8. 283, calculated from Kremers.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at t°.

t°	15°	15°	15°	15°
% $\text{ZnCl}_2$	2.5	4.89	10.0	20.0
Sp. gr.	1.024	1.046	1.094	1.190
t°	15°	15°	15°	
% $\text{ZnCl}_2$	29.86	40.0	58.88	
Sp. gr.	1.297	1.423	1.728	

(Long, W. Ann. 1880, 11. 38.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at room temp. containing:

15.334	23.487	33.752% $\text{ZnCl}_2$ .
1.1459	1.2288	1.3431

(Wagner, W. Ann. 1883, 18. 267.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$  at 25°.

Concentration of $\text{ZnCl}_2 + \text{Aq}$	Sp. gr.
1—normal	1.0590
$\frac{1}{2}$ —	1.0302
$\frac{1}{4}$ —	1.0152
$\frac{1}{8}$ —	1.0077

(Wagner, Z. phys. Ch. 1890, 5. 40.)

Sp. gr. of  $\text{ZnCl}_2 + \text{Aq}$ .

$\frac{1}{2}$ $\text{ZnCl}_2$ g. in 1000 g. of solution	Sp. gr. 16°/16°
0	1.000000
0.5994	1.000560
2.3163	1.002163
5.0406	1.004708
9.8988	1.009243
19.4914	1.018228

(Dijken, Z. phys. Ch. 1897, 24. 108.)

Insol. in  $\text{SbCl}_3$ . (Klemensiewicz, C. C. 1908, II. 1850.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Easily sol. in hot absolute alcohol, and ether. Sol. in 1 pt. strong alcohol at 12.5° (Wenzel.)

Sol. in 0.35 pt. absolute alcohol. (Graham.)

Sol. in butyl (Wurtz), and hexyl (Bouis) alcohol at ord. temp., but decomp. on heating.

Very sol. in acetic ether with evolution of heat. (Cann, C. R. 102. 363.)

Easily sol. in acetone. (Krug and M'Elroy, J. Anal. Ch. 6. 184.)

1 g.  $\text{ZnCl}_2$  is sol. in 2.3 g. acetone at 18°. Sp. gr. of sat. solution 18°/4° = 1.14. (Naumann, B. 1904, 37. 4338.)

Sol. in acetone and in methylal. (Eidmann, C. C. 1899, II. 1014.)

Sol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Sol. in hot benzonitrile, also in other aromatic nitriles.

Sol. in methyl sulphide and in ethyl sulphide. Very sol. in piperidine. (Werner, Z. anorg. 1897, 15. 7.)

Sol. in benzyl alcohol, furfural, methylpropylketone, acetophenone, ethyl monoacetate, ethyl cyanacetate, ethyl acetoacetate, ethyl benzoate, ethyl oxalate, amyl nitrite, pyridine, piperidine, and quinoline.

Insol. in salicylic aldehyde, ethyl nitrate, and nitrobenzene. (Lincoln, J. phys. Chem. 1899, 3. 460.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Sol. in 2 pts. glycerine at ord. temp. (Clever, Bull. Soc. 1872, (2) 18. 372.)

100 g. glycerol dissolve 50 g.  $\text{ZnCl}_2$  at 15.5°. (Ossendowski, Pharm. J. 1907, 79. 575.)

Insol. in  $\text{CS}_2$ . (Arcetowski, Z. anorg. 1894, 6. 257.)

Sol. in urethane. (Castoro, Z. anorg. 1899, 20. 61.)

Mol. weight determined in piperidine; pyridine and methyl sulphide. (Werner, Z. anorg. 1897, 15. 18.)

+ $\text{H}_2\text{O}$ . Very deliquescent. Contains  $1\frac{1}{2}$   $\text{H}_2\text{O}$ . (Engel, C. R. 102. 1111.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	11°	27° (mpt.)
74.33	78.25	84.61 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+ $1\frac{1}{2}$   $\text{H}_2\text{O}$ .

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	10°	20°	26° (mpt.)
67.45	73.65	80.08	83.43 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+ $2\text{H}_2\text{O}$ . Sat. aq. solution contains at:

-20°	-14°	-10°	-4°	-1°
54.7	55.4	56.5	57.4	57.9% salt,

+5°	9°	15°	33°	42°
59.1	60.2	62.0	66.8	68.3% salt.

(Étard, A. ch. 1894, (7) 2. 536.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	10°	19° (mpt.)
67.56	73.70	79.07 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+ $2\frac{1}{2}$   $\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

0°	8°	13° (mpt.)
67.42	71.96	75.14 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

+ $3\text{H}_2\text{O}$ . Sol. in 12.5 pts.  $\text{H}_2\text{O}$  at 0°. (Engel.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

-5°	0°	+7° (mpt.)
64.5	67.58	71.57 g. $\text{ZnCl}_2$ .

(Dietz, Z. anorg. 1899, 20. 245.)

**Zinc hydrogen chloride,  $2\text{ZnCl}_2, \text{HCl} + 2\text{H}_2\text{O}$ .**

Deliquescent. (Engel, C. R. 102. 1068.)

$\text{ZnCl}_2, \text{HCl} + 2\text{H}_2\text{O}$ . (Engel.)

**Zinc hydrazine chloride,  $\text{ZnCl}_2, \text{N}_2\text{H}_4, \text{HCl}$ .**

Very hygroscopic.

Sol. in  $\text{H}_2\text{O}$ . (Curtius, J. pr. 1894, (2) 50. 338.)



**ZnCl<sub>2</sub>, 2(N<sub>2</sub>H<sub>4</sub>, HCl.)** Hygroscopic; very sol. in H<sub>2</sub>O.

Sol. in hot alcohol and NH<sub>4</sub>OH + Aq. (Curtius, J. pr. 1894, (2) 50. 338.)

**Zinc chloride ammonia, ZnCl<sub>2</sub>, 5NH<sub>3</sub> + H<sub>2</sub>O.**

Easily sol. in little, but decomp. by much H<sub>2</sub>O. Still more sol. in ZnCl<sub>2</sub> + Aq with decomp. (Divers, C. N. 18. 13.)

**ZnCl<sub>2</sub>, 4NH<sub>3</sub> + H<sub>2</sub>O.** (Kane.)

**ZnCl<sub>2</sub>, 2NH<sub>3</sub>.** Not completely sol. in H<sub>2</sub>O; can be recryst. from hot NH<sub>4</sub>Cl + Aq. (Ritt-hausen, J. pr. 60. 473.)

Insol. in H<sub>2</sub>O. Sol. in NH<sub>4</sub>Cl or NH<sub>4</sub>OH + Aq. (Thomas, B. 20. 743.)

$\left. \begin{array}{l} + \frac{1}{2} \text{H}_2\text{O} \\ + \frac{1}{2} \text{H}_2\text{O} \\ + \frac{1}{2} \text{H}_2\text{O} \\ + \text{H}_2\text{O} \end{array} \right\}$  Decomp. by H<sub>2</sub>O.

(André, C. R. 1882, 94. 964.)

**ZnCl<sub>2</sub>, NH<sub>3</sub>.** Decomp. by H<sub>2</sub>O. (Kane, A. ch. 72. 290.)

**Zinc chloride cupric oxide, ZnCl<sub>2</sub>, 3CuO + 4H<sub>2</sub>O.**

(Mailhe, C. R. 1901, 134. 226.)

**Zinc chloride hydrazine, ZnCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.**

Ppt. (Franzen, Z. anorg. 1908, 60. 275.)

**ZnCl<sub>2</sub>, 2N<sub>2</sub>H<sub>4</sub>.** Insol. in H<sub>2</sub>O.

Easily sol. in NH<sub>4</sub>OH + Aq. (Curtius, J. pr. 1894, (2) 50. 345.)

**Zinc chloride hydroxylamine, ZnCl<sub>2</sub>, 2NH<sub>2</sub>OH.**

Sl. sol. in cold, somewhat more in warm H<sub>2</sub>O. Very sol. in NH<sub>4</sub>OH + Aq. Very sl. sol. in alcohol and other organic solvents. (Crismer, Bull. Soc. (3) 3. 116.)

1 pt. is dissolved in 100 pts aq. solution sat. at 20°. (Antonoff, C. C. 1906, II. 810.)

**Zinc fluoride, ZnF<sub>2</sub>.**

Sl. sol. in cold, more easily in hot H<sub>2</sub>O. Insol. in 95% alcohol. Sol. in boiling HNO<sub>3</sub>, HCl, or H<sub>2</sub>SO<sub>4</sub>. (Poulenc, C. R. 116. 581.)

Contrary to older statements, ZnF<sub>2</sub> is quite sol. in H<sub>2</sub>O. (Kohlrausch, Z. phys. Ch. 1903, 44. 213.)

Insol. in liquid NH<sub>3</sub>. (Gore, Am. Ch. J. 1898, 20. 830.)

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

+4H<sub>2</sub>O. Difficultly sol. in H<sub>2</sub>O. Somewhat more sol. in H<sub>2</sub>O containing HF, HCl, or HNO<sub>3</sub>. Easily sol. in NH<sub>4</sub>OH + Aq. (Berzelius, Pogg. 1. 26.)

1 l. H<sub>2</sub>O dissolves 16 g. at 18°. (Dietz)

**Zinc hydrogen fluoride.**

Known only in solution.

**Zinc zirconium fluoride.**

See Fluozirconate, zinc.

**Zinc hydrophosphide, Zn<sub>2</sub>H<sub>2</sub>P<sub>2</sub>.**

Decomp. by cold H<sub>2</sub>O and by dil. HCl + Aq. (Drechsel and Finkelstein, B. 1871, 4. 353.)

**Zinc hydroxide, ZnO.H<sub>2</sub>.**

Insol. in H<sub>2</sub>O. Sol. in acids. Sol. in KOH, NaOH, NH<sub>4</sub>OH, or (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> + Aq.

1 l. H<sub>2</sub>O dissolve 0.01 g. ZnO.H<sub>2</sub> at 25°. (Bodländer, Z. phys. Ch. 1898, 27. 66.)

Solubility in H<sub>2</sub>O is calculated to be 2.6 × 10<sup>-4</sup> g. mols. per l. (Hertz, Z. anorg. 1900, 23. 227.)

1 l. H<sub>2</sub>O dissolves 0.0042 g. ZnO.H<sub>2</sub> at 18°. (Dupre and Bialas, Z. angew. Ch. 1903, 16. 55.)

See also Zinc oxide.

Solubility in NH<sub>4</sub>OH + Aq at 25°.

ZnO.H <sub>2</sub> used	NH <sub>3</sub> norm.	G. ZnO per l.
prepared from ZnSO <sub>4</sub>	1.287	7.28
	0.825	3.84
	0.311	0.85
prepared from Zn(NO <sub>3</sub> ) <sub>2</sub>	0.321	0.34
	0.643	0.845
	1.215	2.70
	1.928	5.07
	2.570	7.01
	3.213	10.16

(Bonsdorff, Z. anorg. 1904, 41. 189.)

Solubility of ZnO.H<sub>2</sub> in NH<sub>4</sub>OH and ammonium bases + Aq at 17°-19°.

Normality of the base	G. ZnO in 20 cc. of the solution
0.0942 NH <sub>3</sub>	0.00185
0.236 NH <sub>3</sub>	0.01795
0.707 NH <sub>3</sub>	0.0959
0.0944 NH <sub>4</sub> CH <sub>3</sub>	0.0008
0.472 NH <sub>2</sub> CH <sub>3</sub>	0.01325
0.944 NH <sub>2</sub> CH <sub>3</sub>	0.0484
0.068 NH <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	0.0005
0.51 NH <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	0.0074
0.68 NH <sub>2</sub> C <sub>2</sub> H <sub>5</sub>	0.01605
NH(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub>	insol.
NH(CH <sub>3</sub> ) <sub>2</sub>	"

(Hertz, Z. anorg. 1902, 30. 280.)

Solubility in NH<sub>4</sub>OH + Aq increases with increasing concentration of NH<sub>4</sub>OH. (Euler, B. 1903, 36. 3401.)

2 pts. ZnO.H<sub>2</sub> dissolve in 5 pts. KOH + Aq. (sp. gr. = 1.3.) (Bonnet.)

Solubility of  $\text{ZnO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq.}$ 

G. Zn in 20 ccm.	G. Zn in 20 ccm.
0.1012	0.0040
0.1978	0.0150
0.4278	0.0442
0.6670	0.1771
0.9660	0.9630
1.4951	0.2481
2.9901	0.3700

When zinc hydroxide is treated with alkali, more dissolves at first than corresponds with the true equilibrium under the prevailing conditions, for such solutions spontaneously deposit more or less zinc hydroxide according to the concentration.

(Rubenbauer, Z. anorg. 1902, 30. 333.)

Solubility of  $\text{ZnO}_2\text{H}_2$  in  $\text{NaOH} + \text{Aq}$  at  $25^\circ$ .

G. mol. per l.

Na	Zn
0.2636	0.00311
0.3871	0.0057
0.5414	0.0129
0.9280	0.0425

(Wood, Chem. Soc. 1910, 97. 884.)

Freshly pptd.  $\text{ZnO}_2\text{H}_2$  is easily sol. in  $\text{KOH} + \text{Aq.}$  but it gradually goes over into a stable form which is difficultly sol. in  $\text{KOH} + \text{Aq.}$  (Herz, Z. anorg. 1901, 28. 474.)

Freshly pptd.  $\text{ZnO}_2\text{H}_2$  is sol. in dil. salt solutions (1 %) as follows. The given amts. in mg. (calculated as Zn) were dissolved per l. at  $t^\circ$ .

Salt	Mg. Zn	$t^\circ$
$\text{NaCl}$	51	18
$\text{KCl}$	43	20
$\text{CaCl}_2$	57.5	16
$\text{MgCl}_2$	65	16
$\text{BaCl}_2$	38	18
$\text{K}_2\text{SO}_4$	37.5	20
$\text{MgSO}_4$	27	21
$\text{KNO}_3$	17.5	15
$\text{NaNO}_3$	22	15
$\text{Ba}(\text{NO}_3)_2$	25	21
$\text{K}_2\text{CO}_3$	0	15
$\text{NH}_4\text{Cl}$	95	20
$\text{NH}_4\text{NO}_3$	77	20
$(\text{NH}_4)_2\text{SO}_4$	88	20

(Snyders, B. 11. 936.)

+  $\text{H}_2\text{O}$ .

See also Zinc oxide.

Zinc hydrosulphide,  $\text{Zn}(\text{SH})_2$ .

Very unstable. Decomp. by  $\text{H}_2\text{O}$ . (Zotta, M. 10. 807.)

Sol. in  $\text{NaSH} + \text{Aq.}$  (Thomsen, B. 11. 2044.)

$\text{Zn}_2\text{H}_2\text{S}_4$ . (Zotta.)

Zinc iodide,  $\text{ZnI}_2$ .

Deliquescent. Easily sol. in  $\text{H}_2\text{O}$ .

Sat.  $\text{ZnI}_2 + \text{Aq}$  contains at:

$-18^\circ$	$-5^\circ$	$+17^\circ$	$47^\circ$	$62^\circ$	$73^\circ$
70.9	74.0	80.4	80.3	81.3	81.2% $\text{ZnI}_2$
97°	100°	107°	138°	140°	
82.1	83.0	82.6	83.8% $\text{ZnI}_2$		

(Étard, A. ch. 1894, (7) 2. 544.)

Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$0^\circ$	$18^\circ$	$40^\circ$	$60^\circ$	$80^\circ$	$100^\circ$
81.11	81.20	81.66	82.37	83.05	83.62 g. $\text{ZnI}_2$

(Dietz, Z. anorg. 1899, 20. 251.)

See also under  $+2\text{H}_2\text{O}$ .

Sp. gr. of  $\text{ZnI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

23.1	42.6	56.3	63.5	76.0% $\text{ZnI}_2$
1.2340	1.5121	1.7871	1.9746	2.3976

(Kremers, Pogg. 111. 61.)

Sp. gr. of  $\text{ZnI}_2 + \text{Aq}$  at  $19.5^\circ$  containing:

5	10	15	20	25 % $\text{ZnI}_2$
1.045	1.091	1.140	1.196	1.255
30	35	40	45	50 % $\text{ZnI}_2$
1.368	1.390	1.420	1.560	1.650

55	60	65	70	75 % $\text{ZnI}_2$
1.754	1.875	2.020	2.180	2.360

(Kremers, calculated by Gerlach, Z. anal. 8. 285.)

Sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq.}$

Moderately sol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Sol. in alcohol.

100 pts. glycerine dissolve 40 pts. at ord. temp. (Klever, Bull. Soc. 1872, (2) 18. 372.)

100 g. glycerol dissolve 40 g.  $\text{ZnI}_2$  at  $15.5^\circ$ . (Ossendowski, Pharm. J. 1907, 79. 575.)

More sol. in anhydrous ether than in abs. alcohol. Insol. in  $\text{CS}_2$ . (Hampe, Ch. Z. 1887, 11. 846.)

Sol. in methyl acetate (Naumann, B. 1909, 42. 3790); acetone. (Eidmann, C. C. 1899, II. 1014; Naumann, B. 1904, 37. 4328.)

Sol. in quinoline. (Beckmann and Gabel, Z. anorg. 1906, 51. 236.)

Mol. weight determined in methyl sulphate. (Werner, Z. anorg. 1897, 15. 25.)

+  $2\text{H}_2\text{O}$ . Solubility in  $\text{H}_2\text{O}$ .

100 g. of the sat. solution contain at:

$-10^\circ$	$-5^\circ$	$0^\circ$	$+10^\circ$	$22^\circ$	$27^\circ$ (mpt.)
80.50	80.77	81.16	82.06	83.12	89.52 g. $\text{ZnI}_2$

(Dietz, Z. anorg. 1899, 20. 251.)

+  $4\text{H}_2\text{O}$ . (Lubarski, Z. anorg. 1898, 18. 387.)

Zinc tetraiodide,  $\text{ZnI}_4$ .

Known only in aqueous solution. (Baup, Repert. 14. 412.)

Sol. in fenchone. (Rimini and Olivari, C. C. 1907, II. 241.)

**Zinc iodide ammonia,  $\text{ZnI}_2 \cdot 4\text{NH}_3$ .**

Decomp. by cold  $\text{H}_2\text{O}$ . Easily sol. in acids and  $\text{NH}_4\text{OH} + \text{Aq.}$  (Rammelsberg, Pogg. 48. 152.)

$\text{ZnI}_2 \cdot 5\text{NH}_3$ . Decomp. by cold  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Rammelsberg.)  
 $3\text{ZnI}_2 \cdot 5\text{NH}_3 + 3\text{H}_2\text{O}$ . (Tassily, C. R. 1896, 122. 324.)

**Zinc iodide hydrazine,  $\text{ZnI}_2 \cdot 2\text{N}_2\text{H}_4$ .**

Decomp. by  $\text{H}_2\text{O}$ .

Sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  (Franzen, Z. anorg. 1908, 60. 277.)

**Zinc nitride,  $\text{Zn}_3\text{N}_2$ .**

Decomp. by  $\text{H}_2\text{O}$  with the greatest violence. (Frankland, Phil. Mag. (4) 15. 149.)

Easily decomp. by  $\text{H}_2\text{O}$  when finely powdered. (Rossel, C. R. 1895, 121. 942.)

Sol. in  $\text{HCl}$ . (Fischer, B. 1910, 48. 1468.)

**Zinc oxide,  $\text{ZnO}$ .**

Insol. in  $\text{H}_2\text{O}$ . Some preparations of  $\text{ZnO}$  are sl. sol. in  $\text{H}_2\text{O}$ , never, however, in less than 1 million pts.  $\text{H}_2\text{O}$ . (Bineau, C. R. 41. 510.)

Calculated from electrical conductivity of  $\text{ZnO} + \text{Aq.}$  1 pt.  $\text{ZnO}$  is sol. in 236,000 pts.  $\text{H}_2\text{O}$  at  $18^\circ$ . (Dupre and Bialas, Zeit. angew. Ch. 1903, 16. 55.)

See also Zinc hydroxide.

Easily sol. in acids, even after ignition. Easily sol. in acids, even  $\text{H}_2\text{SO}_4$ , or  $\text{H}_2\text{CO}_3 + \text{Aq.}$

Solubility of  $\text{ZnO}$  in  $\text{CrO}_3 + \text{Aq}$  at  $25^\circ$ .

1 l. of the solution contains:

G. $\text{CrO}_3$	G. $\text{ZnO}$	G. $\text{CrO}_3$	G. $\text{ZnO}$
0.010	0.013	101	44.9
0.010	0.013	151	66.1
0.010	0.013	192	83.8
0.604	0.409	192	83.6
2.14	1.16	285	123
4.19	2.24	392	168
11.4	5.84	450	193
11.5	5.89	461	196
22.2	10.7	463	197
31.4	14.9	475	202
43.1	20.1	574	240
57.5	26.7	660	274
66.5	30.3	769	318
66.7	30.4	879	354
70.6	32.2	970	389
93.3	41.5	...	...

(Gröger, Z. anorg. 1911, 70. 136.)

When moist is easily sol. in  $\text{KOH}$ ,  $\text{NaOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$ , but only sl. sol. therein after ignition. Partially repptd. from solution in  $\text{NH}_4\text{OH} + \text{Aq.}$  by dilution with  $\text{H}_2\text{O}$ .

Anhydrous  $\text{ZnO}$  is insol. in dil., but sol. in conc. alkali hydrates +  $\text{Aq.}$ , but the hydroxide is easily sol., even in dil. alkalis +  $\text{Aq.}$  (Fremy, A. ch. (3) 23. 390.)

Very sl. sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  After igni-

tion its solubility is greatly increased by traces of  $\text{K}$  and  $\text{NH}_4$  salts. Phosphates have the strongest action, then, in the following order: arsenates, chlorides, sulphites, nitrates, acetates, carbonates, tartrates, citrates, and sulphates. Succinates and benzoates increase the solubility in  $\text{NH}_4\text{OH} + \text{Aq.}$  only when it is very dil.; borates, iodides, chlorates, arsenites, gallates, and oxalates do not increase the solubility. (Schindler.)

$\text{ZnO}$  is sol. in  $\text{NH}_4\text{OH} + \text{Aq.}$  only in presence of  $\text{NH}_4$  salts. (Brandhorst, Zeit. angew. Ch. 1904, 17. 513.)

Solubility in  $\text{KOH}$ ,  $\text{NaOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq.}$

An excess over 4 mols.  $\text{KOH}$  to 1 mol.  $\text{ZnO}$  is necessary for solution, but that excess may be neutralised after solution, until only 4 mols. are left, without pptn. of  $\text{ZnO}$ . Solution is pptd. by addition of 12 vols.  $\text{H}_2\text{O}$ .  $\text{KOH} + \text{Aq}$  containing 16.5 g.  $\text{KOH}$  to a litre  $\text{H}_2\text{O}$  is the weakest solution which will dissolve  $\text{ZnO}$ . Three times as much alkali are necessary for solution at  $50^\circ$  as at  $16-17^\circ$ . Less excess of  $\text{NaOH}$  than of  $\text{KOH}$  is necessary. 3 mols.  $\text{NH}_4\text{OH}$  will dissolve 1 mol.  $\text{ZnO}$ , and the temp. and dilution are in this case of little influence. (Prescott.)

100 cc. of 20%  $\text{NaOH} + \text{Aq}$  dissolve in many hours at most 2.97 g. ignited  $\text{ZnO}$ . Pptd.  $\text{ZnO}$  is more quickly dissolved but the action becomes very slow after 100 cc. of the solution contain 3.87 g. of  $\text{Zn}$ . (Förster and Günther, Z. Elektrochem. 1900, 6. 301.)

Solubility of ignited  $\text{ZnO}$  in  $\text{NaOH} + \text{Aq}$  gradually decreases. (Kunschert, Z. anorg. 1904, 41. 343.)

Sol. in hot  $\text{NH}_4\text{Cl} + \text{Aq}$ , either when moist or dry.

Somewhat less sol. in  $\text{NH}_4\text{NO}_3 + \text{Aq.}$

Somewhat sol. in water glass +  $\text{Aq.}$  (Ordway.)

Slowly sol. in cold, easily in hot  $\text{NaCl} + \text{Aq.}$  (Siersch, J. B. 1867. 255.)

Solubility of  $\text{ZnO}$  in  $\text{ZnCl}_2 + \text{Aq}$  at room temp.

g. $\text{ZnCl}_2$ per 100 g. $\text{H}_2\text{O}$	G. $\text{ZnO}$ per 100 g. $\text{H}_2\text{O}$
8.22	0.0137
23.24	0.138
45.95	0.497
51.50	0.604
56.90	0.723
62.85	0.884
96.00	1.792
124.70	3.213
144.80	2.640
203.00	1.590

The solubility curve has a maximum at a point corresponding to about 125 g.  $\text{ZnCl}_2$  per 100 g.  $\text{H}_2\text{O}$ . On the first branch of the curve the solid phase in equilibrium with the solution is  $\text{ZnCl}_2 \cdot 4\text{ZnO} \cdot 6\text{H}_2\text{O}$ ; on the second branch it is  $\text{ZnCl}_2 \cdot \text{ZnO} \cdot 1.5\text{H}_2\text{O}$ .

(Driot, C. R. 1910, 150. 1427.)

Sol. in boiling  $\text{Fe}(\text{NO}_3)_3$  and  $\text{Pb}(\text{NO}_3)_2$  + Aq with pptn. of oxides. Not attacked by  $\text{Co}(\text{NO}_3)_2$ ,  $\text{Ni}(\text{NO}_3)_2$ , and  $\text{Ce}(\text{NO}_3)_3$  + Aq. (Persoz.)

Sol. in boiling  $\text{KCN}$  + Aq.

Insol. in boiling  $\text{K}$  tartrate + Aq. (Kahlenberg and Hillyer, Am. Ch. J. 1894, 16. 101.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

Tartaric acid somewhat hinders the pptn. of  $\text{ZnO}_2\text{H}_2$ .

Insol. in methyl acetate. (Naumann, B. 1909, 42. 3790.)

Insol. in acetone. (Naumann, B. 1904, 37. 4329; Eidmann, C. C. 1899, II. 1014.)

Sol. in methyl amine, but insol. in amyl amine + Aq. (Wurtz.)

1 l. solution containing 174.4 g. sugar and 14.1 g.  $\text{CaO}$  dissolves 0.24 g.  $\text{ZnO}$ . (Bodenbender, J. B. 1885, 600.)

Min. *Zincite*. Sol. in acids.

### Zinc peroxide.

1 pt. sol. in 45,000 pts.  $\text{H}_2\text{O}$ .

Very sol. in acids. (Foregger and Philipp, J. Soc. Chem. Ind. 1906, 25. 300.)

$\text{ZnO}_2$  (?). Ppt. Decomp. by acids with evolution of  $\text{H}_2\text{O}_2$ . (Haass, B. 17. 2249.)

$\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{O}_2$ . (de Forcrand, A. ch. 1902, (7) 27. 58.)

$3\text{ZnO}$ ,  $2\text{H}_2\text{O}_2$ . (de Forcrand.)

$3\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $2\text{H}_2\text{O}_2$ . (de Forcrand.)

$4\text{ZnO}$ ,  $\text{H}_2\text{O}$ ,  $3\text{H}_2\text{O}_2$ . (de Forcrand.)

$\text{ZnO}_2$ ,  $\text{ZnO}_2\text{H}_2$ . Insol. in  $\text{NH}_4\text{OH}$  + Aq. (Kouriloff, A. ch. (6) 23. 431.)

$3\text{ZnO}_2$ ,  $\text{Zn}(\text{OH})_2$ . Sol. in  $\text{NaOH}$  + Aq with evolution of  $\text{O}$ . (Eijkman, C. C. 1905, I. 1628.)

$\text{Zn}_2\text{O}_3$ ,  $3\text{ZnO}$  +  $4\text{H}_2\text{O}$ . Completely sol. in dil.  $\text{H}_2\text{SO}_4$ . (de Forcrand.)

$10\text{ZnO}_2$ ,  $4\text{ZnO}$  +  $5\text{H}_2\text{O}$ . Ppt. (Teletow, C. C. 1911, I. 1799.)

### Zinc oxybromide, $\text{ZnBr}_2$ , $\text{ZnO}$ + $13\text{H}_2\text{O}$ .

$\text{ZnBr}_2$ ,  $4\text{ZnO}$  + 10, 13, and  $19\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  into—

$\text{ZnBr}_2$ ,  $6\text{ZnO}$  +  $35\text{H}_2\text{O}$ . (André.)

$\text{ZnBr}_2$ ,  $5\text{ZnO}$  +  $6\text{H}_2\text{O}$ . (André.)

All oxybromides are sol. in  $\text{KOH}$  and  $\text{NH}_4\text{OH}$  + Aq. (André, C. R. 96. 703.)

### Zinc oxybromide ammonia, $\text{ZnBr}_2$ , $3\text{ZnO}$ , $2\text{NH}_3$ + $6\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (André, C. R. 96. 703.)

### Zinc oxychloride, $\text{ZnO}$ , $3\text{ZnCl}_2$ + $\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ .

Very sol. in dil. acids. (Ephraim, Z. anorg. 1908, 59. 67.)

+  $4\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ ; more sol. in  $\text{ZnCl}_2$  + Aq.

Easily sol. in acids, or  $\text{NH}_4\text{OH}$ , or  $\text{KOH}$  + Aq. (Schindler, Mag. Pharm. 36. 45.)

+  $5\text{H}_2\text{O}$  and  $8\text{H}_2\text{O}$ . (André, A. ch. (6) 3. 94.)

$\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $1\frac{1}{2}\text{H}_2\text{O}$ . (Driot, C. R. 1910, 150. 1427.)

$3\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $2\text{H}_2\text{O}$ . Sl. sol. in  $\text{H}_2\text{O}$ , more easily sol. in  $\text{ZnCl}_2$  + Aq. Easily sol.

in acids and in  $\text{NH}_4\text{OH}$  or  $\text{KOH}$  + Aq. (Schindler, Mag. Pharm. 36. 45.)

+  $3\text{H}_2\text{O}$ . (Werner, B. 1907, 40. 4443.)

+  $5\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 367.)

$3\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $11\text{H}_2\text{O}$ . (André, C. R. 1888, 106. 854.)

$4\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$ . (André, C. R. 1888, 106. 854.)

+  $11\text{H}_2\text{O}$ . (André, A. ch. (6) 3. 94.)

$5\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$ . (Perrot, Bull. Soc. 1895, (3) 13. 976.)

+  $8\text{H}_2\text{O}$ . (André, C. R. 1882, 94. 1524.)

$5\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $26\text{H}_2\text{O}$ . Sol. in  $\text{KOH}$  or  $\text{NH}_4\text{OH}$  + Aq. Decomp. by  $\text{H}_2\text{O}$  into—

$5\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $26\text{H}_2\text{O}$ . Sol. in  $\text{KOH}$  or  $\text{NH}_4\text{OH}$  + Aq. Decomp. by  $\text{H}_2\text{O}$  into—

$6\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $6\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Kane, A. ch. 72. 296.)

$8\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $10\text{H}_2\text{O}$ . (Mailhe, A. ch. 1902, (7) 27. 367.)

$9\text{ZnO}$ ,  $\text{ZnCl}_2$  +  $3\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . Less sol. in  $\text{NH}_4\text{OH}$  + Aq than  $\text{ZnCl}_2$ ,  $3\text{ZnO}$  +  $2\text{H}_2\text{O}$ , but easily sol. in +  $14\text{H}_2\text{O}$ .

$9\text{ZnO}$ ,  $2\text{ZnCl}_2$  +  $12\text{H}_2\text{O}$ . Insol. in hot or cold  $\text{H}_2\text{O}$ . (Habermann, M. 5. 432.)

### Zinc oxychloride ammonia, $6\text{ZnCl}_2$ , $\text{ZnO}$ , $12\text{NH}_3$ + $4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  and boiling alcohol. (André, A. ch. (6) 3. 90.)

$\text{ZnCl}_2$ ,  $3\text{ZnO}$ ,  $2\text{NH}_3$  +  $5\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (André.)

$\text{ZnCl}_2$ ,  $2\text{ZnO}$ ,  $2\text{NH}_3$  +  $3\text{H}_2\text{O}$ . (André.)

$6\text{ZnCl}_2$ ,  $3\text{ZnO}$ ,  $10\text{NH}_3$  +  $13\text{H}_2\text{O}$ . (André.)

$4\text{ZnCl}_2$ ,  $\text{ZnO}$ ,  $8\text{NH}_3$  +  $2\text{H}_2\text{O}$ . (André.)

### Zinc oxyiodide, $\text{ZnI}_2$ , $3\text{ZnO}$ + $2\text{H}_2\text{O}$ .

Insol. in cold, sl. sol. in boiling  $\text{H}_2\text{O}$ . (Müller, J. pr. 36. 441.)

$\text{ZnI}_2$ ,  $9\text{ZnO}$  +  $24\text{H}_2\text{O}$ . Insol. in cold  $\text{H}_2\text{O}$ .

$\text{ZnI}_2$ ,  $5\text{ZnO}$  +  $11\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$ . (Tassilly, C. R. 1896, 122. 324.)

### Zinc oxyphosphide, $\text{ZnP}_2\text{O}_5$ .

(Renault, A. ch. (4) 9. 162.)

Probably is a mixture of zinc phosphate and phosphorus. (Vigier, Bull. Soc. 1861. 5.)

### Zinc oxysulphide, $\text{ZnO}$ , $\text{ZnS}$ .

Sol. in  $\text{HCl}$  + Aq. (Arfvedson, Pogg. 1. 59.)

$4\text{ZnS}$ ,  $\text{ZnO}$ . Not decomp. by boiling  $\text{HC}_2\text{H}_3\text{O}_2$  + Aq. (Kersten, Schw. J. 57. 186.)

Min. *Volzite*. Sol. in  $\text{HCl}$  + Aq.

### Zinc phosphide, $\text{ZnP}_2$ .

Less easily attacked by  $\text{HCl}$  + Aq than  $\text{Zn}_3\text{P}_2$ .

$\text{ZnP}_2$ . Not attacked by hot  $\text{HCl}$  + Aq. (Hvoslef, A. 100. 99.)

$\text{ZnP}_4$ . Insol. in dil.  $\text{HCl}$  + Aq. (Renault.)

$\text{Zn}_3\text{P}_2$ . Insol. in  $\text{H}_2\text{O}$ . Sol. in dil.  $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ , or  $\text{HNO}_3$ +Aq, with evolution of  $\text{PH}_3$ . (Renault, A. ch. (4) 9. 162.)  
 $\text{Zn}_3\text{P}_4$ . Insol. in  $\text{HCl}$ +Aq. (Renault.)

### Zinc selenide, $\text{ZnSe}$ .

Cold dil.  $\text{HNO}_3$ +Aq dissolves out Zn, and Se separates out, which dissolves on warming as  $\text{H}_2\text{SeO}_3$ . (Berzelius.)  
 + $x\text{H}_2\text{O}$ . Insol. in  $\text{H}_2\text{O}$ . (Berzelius.)

### Zinc sulphide, $\text{ZnS}$ .

*Anhydrous*. Insol. in  $\text{H}_2\text{O}$ . Sol. in  $\text{HCl}$ +Aq; insol. in  $\text{HC}_2\text{H}_3\text{O}_2$ +Aq. (Ebelmen, A. ch. (3) 25. 97.)

Sol. in  $\text{H}_2\text{S}$ +Aq under pressure in a sealed tube. (Senarmont, A. ch. (3) 32. 168.)

Min. *Blende*, *Sphalerite*. Sl. attacked by acids, expecting aqua regia.

1 l.  $\text{H}_2\text{O}$  dissolves  $6.65 \times 10^{-4}$  mols. zinc blende at  $18^\circ$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $6.63 \times 10^{-4}$  mols. artificial crystal.  $\text{ZnS}$  at  $18^\circ$ . (Wiegel, Z. phys. Ch. 1907, 58. 294.)

Sol. in an alkaline solution of  $\text{NaClO}$ . (Sadtler, Trans. Am. Electrochem. Soc. 1902, 1. 142.)

Insol. in liquid  $\text{NH}_3$ . (Franklin, Am. Ch. J. 1898, 20. 830.)

+ $\frac{1}{2}$ ,  $\frac{3}{4}$ , or  $1\text{H}_2\text{O}$ .

*Pptd.*  $\text{ZnS}$ .

1 l.  $\text{H}_2\text{O}$  dissolves  $70.60 \times 10^{-4}$  mols. *pptd.*  $\text{ZnS}$  at  $18^\circ$ . (Wiegel, Z. phys. Ch. 1907, 58. 294.)

Insol. in alkali hydrates, carbonates, and sulphides+Aq. Insol. in  $\text{NH}_4\text{OH}$ ,  $\text{HCl}$ , or  $(\text{NH}_4)_2\text{CO}_3$ +Aq. Easily sol. in very dil.  $\text{HCl}$  and  $\text{HNO}_3$ +Aq, but  $\text{H}_2\text{S}$  ppts.  $\text{ZnS}$  in presence of very dil.  $\text{HCl}$ +Aq, or  $\text{H}_2\text{SO}_4$ +Aq. (Eliot and Storer.)

More easily sol. in  $\text{HNO}_3$ +Aq than in  $\text{HCl}$ +Aq. (Fresenius.)

Only sl. sol. in acetic acid. (Wackenroder.)

When still moist is sol. in  $\text{H}_2\text{SO}_4$ +Aq.

Insol. in  $\text{NH}_4\text{Cl}$  or  $\text{NH}_4\text{NO}_3$ +Aq.

$\text{K}_2\text{S}$ +Aq when added to  $\text{ZnSO}_4$ +Aq produces a ppt. in presence of 10,000 pts.  $\text{H}_2\text{O}$ , and a slight opalescence with 20,000 pts. (Lassaigne.)

Slowly sol. in conc.  $\text{KCN}$ +Aq. (Halm, J. B. 1870. 1008.)

Sl. sol. in  $\text{Na}_2\text{S}$ +Aq; sol. in  $\text{NaSH}$ +Aq. (Becker, Sill. Am. J. (3) 33. 199.)

### Zinc pentasulphide, $\text{ZnS}_5$ .

Sol. in acids, with separation of S. (Schiff, A. 115. 74.)

### Zinc sulphosilicide, $\text{ZnSiS}$ .

Decomp. by acids and by alkalis. (Fraenkel, Metall, 1909, 6. 683.)

### Zinc telluride, $\text{ZnTe}$ .

Decomp. by acids. Sol. in  $\text{Br}_2$ +Aq. (Fabre, C. R. 105. 277.)

### Zincic acid.

Zinc hydroxide shows weak acid properties, and forms the following salts.

**Ammonium zincate**,  $3\text{ZnO}$ ,  $4\text{NH}_3$ + $12\text{H}_2\text{O}$ = $3\text{ZnO}$ ,  $2(\text{NH}_4)_2\text{O}$ + $10\text{H}_2\text{O}$ .

Decomp. by much  $\text{H}_2\text{O}$ .

**Barium zincate**,  $\text{BaH}_2\text{Zn}_2\text{O}_4$ + $7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bertrand, C. R. 115. 939.)

**Calcium zincate**,  $\text{CaH}_2\text{Zn}_2\text{O}_4$ + $4\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . Sol. in  $\text{NH}_4\text{OH}$ +Aq. (Bertrand, C. R. 115. 939.)

**Cobaltous zincate**,  $x\text{CoO}$ ,  $y\text{ZnO}$ .

*Rinman's green*. Sol. in acids.  $\text{H}_2\text{CO}_3$ +Aq dissolves out  $\text{ZnO}$ . (Corney.)

**Potassium zincate**,  $\text{ZnO}$ ,  $\text{K}_2\text{O}$ .

Easily sol. in  $\text{H}_2\text{O}$ , but decomp. by boiling. (Laux, A. 9. 183.)

$2\text{ZnO}$ ,  $\text{K}_2\text{O}$ . Decomp. immediately by cold  $\text{H}_2\text{O}$ . (Fremy, C. R. 15. 1106.)

**Sodic zincate**,  $\text{Na}_2\text{O}$ ,  $2\text{ZnO}$ + $8\text{H}_2\text{O}$ , or  $2\text{NaHZnO}_2$ + $7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$  or alcohol. (Corney and Jackson, Am. Ch. J. 11. 145.)

+ $7\text{H}_2\text{O}$ . (Förster and Günther, Z. Elektrochem, 1899, 6. 301.)

$2\text{Na}_2\text{O}$ ,  $3\text{ZnO}$ + $18\text{H}_2\text{O}$  or  $\text{Zn}_2\text{O}_3\text{Na}_4\text{H}_2$ + $17\text{H}_2\text{O}$ . Decomp. by  $\text{H}_2\text{O}$  or alcohol. Insol. in ether. (Corney and Jackson.)

**Strontium zincate**,  $\text{SrH}_2\text{Zn}_2\text{O}_4$ + $7\text{H}_2\text{O}$ .

Decomp. by  $\text{H}_2\text{O}$ . (Bertrand.)

### Zirconic acid.

*See Zirconium hydroxide.*

**Barium zirconate**,  $\text{BaZrO}_3$ .

Insol. in acids. (Ouvrard, C. R. 113. 80.)

**Calcium zirconate**,  $\text{CaZrO}_3$ .

Insol. in acids. (Ouvrard, C. R. 113. 80.)

**Calcium zirconate, acid.**

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl}$ +Aq. (Hiordthal, A. 137. 237.)

**Calcium potassium zirconate**,  $(\text{Ca}, \text{K})\text{LaO}_3$ , (small quantity of  $\text{CaO}$  substituted by  $\text{K}_2\text{O}$ ).

Sol. in  $\text{HCl}$ . (Venable, J. Am. Chem. Soc. 1896, 18. 444.)

**Cupric zirconate.**

(Berthier, A. ch. 59. 195.)

**Lithium zirconate,  $\text{Li}_2\text{ZrO}_3$ .**

Easily attacked by acids. (Ouvrard, C. R. 112. 1444.)

**Magnesium zirconate.**

Insol. in  $\text{H}_2\text{O}$  or  $\text{HCl} + \text{Aq}$ . (Hiordthal, C. R. 61. 215.)

**Potassium zirconate.**

Decomp. by  $\text{HCl} + \text{Aq}$ . (Knop, A. 159. 44.)

**Sodium zirconate,  $\text{Na}_2\text{ZrO}_3$ .**

Decomp. by  $\text{H}_2\text{O}$ .

$\text{Na}_2\text{ZrO}_3$ . Decomp. by  $\text{HCl} + \text{Aq}$ , and is dissolved by subsequent addition of  $\text{H}_2\text{O}$ .  $\text{Na}_2\text{O}$ ,  $8\text{ZrO}_3 + 12\text{H}_2\text{O}$ . (Hiordthal.)

**Strontium zirconate,  $\text{SrZrO}_3$ .**

As  $\text{CaZrO}_3$ . (Ouvrard.)

**Zirconium,  $\text{Zr}$ .**

*Crystallized.* Attacked by conc.  $\text{HCl} + \text{Aq}$  above  $50^\circ$ , but very slowly even at  $100^\circ$ ; rapidly by hot aqua regia. Sol. in cold conc.  $\text{HF} + \text{Aq}$ . (Troost, C. R. 61. 109.)

Very violently attacked by a mixture of  $\text{HNO}_3$  and  $\text{HF}$ . (Berzelius, Pogg. 4. 117.)

*Amorphous.* Slowly attacked by boiling aqua regia,  $\text{H}_2\text{SO}_4$ , or conc.  $\text{HCl} + \text{Aq}$ . (Berzelius.)

Easily sol. in  $\text{HF}$  or  $\text{HNO}_3 + \text{HF}$ .

**Zirconium bromide,  $\text{ZrBr}_4$ .**

Very hygroscopic. Violently decomp. by  $\text{H}_2\text{O}$  to form oxybromide. (Melliss, Zeit. Ch. (2) 6. 296.)

Sl. sol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)

**Zirconium bromide ammonia,  $\text{ZrBr}_4 \cdot 4\text{NH}_3$ .**

Ppt. Insol. in organic solvents. (Matthews, J. Am. Chem. Soc. 1898, 20. 840.)

$\text{ZrBr}_4 \cdot 10\text{NH}_3$ . Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Stähler, B. 1905, 38. 2612.)

**Zirconium carbide,  $\text{ZrC}$ .**

Insol. in  $\text{H}_2\text{O}$  and  $\text{NH}_4\text{OH} + \text{Aq}$  and  $\text{HCl}$  Aq even when heated. Sol. in  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , and fused alkali nitrates, chlorates, or hydroxides. (Moissan, C. R. 1896, 122. 653.)

**Zirconium chloride,  $\text{ZrCl}_4$ .**

Sol. in  $\text{H}_2\text{O}$  with evolution of much heat to form  $\text{ZrOCl}_2$ . Sol. in alcohol. (Hinsberg, A. 239. 253.)

Very unstable.

Probably substances so described in the literature by Nylander and others were oxychlorides. (Venable, J. Am. Chem. Soc. 1894, 16. 471.)

Sol. in ether. (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)

**Zirconium chloride ammonia,  $\text{ZrCl}_4 \cdot 2\text{NH}_3$ .**

Fumes in the air. Decomp. by  $\text{H}_2\text{O}$ . (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)

$\text{ZrCl}_4 \cdot 3\text{NH}_3$ . (Stähler, B. 1905, 38. 2611.)

$\text{ZrCl}_4 \cdot 4\text{NH}_3$ . Decomp. by  $\text{H}_2\text{O}$ . (Paykull.)

Unstable. Decomp. by  $\text{H}_2\text{O}$ . (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)

$\text{ZrCl}_4 \cdot 8\text{NH}_3$ . Stable in the air. Decomp. by  $\text{H}_2\text{O}$ . Insol. in ether. (Matthews, J. Am. Chem. Soc. 1898, 20. 821.)

Very hygroscopic. Decomp. by  $\text{H}_2\text{O}$ . (Stähler, B. 1905, 38. 2611.)

**Zirconium fluoride,  $\text{ZrF}_4$ .**

*Anhydrous.* Insol. in  $\text{H}_2\text{O}$  and acids. (Deville, A. ch. (3) 49. 84.)

Only sl. sol. in  $\text{H}_2\text{O}$ .

1.388 g. dissolve in 100 cc.  $\text{H}_2\text{O}$  without hydrolysis. On warming the solution, zirconium hydrate begins to ppt. out at about  $50^\circ$ . (Wolter, Ch. Z. 1908, 32. 606.)

+  $3\text{H}_2\text{O}$ . Sol. in  $\text{H}_2\text{O}$ , but solution decomposes on diluting, with pptn. of an insol. basic salt. Sol. in dil.  $\text{HF} + \text{Aq}$ . (Berzelius.)

**Zirconium fluoride ammonia,  $5\text{ZrF}_4 \cdot 2\text{NH}_3$ .**

(Wolter, Ch. Z. 1908, 32. 607.)

**Zirconium hydride,  $\text{ZrH}_3$ .**

Not attacked by acids. (Winkler, B. 24. 873.)

**Zirconium hydroxide,  $\text{Zr}(\text{OH})_4$ .**

Insol. in  $\text{H}_2\text{O}$  or alcohol. Sol. in 5000 pts.  $\text{H}_2\text{O}$ . (Melliss.)

Sol. in acids, even oxalic or tartaric acid, when precipitated cold. If precipitated hot, it is slowly dissolved upon heating with conc. acids.

Sol. in dil. or conc. min. acids except  $\text{HI}$ . Readily sol. in oxalic, only sl. sol. in acetic acid.

Much less sol. when pptd. from hot solution than when pptd. from cold solution. (Venable, J. Am. Chem. Soc. 1898, 20. 274.)

Sl. sol. in  $(\text{NH}_4)_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{K}_2\text{CO}_3$  and  $\text{Na}_2\text{CO}_3 + \text{Aq}$ . Insol. in  $\text{NaOH}$ ,  $\text{KOH}$ , and  $\text{NH}_4\text{OH} + \text{Aq}$ .

Sol. in  $(\text{NH}_4)_2\text{C}_2\text{H}_3\text{O}_6 + \text{NH}_4\text{OH} + \text{Aq}$ . Insol. in  $\text{NH}_4$  salts +  $\text{Aq}$ .

**Zirconium iodide,  $\text{ZrI}_4$ .**

Fumes in the air.

Sol. in  $\text{H}_2\text{O}$  and acids with violent reaction.

Decomp. by alcohol. Sol. in abs. ether. Sl. sol. in benzene and  $\text{CS}_2$ . (Stähler, B. 1904, 37. 1137.)

Insol. in  $\text{H}_2\text{O}$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ , aqua regia, and  $\text{CS}_2$ .

Sol. in  $\text{H}_2\text{SO}_4$  with decomp; unchanged by boiling  $\text{H}_2\text{O}$ . (Dennis, J. Am. Chem. Soc. 1896, 18. 678.)

**Zirconium iodide ammonia**,  $ZrI_4 \cdot 6NH_3$ ;  
 $ZrI_4 \cdot 7NH_3$ ;  $ZrI_4 \cdot 8NH_3$ ;  $ZrI_4 \cdot 10NH_3$ .

All above comps. are hygroscopic and lose  $NH_3$  in the air. (Stähler, B. 1905, **38**, 2615.)

### **Zirconium nitride.**

Scarcely attacked by acids, aqua regia, and caustic alkalis. Slowly decomp. by long contact with  $H_2O$ . (Mallet, Sill. Am. J. (2) **28**, 346.)

$Zr_3N_4$ . Decomp. when heated in the air; sol. in HF; insol. in other min. acids. (Mathews, J. Am. Chem. Soc. 1898, **20**, 844.)

$Zr_2N_3$ . Decomp. when heated in the air. Sol. in HF; insol. in other min. acids. (Mathews, J. Am. Chem. Soc. 1898, **20**, 844.)

### **Zirconium oxide, $ZrO_2$ .**

When ignited, is insol. in all acids except HF and  $H_2SO_4$ . Sl. sol. in HF; sol. in  $H_2SO_4$  only when very finely powdered and heated with a mixture of 2 pts.  $H_2SO_4$  and 1 pt.  $H_2O$  until the  $H_2SO_4$  volatilises. (Berzelius.)

### **Zirconium peroxide, $ZrO_2$ .**

(Cleve, Bull. Soc. (2) **43**, 53), or  $Zr_2O_3$  according to Bailey (Chem. Soc. **49**, 150).

Not attacked by cold dil.  $H_2SO_4$  + Aq. (Bailey.)

### **Zirconium silicon oxide.**

Min. *Zircon*. See Silicate, zirconium.

### **Zirconium oxy-compounds.**

See Zirconyl compounds.

### **Zirconium phosphide, $ZrP_3$ .**

Insol. in dil. or conc. acids and alkalis.

Sl. sol. in aqua regia. (Gewecke, A. 1908, **361**, 85.)

### **Zirconium silicide, $ZrSi_3$ .**

Sol. in HF, insol. in other min. acids.

Not acted upon by 10% KOH + Aq or NaOH + Aq.

Decomp. by fusion with KOH. (Hönigschmid, C. R. 1906, **143**, 225.)

### **Zirconium sulphide.**

Insol. in  $H_2O$ . Sol. in HF; slowly sol. in aqua regia. Insol. in  $HNO_3$ , HCl,  $H_2SO_4$ , or KOH + Aq. (Berzelius.)

Insol. in dil. acids. Sol. in conc.  $HNO_3$  + Aq (perhaps an oxysulphide). (Fremy.)

### **Zirconomolybdic acid.**

#### **Ammonium zirconomolybdate,**

$2(NH_4)_2O \cdot ZrO_2 \cdot 12MoO_3 + 10H_2O$ .

Sol. in  $H_2O$ . (Pechard, C. R. 1893, **117**, 790.)

#### **Potassium zirconomolybdate,**

$2K_2O \cdot ZrO_2 \cdot 12MoO_3 + 18H_2O$ .

Sol. in  $H_2O$ . (Pechard.)

### **Zirconotungstic acid.**

#### **Ammonium zirconodecatungstate,**

$3(NH_4)_2O \cdot ZrO_2 \cdot 10WO_3 + 13H_2O$ .

Very sol. in  $H_2O$ .

Efflorescent. (Hallopeau, Bull. Soc. 1896, (3) **15**, 921.)

$3(NH_4)_2O \cdot H_2O \cdot ZrO_2 \cdot 10WO_3 + 13H_2O$ . Sol. in  $H_2O$ ; unstable; effloresces in the air. (Hallopeau.)

#### **Potassium zirconotungstate, $4K_2O \cdot ZrO_2 \cdot WO_3 + 20H_2O$ .**

Sol. in hot  $H_2O$ . (Hallopeau.)

$4K_2O \cdot ZrO_2 \cdot 10WO_3 + 15H_2O$ . More sol. in hot than in cold  $H_2O$ .

Sol. in fused alkali carbonates. (Hallopeau.)

#### **Potassium dizirconodecatungstate,**

$4K_2O \cdot 2ZrO_2 \cdot 10WO_3 + 20H_2O$ .

More sol. in hot than in cold  $H_2O$ .

Sol. in fused alkali carbonates. (Hallopeau.)

### **Zirconyl bromide, $ZrOBr_2 + 3H_2O$ .**

Deliquescent. Decomp. in moist air. Very sol. in  $H_2O$ . (Venable, J. Am. Chem. Soc. 1898, **20**, 324.)

+  $7H_2O$ . Sol. in  $H_2O$ . (Melliss.)

+  $8H_2O$ . Deliquescent. Decomp. in moist air. Very sol. in  $H_2O$ . (Venable, J. Am. Chem. Soc. 1898, **20**, 324.)

+  $13H_2O$ . Deliquescent. Decomp. in moist air.

Very sol. in  $H_2O$ . (Venable.)

+  $14H_2O$ . Deliquescent. Decomp. in moist air. (Venable.)

Very sol. in  $H_2O$ . (Venable.)

$ZrBr(OH)_2 + H_2O$ , and +  $2H_2O$ . Deliquescent, and decomp. in moist air. (Venable.)

### **Zirconyl chloride, $ZrOCl_2$ .**

Sol. in  $H_2O$ ; insol. in HCl. (Venable, J. Am. Chem. Soc. 1894, **16**, 475.)

+  $2H_2O$ . (Chauvenet, C. R. 1912, **154**, 822.)

+  $3H_2O$ . Sol. in  $H_2O$ . (Venable.)

+  $3.5H_2O$ . (Chauvenet, C. R. 1912, **154**, 822.)

+  $6H_2O$ . (Chauvenet.)

Sol. in  $H_2O$ .

Insol. in HCl. (Venable.)

+  $4\frac{1}{2}H_2O$ ,  $6\frac{1}{2}H_2O$ , and  $8H_2O$ .

Efflorescent. Easily sol. in  $H_2O$  and alcohol. Very sl. sol. in conc. HCl + Aq. (Berzelius.)

+  $8H_2O$ . Sol. in  $H_2O$ . (Venable, J. Am. Chem. Soc. 1898, **20**, 321.)

Effloresces in the air.

Sol. in  $H_2O$ . Less sol. in  $HCl + Aq.$  and nearly insol. in conc.  $HCl$ . (Chauvenet, C. R. 1912, **154**, 822.)

$Zr_2OCl_4$ . Sol. in  $H_2O$  and alcohol. (Endemann, J. pr. (2) **11**, 219.)

Not decomp. by  $H_2O$ .

Sol. in dil.  $HCl$ . (Chauvenet, C. R. 1912, **154**, 1236.)

+  $H_2O$ . (Chauvenet, C. R. 1912, **154**, 1236.)

+  $3H_2O$ . Decomp. by  $H_2O$ . Sol. in dil  $HCl$ . (Chauvenet.)

$8ZrO_3 \cdot 7HCl$ . Sol. in  $H_2O$ . (E.)

$Zr_2OCl_4$ . (Troost and Hautefeuille, C. R. **73**, 563.)

$Zr_2OCl_4 = ZrCl_4, 2ZrO_3$ . Insol. in  $H_2O$ . (Hermann.)

Zirconyl iodide,  $ZrOI_3 + 8H_2O$ .

Very sol. in  $H_2O$  and alcohol.

Very hygroscopic. ((Stähler, B. 1904, **37**, 1138.)

$ZrI(OH)_3 + 3H_2O$ . Easily sol. in  $H_2O$ . (Hinsberg, A. **239**, 253.)

Ppt. Sl. sol. in  $HI + Aq.$  (Venable, J. Am. Chem. Soc. 1898, **20**, 328.)

Zirconyl sulphide (?)

Decomp. by  $HNO_3$  with separation of S. (Fremy, A. ch. (3) **33**, 326.)





## APPENDIX

FORMULÆ FOR CONVERTING AREOMETER DEGREES INTO  
SPECIFIC GRAVITY.

$n$  = no. of degrees on the areometer scale; sp. gr. = specific gravity.

Areometer	Temp.	Liquids heavier than H <sub>2</sub> O	Liquids lighter than H <sub>2</sub> O
<p><b>1. Baumé.</b>  (a) According to Baumé's original directions. For liquids heavier than H<sub>2</sub>O. Sp. gr. of a solution of 15 pts. NaCl dissolved in 85 pts. H<sub>2</sub>O at 12.5° (<math>d_{12.5}^{12.5} = 1.1118988</math>) = 15°; H<sub>2</sub>O = 0°. For liquids lighter than H<sub>2</sub>O. Sp. gr. of 10% NaCl + Aq at 12.5° (<math>d_{12.5}^{12.5} = 1.0737665</math>) = 0°; H<sub>2</sub>O = 10°.</p> <p>(b) <i>Old Form.</i> Liquids heavier than H<sub>2</sub>O, 10% NaCl + Aq at 15° (<math>d_{15}^{15} = 1.073350</math>) = 10°; H<sub>2</sub>O = 0°. Liquids lighter than H<sub>2</sub>O, 10% NaCl + Aq = 0°; H<sub>2</sub>O = 10°.</p> <p>(c) <i>New Form.</i> So-called "Rational Scale." Liquids heavier than H<sub>2</sub>O, H<sub>2</sub>SO<sub>4</sub> + Aq <math>\frac{15}{15} = 1.842 = 66°</math>; H<sub>2</sub>O = 0°.</p>	<p>15°</p> <p>12.5°</p> <p>15°</p> <p>17.5°</p> <p>15°</p>	<p>Sp. gr. = <math>\frac{149.05}{149.05 - n}</math></p> <p>Sp. gr. = <math>\frac{145.88}{145.88 - n}</math></p> <p>Sp. gr. = <math>\frac{146.3}{146.3 - n}</math></p> <p>Sp. gr. = <math>\frac{146.78}{146.78 - n}</math></p> <p>Sp. gr. = <math>\frac{144.3}{144.3 - n}</math></p>	<p>Sp. gr. = <math>\frac{145.56}{135.56 + n}</math></p> <p>Sp. gr. = <math>\frac{145.88}{135.88 + n}</math></p> <p>Sp. gr. = <math>\frac{146.3}{136.3 + n}</math></p> <p>Sp. gr. = <math>\frac{146.78}{136.78 + n}</math></p>
<p><b>2. Beck.</b>  H<sub>2</sub>O = 0°; liquid of 0.850 sp. gr. (<math>\frac{12.5}{12.5}</math>) = 30°. Scale continued above and below.</p>	12.5°	Sp. gr. = $\frac{170}{170 - n}$	Sp. gr. = $\frac{170}{170 + n}$
<p><b>3. Twaddle.</b>  H<sub>2</sub>O = 0°. Each degree corresponds to an increase of 0.005 in the sp. gr.</p>	Given on the instrument	Sp. gr. = $1.000 + 0.005n$	

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# TABLES FOR THE CONVERSION OF BAUMÉ DEGREES INTO SP. GR.

Since the original directions of Baumé there have been many slight modifications suggested, so that there are several varieties of Baumé hydrometers with somewhat varying readings, tables for the two principal ones of which are here-given.

## 1. According to Baumé's original directions.

For liquids heavier than H<sub>2</sub>O. Sp. gr. of 15 % NaCl+

$$Aq \left( \frac{12.5^\circ}{12.5^\circ} \right) = 1.1118988 = 15^\circ; H_2O = 0^\circ.$$

Calculated according to the formula, sp. gr. =  $\frac{149.05}{149.05 - n}$ .

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
0	1.00000	20	1.15497	39	1.35438	58	1.63701
1	1.00675	21	1.16399	40	1.36680	59	1.65519
2	1.01360	22	1.17316	41	1.37945	60	1.67378
3	1.02054	23	1.18246	42	1.39234	61	1.69279
4	1.02757	24	1.19192	43	1.40547	62	1.71223
5	1.03471	25	1.20153	44	1.41885	63	1.73213
6	1.04194	26	1.21129	45	1.43248	64	1.75250
7	1.04927	27	1.22122	46	1.44638	65	1.77335
8	1.05671	28	1.23131	47	1.46056	66	1.79470
9	1.06426	29	1.24156	48	1.47501	67	1.81657
10	1.07191	30	1.25199	49	1.48971	68	1.83899
11	1.07968	31	1.26260	50	1.50479	69	1.86196
12	1.08755	32	1.27338	51	1.52014	70	1.88551
13	1.09555	33	1.28436	52	1.53580	71	1.90967
14	1.10366	34	1.29522	53	1.55179	72	1.93446
15	1.11189	35	1.30688	54	1.56812	73	1.95989
16	1.12025	36	1.31844	55	1.58471	74	1.98601
17	1.12873	37	1.33621	56	1.60182	75	2.01283
18	1.13735	38	1.34218	57	1.61923	76	2.04038
19	1.14609	..	...	..	...	..	...

For liquids lighter than  $H_2O$ . Sp. gr. of 10 % NaCl

$$A_q \left( \frac{12.5^\circ}{12.5^\circ} \right) = 1.0737665 = 0^\circ; H_2O = 10^\circ.$$

Calculated according to the formula,  $sp. gr. = \frac{145.56}{135.56 + n}$ .

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
10	1.00000	30	0.87919	50	0.78443	65	0.72577
15	0.96679	35	0.85342	55	0.76385	70	0.70811
20	0.93571	40	0.82912	60	0.74432	75	0.69130
25	0.90657	45	0.80616	..	...	..	...

2. According to the so-called Rational Scale.

$$Sp. gr. of H_2SO_4 + A_q \left( \frac{15^\circ}{15^\circ} \right) = 1.842 = 66^\circ; H_2O = 0^\circ.$$

Calculated according to the formula,  $sp. gr. = \frac{144.3}{144.3 - n}$ .

Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.	Deg. Baumé	Sp. gr.
1	1.007	18	1.142	35	1.320	51	1.547
2	1.014	19	1.152	36	1.332	52	1.563
3	1.021	20	1.161	37	1.345	53	1.580
4	1.029	21	1.170	38	1.357	54	1.598
5	1.036	22	1.180	39	1.370	55	1.616
6	1.043	23	1.190	40	1.384	56	1.634
7	1.051	24	1.200	41	1.397	57	1.653
8	1.059	25	1.210	42	1.411	58	1.672
9	1.066	26	1.220	43	1.424	59	1.692
10	1.074	27	1.230	44	1.439	60	1.712
11	1.082	28	1.241	45	1.453	61	1.732
12	1.091	29	1.251	46	1.468	62	1.753
13	1.099	30	1.262	47	1.483	63	1.775
14	1.107	31	1.274	48	1.498	64	1.797
15	1.116	32	1.285	49	1.514	65	1.820
16	1.125	33	1.296	50	1.530	66	1.842
17	1.133	34	1.308	..	...	..	...

## SYNCHRONISTIC TABLE OF CHEMICAL

Year	A.	A. ch.	Am. J. Sci.	Ann. Min.	Ann. Phil.	Arch. Pharm.	Ch. Gaz.	C. R.	Dingl.
1800	...	(1) 32-34	...	...	...	...	...	...	...
1801	...	35-39	...	...	...	...	...	...	...
1802	...	40-43	...	...	...	...	...	...	...
1803	...	44-47	...	...	...	...	...	...	...
1804	...	48-51	...	...	...	...	...	...	...
1805	...	52-55	...	...	...	...	...	...	...
1806	...	56-60	...	...	...	...	...	...	...
1807	...	61-64	...	...	...	...	...	...	...
1808	...	65-68	...	...	...	...	...	...	...
1809	...	69-72	...	...	...	...	...	...	...
1810	...	73-76	...	...	...	...	...	...	...
1811	...	77-80	...	...	...	...	...	...	...
1812	...	81-84	...	...	...	...	...	...	...
1813	...	85-88	...	...	(1) 1, 2	...	...	...	...
1814	...	89-92	...	...	3, 4	...	...	...	...
1815	...	93-96	...	...	5, 6	...	...	...	...
1816	...	(2) 1-3	...	...	7, 8	...	...	...	...
1817	...	4-6	...	1, 2	9, 10	...	...	...	...
1818	...	7-9	...	3	11, 12	...	...	...	...
1819	...	10-12	(1) 1	4	13, 14	...	...	...	...
1820	...	13-15	2	5	15, 16	...	...	...	1-3
1821	...	16-18	3	6	(2) 1, 2	...	...	...	4-6
1822	...	19-21	4, 5	7	3, 4	1, 2	...	...	7-9
1823	...	22-24	6	8	5, 6	3-6	...	...	10-12
1824	...	25-27	7, 8	9	7, 8	7-10	...	...	13-15
1825	...	28-30	9	10, 11	9, 10	11-14	...	...	16-18
1826	...	31-33	10, 11	12, 13	11, 12	16-19	...	...	19-22
1827	...	34-36	12	(2) 1, 2	...	20-23	...	...	23-26
1828	...	37-39	13, 14	3, 4	...	24-26	...	...	27-30
1829	...	40-42	15, 16	5, 6	...	27-30	...	...	31-34
1830	...	43-45	17, 18	7, 8	...	31-34	...	...	35-38
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1834	9-12	56-57	25-27	5, 6	...	48-50	...	...	51-54
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4-6	...	...	...	6-8	...	...	...	...	3, 4	...
7-9	...	...	...	9-11	...	...	...	...	5, 6	...
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31-33	...	(1) 1	...	33, 34	...	...	...	...	21, 22	...
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40-42	...	4	...	39, 40	...	...	...	...	Schw. J.	4-6
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46-48	...	6	...	43, 44	...	...	...	...	...	10-12
49-51	...	(2) 1	...	45, 46	...	...	...	...	...	13-15
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...	4	14	...	3, 4	12-14	...	...	...	...	22-24
...	5	15	...	5, 6	15-17	...	...	...	...	25-27
...	6	16	...	7, 8	18-20	...	...	...	...	28-30
...	7	17	...	9, 10	21-23	...	...	...	...	(3) 1-3
...	8	18	...	11, (3) 1	24-26	...	1	...	...	4-6
...	9	19	...	2, 3	27-30	1	2	...	...	7-9
...	10	20	1-3	4, 5	31-33	...	...	...	...	Cont. as
...	(2) 1	21	4-6	6, 7	34-36	...	...	...	...	J. pr.
...	2	22	7-9	8, 9	37-39	...	...	...	...	...
...	3	23	10-12	10, 11	40-42	...	3	...	...	...
...	4	24	13-15	12, 13	43-45	...	...	...	...	...
...	5	25	16-18	14, 15	46-48	...	...	...	...	...
...	6	26	19-21	16, 17	49-51	...	...	...	...	...
...	7	27	22-24	18, 19	52-54	...	...	...	...	...
...	8	(3) 1, 2	25-27	20, 21	55-57	...	4	...	...	...
...	9	3, 4	28-30	22, 23	58-60	...	...	...	...	...
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...	(3) 1	7, 8	34-36	26, 27	64-66	...	...	...	...	...
...	2	9, 10	37-39	28, 29	67-69	2	...	...	...	...
...	3	11, 12	40-42	30, 31	70-72	...	...	...	...	...

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1848	65-68	22-24	...	5, 6	...	13, 14	53-56	...	...	...
1849	69-72	25-27	...	7, 8	...	15, 16	57-60	...	...	...
1850	73-76	28-30	...	9, 10	...	17, 18	61-64	...	...	...
1851	77-80	31-33	...	11, 12	...	19, 20	65-68	...	...	...
1852	81-84	34-36	...	13, 14	(5) 1, 2	69-72	...	...	...	...
1853	85-88	37-39	...	15, 16	...	3, 4	73-76	...	...	...
1854	89-92	40-42	...	17, 18	...	5, 6	77-80	...	...	...
1855	93-96	43-45	...	19, 20	...	7, 8	81-84	...	...	...
1856	97-100	46-48	...	21, 22	...	9, 10	85-88	...	...	...
1857	101-104	49-51	...	23, 24	...	11, 12	89-92	...	...	...
1858	105-108	52-54	...	25, 26	...	13, 14	93-96	...	...	...
1859	109-112	55-57	...	27, 28	...	15, 16	97-100	...	...	1
1860	113-116	58-60	...	29, 30	...	17, 18	101-104	...	...	2
1861	117-120	61-63	...	31, 32	...	19, 20	105-108	1	...	3
1862	121-124	64-66	...	33, 34	(6) 1, 2	109-112	2	...	...	4
1863	125-128	67-69	...	35, 36	...	3, 4	113-116	...	...	5
1864	129-132	(4) 1-3	...	37, 38	...	5, 6	117-120	3	(2) 1, 2	...
1865	133-136	4-6	...	39, 40	...	7, 8	121-124	4	...	3, 4
1866	137-140	7-9	...	41, 42	...	9, 10	125-128	...	...	5, 6
1867	141-144	10-12	...	43, 44	...	11, 12	129-132	5	...	7, 8
1868	145-148	13-16	...	45, 56	...	13, 14	133-136	6	1	9, 10
1869	149-152	16-18	...	47, 48	...	15, 16	137-140	...	2	11, 12
1870	153-156	19-21	...	49, 50	...	17, 18	141-144	7	3	13, 14
1871	157-160	22-24	(3) 1, 2*	...	...	19, 20	145-148	...	4	15, 16
1872	161-164	25-27	...	3, 4	(7) 1, 2	149, 150	8	5	5	17, 18
1873	165-170	28-30	...	5, 6	...	3, 4	(3) 1†	...	6	19, 20
1874	171-174	(5) 1-3	...	7, 8	...	5, 6	2, 3	...	7	21, 22
1875	175-179	4-6	...	9, 10	...	7, 8	4, 5	...	8	23, 24
1876	180-183	7-9	...	11, 12	0	9, 10	6, 7	...	9	25, 26
1877	184-189	10-12	...	13, 14	2	11, 12	8, 9	...	10	27, 28
1878	190-194	13-15	...	15, 16	3	13, 14	10, 11	...	11	29, 30
1879	195-199	16-18	1	17, 18	4	15, 16	12, 13	...	12	31, 32
1880	200-205	19-21	2	19, 20	5	17, 18	14, 15	...	13	33, 34
1881	206-210	22-24	3	21, 22	6	19, 20	16, 17	...	14	35, 36
1882	211-215	25-27	4	23, 24	7	(8) 1, 2	18, 19	...	15	37, 38
1883	216-221	28-30	5	25, 26	8	3, 4	20	...	16	39, 40
1884	222-226	(6) 1-3	6	27, 28	9	5, 6	21	...	17	41, 42
1885	227-231	4-6	7	29, 30	10	7, 8	22	...	18	43, 44
1886	232-236	7-9	8	31, 32	-11	9, 10	23	...	19	45, 46
1887	237-242	10-12	9	33, 34	12	11, 12	24	...	20	47, 48
1888	243-249	13-15	10	35, 36	13, 14	13, 14	25	...	21	49, 50
1889	250-255	16-18	11	37, 38	15, 16	15, 16	26	...	22	(3) 1, 2
1890	256-260	19-21	12	39, 40	17, 18	17, 18	27	...	23	3, 4
1891	261-266	22-24	13	41, 42	19, 20	19, 20	228	...	24	5, 6
1892	267-271	25-27	14	43, 44	21, 22	(9) 1, 2	229	...	25	7, 8
1893	272-277	28-30	15	45, 46	23, 24	3, 4	230	...	26	9, 10
1894	278-283	(7) 1-3	16	47, 48	25, 26	5, 6	231	...	27	11, 12
1895	284-289	4-6	17	49, 50	27, 28	7, 8	232	...	28	13, 14
							233	...		

\* Also cited as whole series, 101, 102, 103, etc.

† Also cited as 201, 202, etc.

## OTHER SCIENTIFIC PERIODICALS—Part II.

C. C.	Chem. Ind.	Chem. Soc.	Ch. Gas.	Ch. Ztg.	Cim.	C. N.	C. R.	Dingl.	Gass. ch. it.	J. Am. Chem. Soc.	J. Anal. Ch.
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